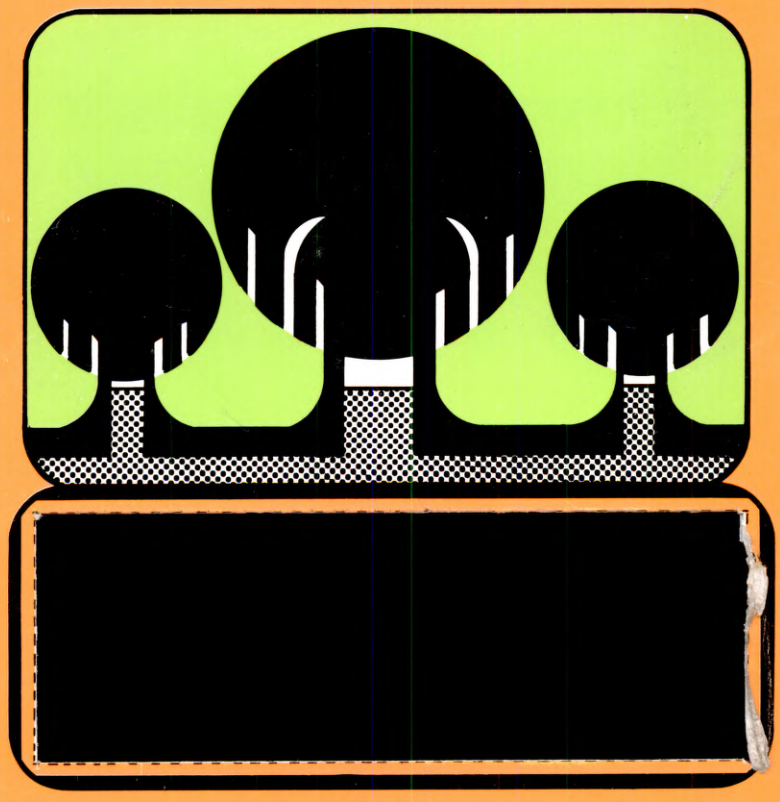
# PROGRAMA SANIDAD VEGETAL





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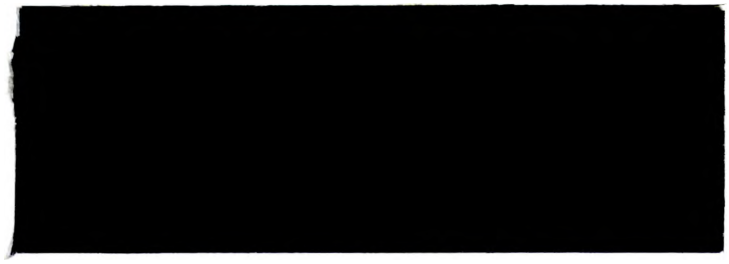

DOCUMENTACION E INFORMACION AGRICOLA No. 90 ISSN 0301 - 438X

# Mosca del Mediterráneo
(*Ceratitis capitata* (Wiedemann))

Bibliografía parcialmente anotada

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Biblioteca y Terminal de Servicios
Turrialba, Costa Rica
1980

IICA
DIA-90 Villegas, Carmen, comp.
Mosca del Mediterráneo (*Ceratitis capitata* (Wiedemann)) bibliografía parcialmente anotada. Comp. por C. Villegas y L. Coto Royo.-Turrialba, Costa Rica, CIDIA, 1981.
166 p.-(Su Documentación e Información Agrícola; no. 90).

1. Ceratitis capitata - Bibliografía 2. Frutas - Plagas 3. Mosca del Mediterráneo 4. Insectos nocivos I. Coto Royo, L., comp. II. Título III. Series

AGRIS H10 DEWEY 632.774016

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# I N T R O D U C C I O N

La creciente importancia económica que tienen las pérdidas ocasionadas por plagas y enfermedades de los cultivos, ha sido preocupación permanente del Instituto Interamericano de Ciencias Agrícolas. Hoy más que nunca, este problema requiere de la atención y sobre todo de una acción enérgica y bien articulada de los que de una u otra forma estamos comprometidos en el desarrollo rural de América Latina y el Caribe.

El sistema económico viene siendo seriamente afectado por el aumento en los precios del petróleo, el que tanto como fuente de energía, como por sus derivados agroquímicos, es un elemento fundamental para la producción del sector agrícola. La crisis energética y su impacto en los precios de los insumos para la producción se equipara con las pérdidas por plagas y enfermedades. Esto sumado a las pérdidas cualitativas y cuantitativas del valor de la producción agrícola, permite preveer consecuencias de magnitudes incalculables para el desarrollo.

En esta difícil coyuntura, cualquier esfuerzo tendiente a contrarrestar la influencia de los factores que inciden negativamente en la producción y la productividad agrícola, debe ser considerado como obra trascendente y humanista.

La información científica y tecnológica relacionada con las plagas y enfermedades que afectan los cultivos de valor económico, es vital para el diseño de estrategias y acciones tendientes al mejoramiento de la sanidad de los cultivos, que permitan edificar una barrera de contención para reducir los riesgos y las pérdidas de la producción y productividad sectorial.

El Instituto Interamericano de Ciencias Agrícolas estableció en 1979 el Programa de Sanidad Vegetal, respondiendo a un mandato de su Junta Directiva, con el propósito fundamental de crear un mecanismo de coordinación para lograr la prevención, combate y, en lo posible, la erradicación de enfermedades y plagas que están ocasionando serios perjuicios a la economía de los países y que amenazan extenderse a otras regiones.

Dentro de estos propósitos, el Programa de Sanidad Vegetal del IICA se complace en presentar esta bibliografía sobre la Mosca del Mediterráneo como parte de la serie bibliográfica en fitosanidad, que tiene como objetivos principal contribuir con los organismos del sector agrícola del continente en la difícil tarea del desarrollo rural.

José Emilio G. Araujo
Director General

San José, Costa Rica
Agosto de 1980

## METODOLOGIA

La compilación de esta Bibliografía sobre Mosca del Mediterráneo, por parte del IICA a través del Programa de Sanidad Vegetal y del Centro Interamericano de Documentación, Información y Comunicación Agrícola (CIDIA), tiene por objetivo principal divulgar la experiencia realizada sobre este tema.

Los documentos presentados son el resultado de una búsqueda retrospectiva que no pretende ser exhaustivo, realizada en las siguientes fuentes bibliográficas:

- Abstracts on Tropical Agriculture (Tropical Abstracts)
- Agrindex
- Agrinter (Bibliografía Agrícola Latinoamericana)
- Bibliography of Agriculture
- Horticultural Abstracts
- Review of Applied Entomology

El período de búsqueda en los repertorios se realizó desde enero de 1970 hasta la fecha, pero al revisar los documentos indizados, nos encontramos con que la bibliografía citada por los autores era importante para complementar la información documentaria ofrecida, e incorporamos estas referencias hasta 1965.

Los resúmenes presentados son: a) tomados de los propios documentos; b) de los repertorios bibliográficos analizados, con la indicación del volumen y número de la referencia; c) realizados por los compiladores.

La Bibliografía tiene 482 referencias bibliográficas, está organizada en orden alfabético de autor o título. Para facilitar el uso de este trabajo, se elaboraron índices de autores y materia.

La Biblioteca Conmemorativa Orton en Turrialba, facilita el acceso a la mayor parte del material incluído en esta Bibliografía. Las referencias que están acompañadas por un asterisco (*) están al alcance de los usuarios a través del Servicio de Reproducción de Documentos del CIDIA.

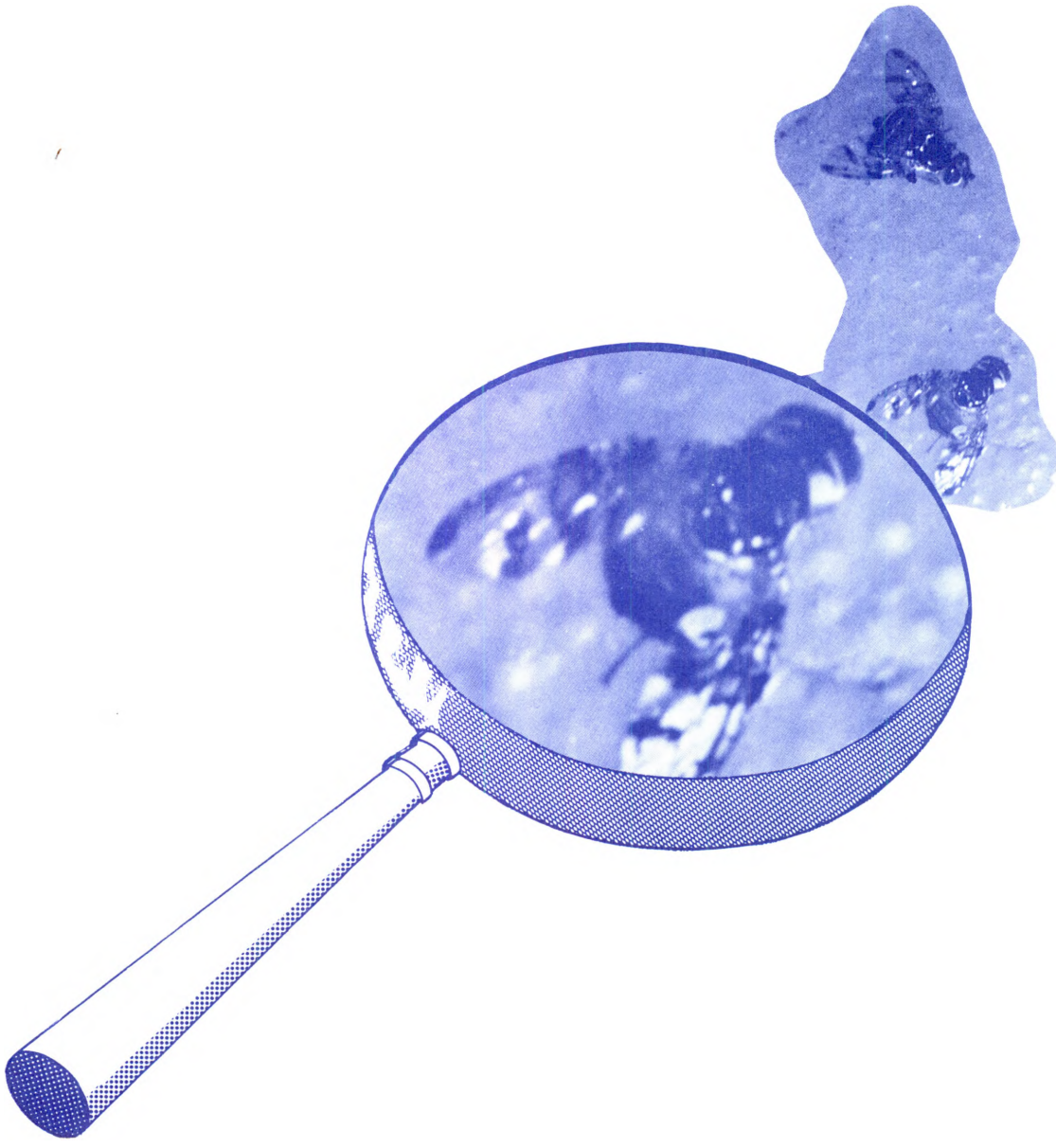
Esperamos que esta publicación sea una herramienta de trabajo efectiva para el combate y erradicación de la Mosca del Mediterráneo.

Turrialba, Costa Rica
Agosto de 1980

RECONOCIMIENTO

Expresamos nuestro agradecimiento al Ing. Agr. Luis A. Salas, Entomólogo, catedrático de la Facultad de Agronomía de la Universidad de Costa Rica, por su colaboración en la revisión del Indice de Materia.

# *MOSCA DEL MEDITERRANEO*



MOSCA DEL MEDITERRANEO

MEDITERRANEAN FRUIT FLY

MOSCAMED

MOSCA DE LA FRUTA

# MOSCA DEL MEDITERRANEO

(*Ceratitis capitata* (Wiedemann))

* ABASA, R. O. y MATHENGE, W. M. The praying mantis, *Sphodromantis* sp. as a predator of the giant looper, *Ascotis selenaria reciprocaria* Walk in Kenya coffee: laboratory evaluation. East African Agricultural and Forestry Journal 37(2): 177-180. 1971. (001

Nymphal and adult *S. viridis* and adult *S. gastrica* were reared in the laboratory and fed on larvae of *Ascotis* and/or adult *C. capitata* for at least six weeks. The nymph of *S. viridis* consumed an average of 26 and the adult an average of 43 *Ascotis* larvae per week. Adult *S. gastrica* consumed an average of 18 *Ascotis* larvae and 33 adult *C. capitata* per week when both prey were presented together. The attributes of *Sphodromantis* sp., as predators of coffee pests, are presented and discussed.

* _____. The Mediterranean fruit fly, *Ceratitis capitata* Wied.; laboratory investigations of its reproductive behaviour in *Coffea arabica* in Kenya. East African Agricultural and Forestry Journal 37(3):181-184. 1972. (002

Adults of *C. capitata*, bred out of ripe berries, were maintained on honey-water in the laboratory. In a choice experiment, with berries of different stages of development presented for oviposition, females preferrred ripe berries just before they turned completely red. They did, however, oviposit in green and red berries also. Eggs were inserted in the bean of young immature green berries. The significance of this oviposition behaviour is discussed. Far more ovipunctures were made by ovipositing females than were used for egg deposition. Each ovipuncture contained an average of 1.69 eggs. Females lived an average of 12 days, including a pre-oviposition period of five to seven days. The number of eggs oviposited in the duration of 27-29 days of active oviposition was far below what was expected.

* _____. Observations on the seasonal emergence of fruit flies on a Kenya coffee estate and studies of the pest status of *Ceratitis capitata* Wied. in coffee. East African Agricultural and Forestry Journal 39(2):144-148. 1973. (003

Studies of seasonal emergence of fruit flies breeding in coffee at the Coffee Research Station, Ruiru, showed that *C. capitata* breeds throughout the year without distinct generations. *C. rosa* and *T. coffeae* were far less abundant during a 2-year period and showed no clear seasonality. Attempts to induce stinkers in coffee liquor using *C. capitata* gave negative results. Neither the colour, quality, acidity, body, flavour, nor final classification of berries infested with larvae were affected. Tests to induce premature berry fall by *C. capitata* indicated that an average of 2.8% of berries attacked by *C. capitata* would fall prematurely compared with 0.26% which fell prematurely due to natural causes.

AKMAN, K., ZUMREOGLU, A. y GOKER, S. A survey of the Mediterranean fruit fly (*Ceratitis capitata*) on citrus in the Aegean region. In Turkey. Tarim Bakanligi Zirai Mucadele ve Zirai Karantina Genel Mudurlugu. Plant Protection Research Annual. Ankara, 1973. s.p. (004

* ALBAJES, R. y SANTIAGO-ALVAREZ, C. Acción del inhibidor de la síntesis de la quitina, TH-6040 sobre *Ceratitis capitata* Wied. (Dipt. Trypetidae). Anales del Instituto Nacional de Investigaciones Agrarias: Protección Vegetal, no. 9:67-74. 1979. (005

En un estudio de laboratorio se ha comprobado la acción insecticida del diflubenzurón sobre larvas de último estado de *Ceratitis capitata* y el 'efecto esterilizante'.

* ALFARO GARCIA, A. Efecto de acaricidas del grupo difenil sulfona en *Ceratitis capitata* Wied. Anales del Instituto Nacional de Investigaciones Agrarias: Protección Vegetal, no. 1:139-145. 1971. (006

Se estudiaron los efectos sobre la puesta de los acaricidas Clorfenson, Clorbenside y Tetradifon, suministrados en la dieta de *Ceratitis capitata* Wied. Se alimentaron machos o hembras separadamente con dieta que contenía los acaricidas citados, complementando cada jaula con insectos no tratados. Todos los productos usados ejercieron algún efecto sobre la puesta deprimiendo durante algún tiempo la curva de puesta por hembra respecto a la edad y disminuyendo la fertilidad aunque no en porcentajes altos. Se discute el fenómeno y se sugiere que el efecto pudiera ser un efecto insecticida subletal.

ALLUE, L. A. Q., BELOCOPITOW, E. y MARECHAL, L. R. Glycosyl transfer to an acceptor lipid from insects. Biochemical and Biophysical Research Communications 66(4):1201-1208. 1975. (007

Chloroform-methanol extracts from *Triatoma infestans* (Klug) and *Ceratitis capitata* (Wied.) were found to contain a lipid that becomes glycosylated when incubated with uridine diphosphate glucose or uridine diphosphate *N*-acetylglucosamine and microsomal enzymes of rat liver. The behaviour of the lipid on column or thin-layer chromatography and its stability to acid were equal to those of dolichol monophosphate. The glycosated compounds were acid labile. Treatment with alkali of the acetylglucosaminyl compound produced a substance that migrated like a hexose phosphate on electrophoresis and that liberated acetylglucosamine on treatment with alkaline phosphatase. The behaviour of the insect glucosylated lipid on thin-layer chromatography and its stability to phenol were similar to dolichol monophosphate glucose and different from ficaprenyl monophosphate glucose. It is concluded that the insect glycosyl acceptor lipid is an *a*-saturated polyprenyl phosphate. (Review of Applied Entomology, A 64:6471)

ALUMOT, E. y CHALUTZ, E. Fumigation of citrus fruit with ethylene dibromide; desoption of residues and ethylene evolution. Pesticide Science 3(5):539-544. 1972. (008

ANDREW, C. O., CATO, J. C. y PROCHASKA, F. J. Potential economic impact of a fruit fly infestation on the U.S. citrus industry. Proceedings of the Florida State Horticultural Society 90:29-32. 1977. (009

The economic effect on certain areas of the U.S. delineated into potential and marginal zones of infestation by four species of the fruit fly /*Ceratitis capitata*, *Dacus dorsalis*, *D. cucurbitae* and *Anastrepha ludens*/ is analyzed. All or parts of four citrus producing states (Florida, California, Texas and Arizona) are within these zones. Eighty-one percent of the 1972-75 production of citrus was in the zone of probable (potential + marginal zones) infestation. Total production losses at a low of 10% in the potential zone and 5% in the marginal zone would amount to 26.7 million boxes of citrus with a value of $70.1 million at 1975 farm-level prices. The estimate of losses at the retail level for oranges and grapefruit is $218.7 million. Export losses and treatment costs are also examined and discussed. (Horticultural Abstracts 48:10915)

* ANWAR, M. et al. Radiation-sterilization of the Mediterranean fruit fly (Diptera: Tephritidae): comparison of spermatogenesis in flies treated as pupae or adults. Annals of the Entomological Society of America 64(3): 627-633. 1971. (010

*Ceratitis capitata* (Wiedemann) were irradiated with 10 kilorad (krad) of gamma radiation from a cobalt-60 source two days prior to and after pupal ecdysis to determine the effects of radiation when administered at these two different stages. Testes were removed from adult flies at intervals of 1, 2, 4, 6, and 8 days after emergence, stained with Feulgen, and whole-mounted for microscopic examination. The radiation dose of 10 krad completely stopped spermatogenesis. In irradiated flies, the sperm in the existing sperm bundles completed their maturation, but no additional sperm were produced. The spermatogonial cells, primary and secondary spermatocytes, and the spermatids were completely aborted. The cytological effects of radiation were manifested in full four days after treatment. The radiation dose of 10 krad produced dominant lethality in the fully differentiated sperm. Irradiation of adult fruit flies is recommended, since these flies have a higher total number of sperm (carrying dominant lethality) available as compared with the flies which were irradiated as pupae.

* ARAMBOURG, Y. y ONILLON, J. Elevage d'*Opius longicaudatus* Ash. *Taiensis* Full., Hym. *Braconidae*, parasite de *Trypetidae*. Annales de Zoologie: Ecologie Animale 2(4):663-665. 1970. (011

Dans le cadre des essais pursuivis à la Station d'Antibes sur la lutte biologique contre *Dacus oleae* Gmel., plusierus espèces de parasites de *Trypetidae* onte été introduites.

L'élevage d'*Opius longicaudatus taiensis* a pu être réalisé sur *Ceratitis capitata* comme hôte de remplacement, à partir d'une souche provenant des îles Fidji.

ARAMBOURG, Y., PRALAVORIO, R. y DOLBEAU, C. Premières observations sur l'action de diflubenzuron (PH 6040) sur la fécondité, la longévite et la viabilité des oeufs de *Ceratitis capitata* Wied. (Dipt. Trypetidae). Revue de Zoologie Agricole et de Pathologie Végétale 76(4):118-126. 1977. (012

An account is given of laboratory tests of a 25% wettable powder of diflubenzuron, continually ingested with the adult diet of hydrolysed protein and sugar by adults of *Ceratitis capitata* (Wied.), for its effect on the eggs of the next generation. The compound reduced egg viability, but only slightly unless a very high dose (1000 p.p.m.) was administered to the parents; administration of a single massive dose of 10,000 p.p.m., followed after four days by substitution of untreated food, permitted a higher hatching rate that was, however, still below the normal. The number of eggs laid by continuously treated females was considerably reduced, regardless of the dose administered; a single massive dose to which the adults were exposed for four days, likewise permitted greater fecundity than did continuous feeding on treated diet, but not a return to normal fecundity. No significant effect of the treatment on adult life-span was observed. These preliminary experiments indicate that the sterilising effect of diflubenzuron is not sufficiently marked to warrant its uses in bait-sprays as part of an integrated control programme against *C. capitata* in the field. (Review of Applied Entomology, A 66:6298)

AREVALO, C. M. Mediterranean fruit fly impact in Central America. Cooperative Plant Pest Report 1(12):117-118. 1976. (013

In 1955 *Ceratitis capitata* (Wied.) was detected for the first time in Costa Rica, and an account is given of its subsequent progress through Central America and of action taken by the Organismo Internacional Regional de Sanidad Agropecuaria (OIRSA) in monitoring populations, disseminating information and imposing quarantine regulations. For lack of resources to begin eradication measures in Costa Rica in 1956, *C. capitata* spread to Nicaragua and Panama in 1960. Despite preliminary work on sterile-male releases in Costa Rica and on low-volume application of insecticides from aircraft in Nicaragua in 1963-64, a cooperative trapping programme in Honduras in 1972, and quarantine inspection and trapping along the borders of Guatemala, Honduras and El Salvador in 1975, the fruit-fly invaded these countries also in April 1975 and a state of emergency was declared in El Salvador, where it had spread through the entire State. International cooperation is now required to prevent further spread, and OIRSA is now collaborating with the United States Department of Agriculture to this end. (Review of Applied Entomology, A 65:667)

ARIAS, E. La mosca del Mediterráneo en Honduras y su importancia económica. In Reunión Anual del Programa Cooperativo Centroamericano para el Mejoramiento de Cultivos Alimenticios, 25a., Tegucigalpa, Honduras, 1979. Memoria. Tegucigalpa, Honduras, 1979. v.4, pp. H32-1/H32-9. (014

* ARMSTRONG, J. W., VRIESENGA, J. D. y LEE, C. Y. L. Resistance of pineapple varieties D-10 and D-20 to field populations of oriental fruit flies and melon flies. Journal of Economic Entomology 72(1):6-7. 1979. (015

When three pineapple varieties (D-10, D-20, and Smooth Cayenne) were exposed to field populations of melon flies, *Dacus cucurbitae* Coquillett, and oriental fruit flies, *D. dorsalis* Hendel, no larvae or pupae developed from them. Thus, none of the three varieties was any more susceptible than the others to infestation by either pest species.

* ARROYO V., M. La mosca de las frutas. Chacra (Perú) 23(116):13-15. 1970. (016

El autor hace una descripción del insecto, da información sobre la biología del mismo, así como los factores más importantes para su desarrollo. Menciona algunos de los frutos que ataca. Pasa luego a dar indicaciones sobre algunos de los procedimientos de lucha contra la *Ceratitis*, como son: empleo de frascos cazamoscas con sustancia atractiva; pulverizaciones totales del árbol con insecticidas concentrados de síntesis; empleo de cebos envenenados con insecticidas; medidas agronómicas complementarias; destrucción del fruto agusanado; control biológico con su parásito natural (*Opius concolor*), así como el "empleo de machos estériles". (CV)

* _____ et al. Ensayos de lucha autocida contra *Ceratitis capitata* Wied. Programas realizados en 1970. Anales del Instituto Nacional de Investigaciones Agrarias: Protección Vegetal, no. 2:215-231. 1972. (017

En los ensayos de campo realizados en años anteriores, se puso de manifiesto que la aplicación del método de 'machos estériles' puede dar lugar a la aparición de 'picaduras estériles' en algunos frutales de hueso, que sin dañar al fruto, puedan, sin embargo, afectar su aspecto externo. Para estudiar este problema se realizó un ensayo de campo sobre melocotoneros de cinco variedades distintas encerrados en jaulas de malla, en cuyo interior se liberaron insectos estériles en distintas proporciones. Sólo se presentaron picaduras estériles de importancia por su visibilidad en dos de las variedades ensayadas. Se efectuaron también ensayos preliminares de campo comparando insectos irradiados con 7 y 9 Krad. Los resultados no fueron concluyentes. Se prosiguió la cría artificial masiva de *C. capitata*, superándose la producción de años anteriores.

ASHRAF, M., KEISER, I. y HARRIS, E. J. Sexual sterilization of oriental fruit flies and Mediterranean fruit flies by thiotepa; dosage-response, mating competitiveness, and resistance to deprivation of food and water. Journal of Environmental Science and Health, A: Environmental Science and Engineering 11(7):469-479. 1976. (018

AWADALLAH, A. y FARES, F. Application of certain dimethoate compounds on peaches for control of the medfly, *Ceratitis capitata* (Wied.) (Diptera: Tephritidae). Bulletin of the Entomological Society of Egypt: Economic Series 3:75-80. 1969. (019

Sprays for four formulations of dimethoate (Roxion, Rogor, Perfektion and Bi 58) applied at a rate of 75 cc/100 litres water two weeks before ripening and again three weeks later gave complete protection of peaches from attack by *Ceratitis capitata* (Wied.) in field tests in Egypt in 1965-66. None of the formulations was phytotoxic. (Review of Applied Entomology, A 61:3942)

_____ y FARES, F. Is one insecticidal application sufficient for control of the "medfly", *Ceratitis capitata* (Wied.) on peaches? Agricultural Research Review 49(1):60-63. 1971. (020

In field tests in Egypt in 1968, a single spray of a 40% emulsion concentrate of dimethoate (as either Roxion or Perfeckthion) applied at a rate of 125 $cm^3$ formulation/100 litres water on 27th June was as effective in controlling *Ceratitis capitata* (Wied.) on peach as two sprays applied at 75 $cm^3$ on 16th June and 7th July. The former treatment was more economical and remained effective for longer than the latter. Neither treatment was phytotoxic. (Review of Applied Entomology, A 63:1702)

_____ y FARES, F. A low-cost artificial medium for the mass rearing of the Mediterranean fruit fly, *Ceratitis capitata* (Wied.). Agricultural Research Review 51(1):63-67. 1973. (021

The suitability of artificial diets for mass-rearing larvae of *Ceratitis capitata* (Wied.) was determined in the laboratory in Egypt. Inexpensive diets containing 400 g dried carrot, 250 g dried yeast, 15 g sodium benzoate, 30 ml 2N hydrochloric acid, 4000 ml water and 500 g wheat bran or rice bran were as good as a more expensive version containing the basic ingredients but with 900 g dried carrot and no wheat or rice bran. (Review of Applied Entomology, A 63:1976)

_____ y HASHIM SULTAN FOUDA, A. F. G. A trial for testing the sterile male technique as a means of controlling the medfly, *Ceratitis capitata* (Wied.) in Egypt. Agricultural Research Review 52(1):41-49. 1974. (022

Pupae of the fruit fly were irradiated with cobalt-60 two days before the emergence of the flies. The sterilized flies were then released at the centre of an orchard for a period of 18 months. This sterile male release technique was found more or less applicable in heavily infested orchards, provided that releases were to be made as soon as the population density of the fruit fly decreased to its minimum level. Continuous releases for 18 months decreased insect infestation to the minimum when the overflooding ration reached more than 10:1 (sterile:wild flies). For

the success of this technique one application with a contact insecticide is required to reduce the maximum population density of the insect to a minimum level. (Abstracts on Tropical Agriculture 1:7504440)

AYTUG, N. Bibliography of the Mediterranean fruit fly. TURDOK Biblyografya Serisi, no. 16:1-31. 1973. (023

The 268 entries in this bibliography of papers on *Ceratitis capitata* (Wied.) published between 1962 and 1972 are arranged in four sections dealing, respectively, with general topics, biology, ecology and control. (Review of Applied Entomology, A 63:812)

AZAB, A. K., ALI, A. M. y EL-HAKIM, A. M. On the tolerance of the Mediterranean fruit fly, *Ceratitis capitata* (Wied.) to currently used insecticides. Agricultural Research Review 52(1):73-80. 1974. (024

Four-day-old adult flies bred from infested fruits obtained from five different locations were treated with three insecticides. The results showed that the tolerance of flies to lebaycid (fenthion) did not vary with locations. The same held true with dimethoate. Tolerance of lindane varied with locations. (Abstracts on Tropical Agriculture 1: 7504444)

* BARDNER, R. y MATHENGE, W. M. Control of fruit flies. Kenya Coffee 39(460): 207-208. 1974. (025

Field trials, conducted in Kenya, showed that application of 330 ml fenthion and 660 ml hydrolysed protein in 66 l of water per ha to every 4th row of coffee gave satisfactory control of the fruit fly. (Abstracts on Tropical Agriculture 1:7502170)

BARNES, B. N., RUST, D. J. y BOSMAN, I. P. Fruit fly brought to bay. Deciduous Fruit Grower 25(5):126-129. 1975. (026

The Mediterranean fruit fly, *Ceratitis capitata*, and the Natal fruit fly, *Pterandrus rosa*, are serious pests of top fruit (mainly peaches) and grapevines. Details are given of the recommended control measures on stone fruits. (Horticultural Abstracts 46:5466)

_____. Irradiation-disinfestation of export fruit as a quarantine treatment for proclaimed insects: the potentialities and problems. In Congress of the Entomological Society of Southern Africa, Stellenbosch, 1974. Proceedings. Pretoria, South Africa, 1975. pp. 103-171. (027

The insect pests referred to in this review of the prospects and problems of the disinfestaion of fruit in South Africa by irradiation are *Ceratitis capitata* (Wied.), *Dacus dorsalis* Hend., *Parlatoria ziziphus* (Lucas), *Pseudococcus comstocki*

(Kuw.), P. *maritimus* (Ehrh.), *Nipaecoccus nipae* (Mask.) (*P. nipae*), *Quadraspidiotus perniciosus* (Comst.), *Tetranychus mcdanieli* McG. and *Cydia pomonella* (L.) (*Laspeyresia pomonella*). (Review of Applied Entomology, A 64:5953)

BARNES, B. N. Mass rearing the Natal fruit fly *Pterandrus rosa* (Ksh.) (Diptera: Trypetidae). Journal of the Entomological Society of Southern Africa 39(1): 121-124. 1976. (028

An improved method for rearing *Ceratitis rosa* Karsch (*Pterandrus rosa*) that was developed in South Africa in connection with investigations on the use of irradiation to control *C. rosa* and *C. capitata* (Wied.) in packed export fruit is described. It differs from earlier methods in the composition of the larval rearing medium and in the methods for collecting eggs and pupae. (Review of Applied Entomology, A 65:681)

BELOCOPITOW, E., MARECHAL, L. R. y QUESADA ALLUE, L. A. Enzymatic synthesis of polyprenol monophosphate mannose in insects. Molecular and Cellular Biochemistry 16(2/3):127-134. 1977. (029

In studies in Argentina in which larvae and pupae of *Ceratitis capitata* (Wied.) and nymphs of *Triatoma infestans* (Klug) were used, the microsomal fraction of insects was found to contain an enzyme transforming mannose from guanosine diphosphate mannose to an endogenous or exogenous insect lipid and to other acceptors such as dolichol monophosphate or ficaprenol monophosphate. This activity was dependent on the presence of Triton X-100 and magnesium ions, the optimum concentration of the latter being 10 mM. The optimum temperature of the reaction was 25°C, and the maximum activity was obtained at pH 7.9. The mannolipid formed behaved as a monophosphodiester when chromatographed on DEAE-cellulose. Its behaviour indicates the presence of a number of isoprenyl units similar to the dolichol and different from the ficaprenol derivative. Stability to phenol treatment indicated that the lipid fraction of the mannolipid is an $\alpha$-saturated polyprenol phosphate similar to dolichol monophosphate. (Review of Applied Entomology, A 66:2981)

* BENNETT, F. D. y SQUIRE, F. A. Investigations on the biological control of some insect pests in Bolivia. PANS 18(4):459-467. 1972. (030

In 1963 proposals for the introduction of natural enemies of three widespread insect pests of agricultural crops into Bolivia were submitted to the Ministry of Overseas Development (United Kingdom). Following a later visit funds were provided to cover the costs of procuring and shipping stocks to Bolivia where, under the supervision of the British Mission in Tropical Agriculture, Bolivian counterpart entomologists undertook laboratory tests and made field releases. Provision also was made for periodic visits by a member of the CIBC staff and interim reports were prepared following each visit. The project, due to terminate in 1971, was extended

for a further year and a final visit to Bolivia was made in March 1972. Although most of the information included herein is given in earlier unpublished reports, details of the various introductions, field recoveries in Bolivia, etc., are summarised to make this report more comprehensive. The three pests for which natural enemies were requested were the following: the corn earworm *Heliothis zea* (Boddie), the sugar-cane borers *Diatraea* spp., and the Mediterranean fruit fly, *Ceratitis capitata* (Wied.). Later when World Health Organization funds became available to the CIBC, work was started on the search for parasites of triatomines.

BERVILLE, P. La lutte contre la mouche des fruits en Espagne. Phytoma 21(210): 35-36. 1969. (031

An outbreak of *Ceratitis capitata* (Wied.) on orange in Spain in 1964, so severe that it resulted in the rejection of large quantities of fruit intended for export to France and Germany, was brought under control by a government-sponsored spray programme in 1965-68. The author describes a survey made by himself in October 1968 of the various types of treatment contained in this programme. These included sprays from aeroplanes in the Provinces of Castille, Valencia and Seville, from helicopters in the Province of Alicante and from ground apparatus in the Provinces of Tarragona, Murcia, Almería, Granada and Córdoba, the insecticide in each case being fenthion mixed with a protein bait to attract adults from the untreated strips that were left between the sprayed ones in order to maintain populations of the natural enemies of *C. capitata*. Catches of adults in traps hung in the orange trees indicated the intervals at which treatment needed to be repeated; usually three applications 15-30 days apart were made during the summer and autumn. Other fruit trees near orange groves were also inspected and sprayed. Treatment against insect pests of *Citrus* other than *Ceratitis* (mostly Coccids and aphids) was organised locally and carried out concurrently with ground sprayers only. The programme had excellent results, although occasional infested fruits were still found among oranges intended for export. (Review of Applied Entomology, A 58:3413)

BIASE, L. M. DE. Gli afidi (Homoptera-Aphidoidea) degli agrumi in Calabria. Bollettino del Laboratorio di Entomologia Agraria 'Filippo Silvestri' 32: 111-124. 1975. (032

During an investigation in 1971-73 on the aphid fauna of *Citrus* in some parts of Calabria in Italy, *Myzus persicae* (Sulz.), *Macrosiphum euphorbiae* (Thos.), *Toxoptera aurantii* (Boy), *Rhopalosiphum maidis* (Fitch), *Aphis citricola* v.d. Goot, A. *craccivora* Koch and A. *gossypii* Glov. were found. A key is given to these species together with information on their morpholohy and food-plants. A. *citricola* caused greater damage than any of the other species. The use of light mineral oils in alternate years, and occasional applications of dimethoate against *Ceratitis capitata* (Wied.) were sufficient to maintain aphid populations below the economic level in the areas studied. (Review of Applied Entomology, A 64:6746)

BOHM, H. 25 years of the fall webworm (*Hyphantria cunea* Drury) and the Mediterranean fruit fly (*Ceratitis capitata* Wied.) in Austria. In Faber, W. Land- und Forstwirtschaftliche Forschung in Osterreich. Austria, Osterreichischer Agrarverlag, 1976. pp. 81-88. (033

*Hyphantria cunea* (Dru.) was first recorded in Austria in 1951 and *Ceratitis capitata* (Wied.) in 1931, becoming a pest of orchards in the Vienna area in 1952. The past and present distribution of *H. cunea* (in the east of the country) is described with the aid of maps, and notes are provided on the foodplants, biology and control of the arctiid there. Its natural enemies are discussed, and a list is given of 8 hymenopterous and dipterous parasites (mainly polyphagous species) that have been found in the outbreak area. Notes are also provided on the biology, injuriousness and control of *C. capitata* in orchards in the Vienna area. (Review of Applied Entomology, A 65:4851)

BOYES, W. W. y GINSBURG, L. Navel and Valencia Late storage at temperatures low enough to destroy all traces of fruit fly. South African Citrus Journal, no. 425:5-12. 1969. (034

The development of cold injury was studied in oranges subjected to low temperatures to destroy traces of fruit fly. The development of rind stain in Washington Navels was much more severe at 31°F and 34° than at 40°. There was a definite increase in rind stain with longer storage time. After two weeks the incidence of rind stain at 31° was only slight, which is of importance since the sterilization period for fruit fly at this temperature is only 12 days. Navel oranges picked during the early season showed far less rind stain damage than those picked during the late season. Damage due to rind pitting was slight and found at all temperatures. Rind stain damage in Valencia Late oranges was less severe in fruit stored at 31° than in that stored at 34°. The time/temperature relationship was more pronounced than with Navels. In contrast to Navels, early-season Valencias were more prone to cold injury than late-season Valencias. The difference in cold injury in oranges from different areas was less than in oranges from the same area harvested at different times of the year. The size of the oranges played little role in the subsequent development of cold injury. The loss in weight of oranges stored at 31° was half that of comparable oranges stored at 40°. All oranges were stored at temperatures of 31° to 34° for periods long enough to sterilize them against Mediterranean (*Ceratitis capitata*) and Natal (*Pterandrus rosa*) fruit flies, but no long enough against false codling moth (*Crytophlebia leucotreta*). (Horticultural Abstracts 40:2282).

BOZZINI, A. y MURTAS, I. D. DE. Insect pest control and insect breeding. Redia 56:473-487. 1975. (035

After a discussion of modern trends towards biological and integrated methods of insect control, including the sterile-adult technique, attention is drawn to the importance of correct methods of rearing insects on a large scale for this

purpose. It is suggested that mass-rearing is the first stage towards domestication, and therefore ought to follow rules of selection for improvement of the strain, whereas laboratory populations reared without deliberate selection tend to decline in sexual competitiveness and egg viability; the depressive effect of inbreeding on a population is a common problem and could be combated by periodic introduction of wild-caught males. The difficulties of mass-rearing and possible methods of overcoming them are illustrated by a detailed account of selection experiments with a laboratory population of *Ceratitis capitata* (Wied.). (Review of Applied Entomology, A 65:2544)

* BURDITT JUNIOR, A. K. Factors affecting rate of loss of trimedlure used to bait traps for fruit flies in Florida. Florida Entomologist 57(4):371-376. 1974. (036

Test were made to determine the rate of loss of trimedlure (g/wick per week) impregnated on cotton dental wicks (3/4 x 1 inch or 3/8 x 2 inch) and exposed in plastic fruit fly traps in central Florida. The rate of loss from wicks placed on the sunny side of trees was significantly greater than that from wicks placed on the shady side. However, the rate of loss from the two sizes of wicks on the sunny side of trees were not significantly different. The 2-inch wicks held less lure and had to be retreated with attractant more often than the 1-inch wicks. Temperature was the most important factor influencing the rate of loss of trimedlure.

* BUSSEL, J. y KAMBUROV, S. S. Ethylene dibromide fumigation of citrus fruit to control the Mediterranean fruit fly, *Ceratitis capitata* (Wied.). Journal of the American Society for Horticultural Science 101(1):11-14. 1976. (037

Grapefruit, orange, and lemon fruits were fumigated with ethylene dibromide (EDB) at 12 and 14 g/$m^3$ for two hour exposures against eggs, larvae, and pupae of the Mediterranean fruit fly. Grapefruit also was fumigated at 16 g/$m^3$ for 2 and 2.5 hr exposures. EDB sorption was determined in an empty chamber and when the chamber was loaded with fruit. At EDB dosages of 12 and 14 g/$m^3$, a complete kill of eggs, larvae, and pupae was obtained by fumigating artificially infested oranges and lemons. With grapefruit, complete kill of eggs and pupae and high mortality of larvae were obtained at those dosages. When the dosage was increased to 16 g/$m^3$ and exposure prolonged to 2.5 hr a 100% kill of larvae was obtained. All citrus fruits were tolerant to dosages used and no peel injury occurred during subsequent 1 month storage and 2 weeks under shelf-life conditions. The rate of EDB residue desorption from various citrus fruits after fumigation was determined. The amounts of inorganic bromide residue resulting from fumigation were below safety limits.

* CABEZUELO PEREZ, P. y SAMPAYO FERNANDEZ, M. Primeros ensayos de "lucha dirigida", previos al establecimiento de un programa de "lucha integrada". Boletín Informativo de Plagas, no. 96:55-80. 1972. (038

Puntos de partida: La ocasión presentada con motivo de las Jornadas de Estudio sobre Lucha Integrada de cambiar impresiones con los señores Arroyo, Audemard, Baggiolini, Biliotti, Feron, Milaire, sobre las posibilidades de la lucha integrada en España, fue el punto de partida de esta idea. Se contaba además con el ofrecimiento del señor Boné de una finca de peral y melocotonero, próxima a la Estación y con un grave problema de "araña roja". Se decidió, por tanto, empezar a dar los primeros pasos en esta línea. Fases del programa: La primera fase era lógicamente hacer un inventario de problemas mediante una observación invernal y una encuesta a los responsables de la finca. La segunda decisión tomada fue la de eliminar de los programas algunos insecticidas y fungicidas reputados como "favorecedores" de la pululación de "araña roja". La tercera fase fue la de hacer sistemáticamente observaciones en los momentos clave de la biología de las diferentes plagas, orientados por las observaciones hechas por el Departamento en sus parcelas "clínicas". La cuarta parte (sin duda la más delicada) era la de tomar decisiones respecto a los tratamientos. En este sentido se ha procurado siempre delimitar las parcelas o focos más atacados en los que se justificaba una aplicación, de forma que pocas veces los tratamientos han sido generales. En este punto se puede decir que para el primer año había que mostrarse prudentes, por tratarse de una finca de propiedad particular, y por la falta de experiencia en el sentido de saber *a priori* si un determinado nivel de población es susceptible o no de un tratamiento inmediato; así se tiene la impresión de haber dado excesivos tratamientos contra el "agusanado" y el "pulgón verde". Pero precisamente para corregir estas lagunas se ha programado este 'ensayo' que ha de durar varios años. Ventajas conseguidas: La primera ha sido la de simplificar enormemente los programas de tratamientos que venían siguiéndose en esta finca. La segunda, el disminuir el número de aplicaciones con su doble ventaja económica y biológica. La tercera, solucionar favorablemente el principal problema que tenía esta finca: la "araña roja", cuyo nivel de población en la actualidad es bajísimo. Problemas que subsisten: El "plomo" del melocotonero, sobre el cual poco o nada puede hacerse, y que se espera resuelva el propio agricultor arrancando los árboles afectados. El "moteado" del peral, donde el ahorro de tratamientos viene impuesto por la evolución del clima, aunque, por supuesto, no se dará el mismo trato a la variedad "Blanquilla", sumamente sensible, que a la "Limonera", prácticamente resistente. El "pulgón verde" del melocotonero para el cual la lucha ha de recomenzar cada año, ya que el nivel de puestas de invierno es independiente de que se haya combatido bien el año anterior, pues los individuos que la realizan proceden de otros cultivos en vuelo de retorno. De todas formas, la protección lograda este año ha sido satisfactoria, pero se tiene la impresión de que se podía haber ahorrado algún tratamiento. Previsiones futuras: Las previsiones de este programa para los próximos años son los siguientes: Continuar este programa de lucha dirigida procurando el máximo ahorro de tratamiento compatible con el buen estado sanitario de las plantaciones.

Comenzar a hacer observaciones sobre la fauna auxiliar. Para mosca del mediterráneo, tratamiento con Fenthion e instalación de trampas de captura. Ir formando al encargado de la finca para que poco a poco sea él quien realice la mayor parte de las observaciones y tome las decisiones correspondientes. Por nuestra parte, el interés se centra en ir cogiendo práctica mediante el establecimiento de programas de lucha dirigida, para, si ello es posible, de acuerdo con los resultados obtenidos, pasar a la aplicación de este nuevo concepto de protección antiparasitaria "la lucha integrada" en algunas fincas piloto.

* CALDERON CORRAL, M. Efecto de la radiación gamma sobre la biología de la primera generación de la mosca del Mediterráneo, *Ceratitis capitata* Wied. Acta Agronómica (Colombia) 22(1):1-24. 1972. (039

En la presente investigación se trabajó con la mosca del mediterráneo, *Ceratitis capitata* Wied., a fin de estudiar la posible acción que la radiación gamma pudiera tener sobre los diferentes estados que comprende el ciclo biológico de la mosca del mediterráneo, cuando ésta proviene de pupas irradiadas. Partiendo de pupas irradiadas con una dosis de 10.000r se efectuaron los cruzamientos de 2.500 machos provenientes de pupas irradiadas, con 2.500 hembras normales a fin de obtener grandes cantidades de huevos, de los cuales se utilizaron las larvas que lograron eclosionar para iniciar el estudio. El porcentaje de fertilidad que se obtuvo y con el cual se trabajó durante toda la investigación fue de 0,18% de fertilidad. Partiendo de un número de 2.000 larvas (procedentes de padre irradiado y madre normal) se estudió la duración del estado larval, el porcentaje de pupación, la duración del estado pupal, el porcentaje de emergencia de adultos, la fertilidad de los adultos y su longevidad. Se encontró que la radiación gamma no tiene influencia sobre el período de incubación del huevo de la mosca del mediterráneo. La supervivencia, medida en la cantidad de larvas que lograron nacer de huevos puestos por hembras normales que copularon con machos procedentes de pupas irradiadas, fue de 0,18%. El período larval se ve afectado por la radiación mientras que el período pupal no es afectado por ésta. El porcentaje de pupación de larvas desarrolladas de huevos puestos por hembras normales que copularon con machos procedentes de pupas irradiadas fue inferior al porcentaje de pupación de las larvas desarrolladas de huevos puestos por hembras normales que copularon con machos normales. La emergencia de los adultos procedentes de pupas irradiadas fue inferior al porcentaje de emergencia de adultos procedentes de pupas normales. La emergencia de hembras procedentes de pupas irradiadas fue inferior a la emergencia de hembras procedentes de pupas normales mientras que la emergencia de machos procedentes de pupas irradiadas fue mayor que la de los machos procedentes de pupas normales. La radiación gamma tiene influencia sobre la fertilidad de la hembra y del macho de la mosca del mediterráneo ya que la reduce en 75,5% y 36,4% con respecto a los adultos normales. La longevidad de los machos tanto irradiados como normales es inferior a la longevidad de las hembras de las mismas procedencias.

* CALS-USCIATI, J. Altérations de la morphogenèse nymphale de *Ceratitis capitata* Wied. (Insecte, Diptère) après irradiation γ de larves du stade terminal. Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, D 273(1):79-82. 1971. (040

Des irradiations γ de larves de *Ceratitis capitata* au troisième stade, 30 h avant la période critique, à des doses inférieures à 40 Krads, ne causent aucune perturbation inmmédiate des phénomènes d'apolysis et d'ecdysis qui accompagnent la mue nymphale. Si le contrôle endocrine et les mouvements morphogénétiques conduisant à la nymphe phanérocéphale ne semblent pas affectés, l'atrophie des fourreaux correspondant aux disques imaginaux dénote, par contre, une radiosensibilité particulière des organes à forte activité mitotique, en voie de différenciation.

* _____. Les relations hôte-parasite dans le couple *Ceratitis capitata* Wiedemann (Diptera, Trypetidae) et *Opius concolor* Szepligetti (Hymenoptera, Braconidae). I. Morphologie et organogenèse de *Ceratitis capitata* (développement larvaire et nymphal) et d'*Opius concolor* (développement embryonnaire et larvaire). Annales de Zoologie, Ecologie Animale 4(4):427-481. 1972. (041

By comparing cuticle structures of larvae of *Ceratitis capitata* we have been able to note the characteristics defining each of the three larval instars. A cellular epidermic strain corresponding to the dehiscence line of the puparium has been noticed; its evolution has been studies during the last two instars. The cuticle structures have been investigated by cytological methods during the puparium formation, in order to study the infracuticle evolution. The methods of investigation of the cuticle, when applied to the pupa result in a better definition of the structural characteristics needed for the diagnosis of the phases of the pupal development, and are displayed in a chronological table. The study of the embryonic morphology and of the morphological and organogenetical development of the larvae of *Opius concolor* has resulted in an accurate knowledge of the phenomenology and chronology of development of this Braconid. It was possible to describe the larval anatomy as soon as the 1st instar *in toto* and at the cellular level, using particular techniques of dissection and histologic and cuticle colorations. The existence of 4 larval instars has thus been made obvious for *Opius concolor*. This study has given biometrical data for the cephalic structures (mandibles, stomodeum, tentorium) and morphological observations for the organs in constant retrogression (pronotum and caudal processes) or presenting a progressive differentiation (nervous system, imaginal discs).

_____. Retard et arrêt de la formation du puparium après irradiation gamma des larves du dernier stade de *Ceratitis capitata* (Dipt. trypetidae). Annales de la Société Entomologique de France 8(3):707-727. 1972. (042

The author reviews from the literature the effect on the pupation of larvae of Coleoptera, Lepidoptera, Hymenoptera and Diptera of exposure to γ-radiation or X-rays and gives a detailed account of studies in France on the effects on the

formation of the puparium of *Ceratitis capitata* (Wied.) of exposure of the last-instar larvae to γ-radiation from a radioactive cobalt ($^{60}$Co) source. It was established that the critical period during which the moulting hormone responsible for the formation of the puparium is active begins 2-3 h after the characteristic 'jump' made by the full-fed larvae, that is, some 5-6 h before the formation of the puparium. Larvae were exposed to doses of 1, 5, 10, 20, 40, 60, 80 or 95 krad, 2, 6 or 30 h before the critical period or 2 h after it. Irradiation delayed the formation of the puparium. When the larvae were irradiated after the critical period, in most cases the formation of the puparium was delayed by up to 1 h, but the delay was not a function of the dose and individuals exposed to 5 or 40 krad formed puparia earlier than non-irradiated individuals. When the larvae were irradiated 2 h before the critical period, the delay in puparium formation was a function of the dose and varied from 0.47 h to 2.6 h. The corresponding delays following irradiation 6 h before the critical period ranged from 0.28 to 1.92 days, doses of 5 and 20 krad being sufficient to induce delays of 0.6 and 0.91 days, respectively. When larvae were irradiated 30 h before the critical period, 20 krad and 40-60 krad resulted in delays of about 2 and 3 days, respectively. Only 41 and 23% of the larvae exposed to 80 and 95 krad, respectively, succeeded in forming puparia. Considerable numbers of the larvae exposed to 80-95 krad 6 h before the critical period were also unable to form puparia. All doses between 5 and 95 krad were lethal; and no adults emerged from any of the puparia formed. Possible mechanisms by which irradiation effects the activity of the moulting hormone are discussed. The author also discusses the practical value of the present findings for studies on the relation between C. *capitata* and its parasite *Opius concolor* Szépl., which, in the laboratory, has been found to oviposit in the last instar larva between the 'jump' and the formation of the puparium. (Review of Applied Entomology, A 62:2113)

* CALS-USCIATI, J. Répercussion de la modification du cycle normal de *Ceratitis capitata* Wied (Diptère Trypetidae), par irradiation γ et injection d'ecdysone, sur le développement de son parasite *Opius concolor* Szepl. (Hyménoptère Braconidae). Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, D 281(4):275-278. 1975. (043

Dans les larves permanentes de *Ceratitis*, obtenues par irradiation γ, l'Hyménoptère parasite se développe normalement jusqu'au premier stade larvaire, mais les larves primaires d'*Opius* n'achèvent pas leur croissance et ne muent pas. La reprise du développement des larves permanentes de l'hôte, provoquée par une injection d'ecdysone, induit la reprise de la croissance de la larve primaire d'*Opius* et le déroulement de sa mue. Les mues larvaires ultérieures sont normales. Les modifications de l'activité métabolique de l'hote, sous l'effet de l'ecdysone, pourraient être responsables de la reprise du développement du parasite.

* CAÑAMAS MENDOZA, R. Evolución de los tratamientos contra *Ceratitis capitata* en la Provincia de Valencia. Boletín Informativo de Plagas, no. 92:23-31. 1972. (044

El autor hace una reseña sobre los antecedentes de la creación de la Comisión Provincial de Lucha contra la *Ceratitis capitata*; da a conocer criterios que se consideraron necesarios para alcanzar el éxito en la lucha contra la *Ceratitis*; oportunidad de las aplicaciones, según biología del insecto: tratamiento sobre amplias superficies en muy corto espacio de tiempo; método de aplicación y productos plaguicidas adecuados (se utilizaron Lebaycid-50-E /50% de Fentión/ y Cebo Buminal /proteínas hidrolizadas/); en 1968 se introduce el uso de Malathion U.L.V.; dirección técnica única. Hace un análisis de la evaluación de los tratamientos realizados desde 1966, así como de costos.

**Evolución del número de tratamientos**

| | HECTAREAS CON: | | | | | | |
|---|---|---|---|---|---|---|---|
| Año | O. trat. | 1 trat. | 2 trat | 3 trat. | 4 trat. | 5 trat. | 6 trat. |
| 1966 | — | — | — | 72.873 | — | — | — |
| 1967 | — | — | 26.573 | 46.300 | — | — | — |
| 1968 | — | 98 | 13.845 | 18.736 | 15.475 | 19.793 | 4.924 |
| 1969 | 5.077 | 30.272 | 17.945 | 12.227 | 850 | — | — |
| 1970 | 19.947 | 24.813 | 16.322 | 9.915 | 1.874 | — | — |
| 1971 | 72.349 | 522 | — | — | — | — | — |

NOTA.—Durante 1969 se efectuó tratamiento terrestre sobre 6.500 Ha.

**Evolución de costos de tratamiento contra *Ceratitis capitata***

| Año | Aplicación | Productos | Total |
|---|---|---|---|
| 1966 | 25.801.875 | 30.610.406 | 56.412.281 |
| 1967 | 17.998.290 | 26.097.520 | 44.095.810 |
| 1968 | 12.317.776 | 22.523.060 | 34.840.836 |
| 1969 tratamiento aéreo | 3.399.420 | 7.348.224 | |
| tratamiento terrestre | 4.989.103 | 5.144.580 | 20.881.327 |
| 1970 | 4.189.018 | 6.475.780 | 10.664.798 |
| 1971 | 44.935 | 68.250 | 113.185 |

Indica que se puede considerar practicamente erradicada la *Ceratitis capitata* de la Provincia de Valencia. (Cuadros del autor). (CV)

CARMI, Y. y CALDERON, M. Fumigation of citrus fruit with mixtures of ethylene dibromide (EDB) and carbon dioxide. Israel. Stored Products Division. Progress Report 1977/78, no. 117. 1978. pp. 41-46. (045

Valencia oranges were fumigated with EDB at 2-6 mg/l or EDB + $CO_2$ at 0-15%. The addition of $CO_2$ did not significantly increase the toxicity of EDB to *Ceratitis capitata* larvae in the fruit. The effective dosage of EDB for larvae control was 6 g/m$^3$. (Horticultural Abstracts 49:6289)

CASILLI, O., LACCONE, G. y BALACCO, L. La lotta contro la mosca della frutta (*Ceratitis capitata* Wied.) su agrumi in Puglia. In Congresso Nazionale Italiano di Entomologia, 11., Portici-Sorrento, 1976. Atti. Napoli, 1978. pp. 385-389. (046

Tests in 1974-75 for the control of *Ceratitis capitata* (Wied.) in orange and mandarin groves at Taranto in the Italian Province of Puglia, with protein baits (Buminal and Nasiman) treated with 0.5% fenthion and with sprays containing a formulation of dimethoate (Aragol) at 150 or 300 g/hl, confirmed indications from previous authors reviewed in the literature that the incidence of damage to citrus by this pest in this region did not warrant regular chemical treatment; however, they also confirmed the effectiveness of poisoned baits if and when treatment again becomes necessary. (Review of Applied Entomology, A 67:990)

CASTILLON, M. P. et al. Biochemistry of the development of the fly *Ceratitis capitata*; evolution of fatty acids of individual phospholipids. Insect Biochemistry 1(3):309-315. 1971. (047

_____ et al. Biochemistry of the development of the insects *Dacus oleae* and *Ceratitis capitata*; evolution on the phospholipids. Comparative Biochemistry and Physiology 38B:109-117. 1971. (048

* _____, CATALAN, R. E. y MUNICIO, A. M. Effect of whole-body irradiation of pharate adult *Ceratitis capitata* on the activity of acetylcholinesterase during final development. Journal of Insect Physiology 18(3):565-570. 1972. (049

Acetylcholinesterase activity has been studied during the development of *Ceratitis capitata* and under several γ-irradiation conditions. A slight and gradual increase takes place until the 4 day pharate adult from which the activity rises more sharply reaching the maximum level at 3 to 4 days after emergence. Irradiation (8·4 krad) of 4 day pharate adults reduced emergence and the levels of enzymatic activity, but its effect on the non-emerged pharate adults is very similar to that on emerged adult insects. Doses of 18 krad completely prevented emergence.

CASTILLON, M. P. et al. Time course of $^{32}P$ orthophosphate incorporation into different classes of phospholipids by larval and pharate adult homogenates of *Ceratitis capitata*. Insect Biochemistry 2(5):1-7. 1972. (050

_____. Adenyl cyclase variation during development of insect *Ceratitis capitata*. FEBS Letters 32(1):113-115. 1973. (051

_____ et al. Biochemistry of the insects *Dacus oleae* and *Ceratitis capitata*. Changes of cholinesterases and triglyceride hydrolyzing enzymes. Comparative Biochemistry and Physiology, B 44(3):639-646. 1973. (052

* _____ et al. Effect of dietary lipids on phospholipid composition of *Ceratitis capitata*. Journal of Insect Physiology 20(3):507-512. 1974. (053

The effects of varying the nature of lipids in the diet of *Ceratitis capitata* larvae on the levels of total phospholipids and the different phospholipid classes in larvae and pharate adults were investigated. Reduction of lipids in the diet caused no change in the phospholipid levels of larvae, whereas the addition of either saturated or unsaturated fatty acids to the diet clearly increased these levels as a consequence of the significant increase in the content of phosphatidylethanolamine. Metamorphosis is accompanied with a notable decrease in the content of phospholipids regardless of the diets on which larvae were reared; this diminution was particularly remarkable in the case of larvae fed on linoleic acid-supplemented diet, and it affects both phosphatidylcholine and phosphatidylethanolamine. The presence of cholesterol in the diets of larvae exhibited a general tendency to counterbalance the decrease that occurs during metamorphosis, which is induced by the higher content of phosphatidylethanolamine.

CATALAN, R. E., VILA, T. y CASTILLON, M. P. Cyclic AMP during development and ageing of the insect *Ceratitis capitata*. Experientia 32(7):843-844. 1976. (054

In further investigations on enzyme systems in *Ceratitis capitata* (Wied.), cyclic AMP was determined during development and ageing. The concentration of the nucleotide reached a peak at apolysis, with a sharp decline in the pharate adult stage. A gradual increase took place through adult life, a maximum being reached at the end of life. These results are discussed in relation to the function of the nucleotide in vertebrates, in which it has been suggested to be the second messenger which mediates the action of a variety of hormones and neurohormones. (Review of Applied Entomology, A 65:3018)

_____, CASTILLON, M. P. y MUNICIO, A. M. Cyclic nucleotide cyclase variation during development of the insect *Ceratitis capitata*. Biochemical and Biophysical Research Communications 69(4):914-919. 1976. (055

CATALAN, R. E., CASTILLON, M. P. y MUNICIO, A. M. Variation of the levels of cyclic AMP and cyclic GMP during development of the insect *Ceratitis capitata*. Biochemical and Biophysical Research Communications 72(1):184-189. 1976. (056

* CAUSSE, R. Etude, au moyen d'insectes irradiés, des conséquences de deux accouplements successifs chez la mouche méditerranéenne des fruits *Ceratitis capitata* Wied. (Dipt. Trypetidae). Annales de Zoologie: Ecologie Animale 2(4):607-615. 1970. (057

The relative distribution of sperm in cases of multiple matings among *Ceratitis capitata* Wied. was investigated. Females were allowed to mate successively with normal males and males emerged from 8 days 9000 rads irradiated pupae and opposite. During the two or three days after the first mating the fecundation is achieved by the last introduced sperm. These sperm accumulate probably at the entry of the spermatheca or in the female genital ducts and so are the best situated to fertilize the eggs. Then occurs an equal competition between the normal and irradiated sperm. The two kinds of gametes mix in the female spermathecae with the approximate rate of 3/4 and 1/4. Those introduced during the second mating represent only 1/4 of the total stock of sperm.

* _____. Ontogenèse des cellules reproductrices chez *Ceratitis capitata* Wiedemann (Diptère Trypetidae). Annales de Zoologie: Ecologie Animale 4(1):35-53. 1972. (058

The ontogenesis of reproductive cells in *C. capitata* evolves as a classic process already observed in other Cyclorrhaphae Diptera and the sexual differenciation may be observed from the 3rd instar larva. The spermatogenesis occurs mainly during the pupal stage: the first spermatids develop in the three days old pupa. The testes develop completely only in the five days old adult insect. The ovogenesis is slow during the pupal stage when the differenciation of the ovarioles and of the first folicles occurs. From the two days old adult insect, the growth of the follicles takes place very fast and the females reach their complete sexual maturity when they are five days old. The ovary is of the polytrophic meroistic type, with four successive divisions of the preovocyte.

* _____. Etude d'un rythme circadien du comportement de prénymphose chez *Ceratitis capitata* Wiedemann (Diptère Trypetidae). Annales de Zoologie: Ecologie Animale 6(4):475-498. 1974. (059

The emergence behaviour from the breeding medium shows a peculiar habit of the larval jumping in search of a nymphal substrate. This emergence shows a circadian rythmn in direct relationship with the light/dark cycle. In natural conditions of dayly fluctuating light as well as in laboratory 12 : 12 LD cycle (and at constant temperature), this behaviour displays itself in a short time period of 3-4 hours. It occurs during the last hours of darkness and the first hour of light. In variable LD cycle the characteristics

of the rhythm include: a) a peack of activity on the 10th-13th hour after the transition from light to dark, and b) another period of activity induced by the first hour of light. This rhythm in endogenous and persists in a 24-hourly periodicity in constant darkness if the larvae have been reared in LD cycle or even exposed to a single time-cue at the end of their larval life. The circadian rhythm appears also if constant light or constant darkness have been maintained since the eggs laying but the amplitude is then very narrow. A single transition from light to dark increases the rhythm amplitude, more especially so if this change happens late in the larval life.

* CAUSSE, R. Influence du sex-ratio sur le nombre d'accouplements dans une population de *Ceratitis capitata* Wiedemann (Diptere Trypetidae). Annales de Zoologie: Ecologie Animale 6(4):499-502. 1974. (060

In a population of *C. capitata* confined in a cage, the maximum of matings in a limited time occurs when the number of males is lower than the number of females. This phenomenon is important for certain experimental works and might play a role in the population dynamics of this insect.

CAVALLORO, R. y DELRIO, G. Studi sulla radiosterilizzazione di *Ceratitis capitata* Wiedemann e sul comportamento dell'insetto normale e sterile. Redia 52:511-547. 1971. (061

Investigations into the sexual biology of *Ceratitis capitata* (Wied.) and the effects of irradiation on it were carried out in the laboratory at Ispra in Italy in view of the reduced competitiveness of completely sterilised males and the current interest in using males irradiated at lower rates for control purposes. Results were obtained by direct observation of insects marked with fluorescent pigments, by examination of the spermathecae of dissected females and by counting the eggs that were laid and hatched. Close relations were found between the beginning of pairing and the number, duration and frequency of matings on the one hand and photoperiod, diet, female size and the physiological state of the male on the other. A factor was found to be transmitted by the male during copulation that made females unreceptive to subsequent matings at least for a time, even if the first male was sterile or aspermic or the mating period was interrupted. The sensitivity of *C. capitata* to γ-radiation at each stage of its life-cycle was determined. The dose giving total male sterility was established as 12 krad for pupae two days before adult emergence and 13 krad for adults one day after emergence. The substerilising doses that allowed males to remain competitive while reducing fertility to about 3% were found to be 6 and 8 krad for pupae and adults, respectively, and the advisability of releasing males treated in this way was confirmed. In females that paired more than once, mating with a normal and them with a sterile male reduced female fertility, whereas mating firstly with a sterile and secondly with a normal male increased if. Females proved more sensitive than males

to irradiation and were completely sterile after treatment at 4-5 krad, although they were still sexually vigorous and laid a few non-viable eggs. It is recommended that sterile females should also be considered for field release. (Review of Applied Entomology, A 62:1195)

CAVALLORO, R., DELRIO, G. y ANSELMI, L. Criterio di stima dell'efficacia di maschi sterili e substerili nella lotta contro gli insetti, con particolare referimento a *Ceratitis capitata* Wiedemann. Note ed Appunti Sperimentali di Entomologia Agraria 14:57-65. 1973. (062

The authors describe a simple mathematical method of evaluating the relative effectiveness of irradiated male insects with various degrees of sterility and distributed in various ratios to the males in the population to be controlled. A close positive correlation existed between the radiation dose and the degree of sterility of the treated insects, and a close negative one between the dose and the degree of competitiveness; there was also a correlation between dose, competitiveness and the number of treated insects required to be distributed. The validity of the model was tested on data concerning *Ceratitis capitata* (Wied.), and it was clearly shown that the use of substerile males is more effective than the use of completely sterile ones. (Review of Applied Entomology, A 63:1176)

_____ y DELRIO, G. The effects of fast neutrons on the Mediterranean fruit fly (*Ceratitis capitata* Wiedemann). In International Plant Protection Congress, 8th., Moscow, 1975. Reports and information. V. Biological and genetic control. Moscow, USSR, 1975. v.5, pp. 53-62. (063

Laboratory test were carried out in Italy on the effect of *Ceratitis capitata* (Wied.) of exposure to fast neutrons. Males were generally more sensitive to treatment than were females. The doses required to prevent adult emergence were 761, 761, 1521 and more than 2979 rad for eggs, newly hatched larvae, full-fed larvae, and pupae three days old, respectively. Exposure of pupae or adults to 2979 rad caused a high percentage of adult sterility, without affecting the length of life. The data showed that neutrons were more effective than γ-radiation for producing mortality in the pre-imaginal stages and dominant lethals in the adult stage (especially in the male). When compared with normal males, those sterilised with fast neutrons showed a higher sexual competitiveness than did those sterilised with γ-radiation. (Review of Applied Entomology, A 65:970)

_____ y DELRIO, G. Fattori edafici influenzanti l'impupamento di *Ceratitis capitata* Wiedemann. Bollettino del Laboratorio di Entomologia Agraria 'Filippo Silvestri' 32:190-195. 1975. (064

During research on factors influencing the spread and fluctuation of populations of *Ceratitis capitata* (Wied.) in Italy, the effect of seven different soil types on the pupation of this tephritid was investigated in the laboratory. It was found that pupation was affected not by the chemical

composition of the soil but by its physical structure and moisture content at the time of entry by the mature larvae, which tended to enter more deeply into dry, cracked soil than into wet soil but did not usually go further than 5 cm from the surface; this was not deep enough to protect the ensuing pupae from extremes of heat or cold or from predators, and these factors together were the main causes of pupal mortality during the long period passed in the soil. (Review of Applied Entomology, A 64:6464)

CAVALLORO, R. Measuring mating frequency rhythmicity, duration and refraction in *Ceratitis capitata*. Bull. SROP Int. Organ Biol. Control Noxious Anim. Plants West Palearctic Reg. Sec. 5:100-101. 1977. (065

CAVICCHI, S. Lo studio della *Ceratitis capitata* in laboratorio. I. Metodi di allevamento (Diptera). Bollettino della Societa Entomologica Italiana 103(7/8):117-124. 1971. (066

Experimental rearing of *Ceratitis capitata* (Wied.) in the laboratory has so far usually been carried out on a large scale. However, mass rearing is not suitable for obtaining genetic information requiring the observation of single genotypes. Equipment devised and used at Bologna in Italy for rearing in the mass, in small groups of 15 pairs and in single pairs is described and illustrated. For large numbers of flies, a cage 25 x 35 x 22 cm was used, with a wooden frame and bottom, two glass sides and two wire-mesh sides, the open end being covered with a sleeve of nylon mesh; it contained artificial fruits for oviposition and one of several adult diets, of which the most effective (in terms of survival and fecundity) consisted of water, agar, molasses, Nipagin and Nutramine (25%). Small groups were kept in square boxes (9 x 7 x 7 cm) of transparent polystyrene, to the open end of which a similar nylon sleeve was fitted. Single pairs were kept in small cylindrical polystyrene tubes with push-in plastic tops; if the adult diet was spread on the bottom of the tube, the flies became stuck either in the medium itself or in the condensation forming on the sides of the tube, and so holes were bored in the bottom of an empty tube, which was then placed on a metal tray containing the food. Comparison of flies maintained according to these three techniques showed that crowding stimulates reproduction; with isolated pairs, only 30-40% of the females were fertilised and the number of eggs/female was about half that produced by mass-reared females. (Review of Applied Entomology, A 61:4849)

_____. Genetic polymorphism of puparium colour in *Ceratitis capitata* Wied. Monitore Zoologico Italiano 7(3):135-144. 1973. (067

* CAVIN, G. A. Programa de prevención y cuarentena contra las moscas de las frutas en los Estados Unidos de Norteamérica. Folia Entomológica Mexicana, no. 39-40:178. 1978. (068

En este trabajo se da un panorama general de los trabajos de prevención y cuarentena llevados a cabo con la mosca del mediterráneo, *Ceratitis capitata*; la mosca oriental de la fruta, *Dacus dorsalis*; la mosca del melón, *Dacus cucurbitae* y la mosca de la fruta, *Anastrepha ludens*, especies de un potencial económico ya conocido, que están actualmente limitadas en áreas relativamente pequeñas de los Estados Unidos y que han sido erradicadas una o más veces del continente de Estados Unidos.

* CERMELI L., M., NIEVES, M. y MENDOZA P., V. Estudios preliminares sobre las moscas del fruto del durazno en las zonas altas de los Estados Aragua y Miranda. In Jornadas Agronómicas, Caracas, 1969. Memorias. Caracas, Venezuela, 1970. v.4, 13 p. (Trabajo, no. 72). (069

*Anastrepha fraterculus* (W.) y *Ceratitis capitata* (W.) (Diptera, Tephritidae) constituyen las especies de mayor importancia como plagas del fruto en durazno. *Silba glaberrima* (W.) es una especie frecuente pero su importancia primaria no está aún bien definida. Se describen las observaciones de campo efectuadas con trampas Steiner, siendo el mejor atrayente para la mosca del mediterráneo el Trimedlure (winter grade) y como insecticida el diazinon (Basudin). Para *Anastrepha* ninguno de los atrayentes resultó efectivo. Se reportan los resultados de las capturas de *Ceratitis* en varias localidades de la Colonia Tovar y El Jarillo en los años de 1967 y 1968. Las poblaciones de moscas de los frutos en general sufren un aumento al comienzo de la estación lluviosa y mantienen niveles altos hasta fines de año, a partir de noviembre disminuyen para llegar a un mínimo en los meses de sequía (enero-marzo). Los ataques son esporádicos y muy localizados, pero de gran importancia económica. Generalmente predomina una especie según la zona, pero se han dado casos de ataques conjuntos por dos o las tres especies. En pruebas con insecticidas, los mejores resultados se obtuvieron con aspersiones a bajo volumen con *fention* (Lebaycid) o *dimetoato* (Dimetoato) en concentraciones del 5%, comenzando las aplicaciones al aparecer los primeros frutos pintones y repitiendo el tratamiento a los 20 días.

* CHAILLOU, C. Effect of delayed availability of a site for ovoposition on *Ceratitis capitata* Wied. (Diptera, Trypetidae). Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, D 272(8):1126-1129. 1971. (070

Certains stimulus, liés à un milieu favorable à la ponte, peuvent accélérer le déroulement de la vitellogenèse et conditionner le rejet d'oeufs en nombre important chez certains Insectes. L'absence d'un lieu favorable à la ponte réduit très fortement la fécondité des femelles de *Ceratitis capitata* W. L'introduction, différée au 10e jour, d'un pondoir artificiel, permet l'examen des répercussions de l'absence, pendant les 10 premiers jours de

la vie imaginale de la femelle, des stimulations sensorielles spécifiques de l'activité de ponte sur le fonctionnement ovarien et l'évolution de la fécondité. Les observations portent sur des couples isolés provenant de larves élevées au laboratoire dans des conditions standard. La comparaison des paramètres, caractérisant l'activité reproductrice dans les trois situations, permet de mettre en évidence l'action du retard à l'introduction.

* CHAILLOU, C. Répercussions de la présence discontinue du pondoir su l'activité de ponte de *Ceratitis capitata* W. (Diptere, Trypetidae). Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, D 271(23):2179-2181. 1970. (071

Chez certains Insectes, une stimulation discontinue de l'activité de ponte a des répercussions sur le rythme et l'importance des effectifs émis. Chez *Ceratitis capitata* W., en l'absence d'un lieu favorable à la ponte, les nombres d'oeufs déposés sont très faibles. La présence discontinue d'un pondoir artificiel, utilisé pour les élevages de masse de cet Insecte, pendant un jour sur cinq, permet d'examiner l'influence de l'interruption des stimulations sur l'évolution de l'activité de ponte des femelles. Les résultats obtenus avec une introduction périodique du pondoir à partir du cinquième et du dixième jour sont comparés à ceux obtenus lorsque le pondoir est présent ou absent de façon permanente, et, accessoirement, lorsque le pondoir permanent est introduit le 10$^{e}$ jour. Toutes les expériences ont été effectuées sur des couples isolés dès le stade imaginal et provenant d'une souche élevée au laboratoire.

CHAMBERS, D. L. et al. Treating Tephritids with attractants to enhance their effectiveness in sterile-release programs. Journal of Economic Entomology 65(1):279-282. 1972. (072

The following is virtually the authors' abstract. When adults of *Ceratitis capitata* (Wied.), *Dacus dorsalis* Hend. and *D. cucurbitae* Coq. were treated topically with the male attractants trimedlure, methyl eugenol and cue-lure, respectively, and placed in outdoor cages in Hawaii, untreated adults of *D. dorsalis* and *D. cucurbitae* were found to be attracted to the treated ones. Also, males of *D. cucurbitae* that had been exposed to the odour of cue-lure for 4-5 days after adult emergence were subsequently 3-10 times less responsive to traps baited with cue-lure, indicating that the flies had become habituated to the attractant. It is concluded that control or eradication by the techniques of male annihilation and sterile release may be improved by using sterilised insects that do not respond to mixtures of attractant and insecticide. (Review of Applied Entomology, A 60:2535)

* CHEIKH, M. et al. Suppression of the Mediterranean fruit fly in Tunisia with released sterile insects. Journal of Economic Entomology 68(2):237-243. 1975. (073

The Government of Tunisia, U. S. Agency for International Development, and U. S. Department of Agriculture cooperatively developed a program for suppression of *Ceratitis capitata* (Wiedemann) in Tunisia. Mediterranean fruit flies were reared on an artificial diet, sterilized with 10 krad irradiation from a cobalt source, and the emerged adults were marked and then distributed by hand throughout the release area, 600 ha in the vicinity of Porto-Farina. Some aerial releases were made late in the season. Winter larval hosts were removed to lower the over-wintering population, and sterile fly releases were begun early (Mar. 1) to prevent fertile matings of flies which emerged during warm winter days. All fruit on the periphery of the release area was sprayed periodically (5 applications), as was the major fruit-growing areas within the region but outside the test zone, to minimize the possibility of fertile flies entering the release area. Daily from March to November, ca. 1,000,000 sterile flies were released. Trap catches indicated that the suppression obtained was about equal to that obtained using poison bait sprays. The early preferred host crops had no or negligible infestation (loquats, apricots, early peaches, and figs). The infestation of preferred summer fruits (peaches and figs) was reduced but not controlled. Less susceptible summer fruits were seldom infested. The estimated population was ca. 82.3% lower than in the previous year when no releases were made. Isolation and sterile fly distribution was inadequate to completely suppress the Mediterranean fruit fly population.

* CHINCHILLA SANTOS, J. J. Evaluación de tres atrayentes alimenticios para el control de *Ceratitis capitata*, Wiedman. Tesis Ing. Agr. Guatemala, Universidad de San Carlos de Guatemala, Facultad de Agronomía, 1978. 36 p. (074

Esta evaluación tuvo por objetivo principal el de seleccionar el atrayente que mejor se adapte a las condiciones ecológicas imperantes en Guatemala y que presente mayor capacidad de atracción en la lucha contra la mosca del mediterráneo. El análisis estadístico del número de moscas capturadas por tratamiento indicó que no existen diferencias significativas entre los tratamientos, por lo que se considera que las tres proteínas hidrolizadas evaluadas en el período, tuvieron similar poder de atracción hacia la mosca del mediterráneo en la finca "Chanteros" (Guatemala), en la época en que se efectuó el estudio. Los resultados obtenidos en este experimento estuvieron influenciados en parte a que las poblaciones de la plaga en esa época eran muy bajas.

CIGLIANO, G. y BONO, A. DE. Prove di lotta in Calabria contro il *Dacus oleae* e la *Ceratitis capitata* con esche avvelenate. Informatore Fitopatologico 22(21/22):38-41. 1972. (075

In two olive plantations spraying with 0.5 kg/ha of a protein bait mixed with 0.125 kg/ha fenthion in 50 l water gave

satisfactory control of *D. oleae*, three treatments were needed in one plantation and two in the other. In an orange plantation *C. capitata* was controlled well by two treatments with 2 kg/ha of bait and 0.80 kg/ha DDT in 400 l water. (Horticultural Abstracts 43:7165)

CIGLIANO, G. y BONO, A. DE. Lotta contro la mosca degli agrumi con l'impiego di miscele a base di esche proteiche. Informatore Agrario 29(29):13073-13075. 1973. (076

Lysatex (a French product) was applied to Tarocco oranges or Clementines in late September at a rate of 500 g/100 1/4 ha plus 50 g of ethion, fenthion or methomyl, or 60 g dimethoate + 200 g DDT. All treatments were highly effective against *Ceratitis capitata* reducing the proportion of damaged fruit from 33% to 0.06, 0.05, 2.30 and 0.75%, respectively. (Horticultural Abstracts 44:5078)

CIRIO, U. et al. Preliminary ecological observations of *Ceratitis capitata* Wied. on the island of Procida with an attempt to control the species using the sterile-male technique. Bollettino del Laboratorio di Entomologia Agraria 'Filippo Silvestri' 30:175-188. 1972-1973. (077

Investigations were made in 1968-69 into the natural populations of *Ceratitis capitata* (Wied.) on the Italian island of Procida and into the conditions favouring its development there, with a view to determining the number of sterile adults required and the best date and method for beginning to release them as a means of control. The climate was favourable in all months except January, and the wide variety of fruit trees, mostly grown in small orchards and gardens, provided suitable host fruits throughout the year. Sour orange appeared to be preferred, and it was attacked early in the year after harbouring larvae and pupae during the winter. Sweet orange, medlar, peach and apricot were heavily infested from June onwards and plum, lemon, apple and unripe peach and apricot in the later months of the season; the widest range of fruits was attacked during the population peaks. The number of larvae per fruit was related to the time of year, climatic conditions, the quantity of fruit present and adult population size. Eggs and larvae of all instars were sometimes found in a single fruit. Adults were marked and recaptured in Nadel traps, which were examined weekly. In favourable conditions, especially in July and August, *C. capitata* was able to multiply up to 42-fold in a single generation. The sterile-male control technique would therefore be difficult to apply, but it is estimated that the population could be brought below the economic level by means of weekly releases of at least 3,000,000 sterile insects from early April until autumn; complete eradication would require a combination of releases with poisoned bait sprays, the destruction of sour orange trees and the quarantining of all imported fruit. (Review of Applied Entomology, A 63:771)

CIRIO, U. y MURTAS, I. DE. Status of Mediterranean fruit fly control by the sterile-male technique on the island of Procida. In Panel on the Practical Use of the Sterile-Male Technique for Insect Control, Vienna, 1972. Proceedings. Vienna, Austria, 1974. pp. 5-16. (078

Studies to perfect the sterile-insect release technique for the control of *Ceratitis capitata* (Wied.) are being continued on the Italian Island of Procida and an account is given of work carried out there in 1972. The objectives were to show that this method can be used successfully in an area where conditions are optimum for the fly and can be integrated with other measures, to evaluate the real cost of control based principally on this method, to obtain further ecological information to improve the practical application of the method, and to encourage growers to group together to organise control operations. Since larvae, pupae and adults are present in Procida even during the winter (the larvae and pupae in sour orange), some 5000 traps baited with trimeldure were operated throughout the island 5-6 months before the first releases to reduce the chances of fertile pairings and the overwintering of gravid females; in addition, 90% of the sour oranges were collected and destroyed. Some 4-5 million adults were available each week from the insectary at the Casaccia Centre near Rome, and they were transported to Procida by car and ferry twice a week in paper bags in which they had been subjected to γ-radiation at doses between 9.2 and 13 krad. Between 24th March and 28th October, nearly 85.5 million adults were released. In March, only 4% of the sour oranges were found to be infested and no other signs of infestation were observed until late August in the many fruits examined. Some infestation occurred in peaches in late August, but the attack remained localised. The evidence suggested that fertilised females had reached Procida from the mainland, which is only 2.7 km away. Traps were operated throughout the period of the releases; wild males were taken only at the start of the season and again from August, but numbers were always very small. The information obtained on seasonal development is compared with that obtained on the mainland and on the islands of Ischia and Capri. It is concluded that the technique can be used to eradicate the fly even from areas that are most favourable for its development. (Review of Applied Entomology, A 63:3335)

_____ y SALEMME, S. Contributo al miglioramento dell'allevamento di *Ceratitis capitata* Wied. (Diptera, Trypetidae). Bollettino del Laboratorio di Entomologia Agraria 'Filippo Silvestri' 32:180-189. 1975. (079

Recent improvements are described in techniques for mass-rearing *Ceratitis capitata* (Wied.) that were used in the insectary of the CNEN in Rome, especially the mechanism of egg collection, incubation, the administration of the larval diet and the collection of pupae, and the formulation of a less expensive larval diet containing water, straw, dried torula yeast (instead of brewer's yeast), molasses (instead of sugar), Nipagin /methyl 4-hydroxybenzoate/, sodium benzoate and hydrochloric acid. Adults reared on this diet appeared to be as sexually vigorous as wild ones, although less mobile. The author

points out the preoccupation in the past with rearing large quantities of insects without sufficient attention to the quality of the adults produced, which is particularly important with regard to flies used for the sterile-adult control method. (Review of Applied Entomology, A 64:6568)

CIRIO, U. y CAPPARELLA, M. Experienza con insetti sterili nel controllo della *Ceratitis capitata* Wied. Frutticoltura 38(2):21-25. 1976. (080

_____ y VITA, G. Natural chemical substances affecting cherry fruit fly behaviour. I. Laboratory trials. Bollettino del Laboratorio di Entomologia Agraria 'Filippo Silvestri' 33:310-314. 1976. (081

The behavioural responses of ovipositing females of *Rhagoletis cerasi* (L.) to two natural chemicals of plant origin that had already been found to have a repellent action on *Dacus oleae* (Gmel.) and *Ceratitis capitata* (Wied.) was tested in the laboratory by caging mated females or pairs of adults with cherries or black ceresin oviposition domes, some of which had been treated with either an orthodiphenyl extract from olives or an acetone-soluble soy-bean lecithin fraction. Both compounds were repellent at first and lost their repellency as they dried, but the soy-bean lecithin fraction inhibited oviposition for at least a week whereas the orthodiphenyl extract was effective for only two days. It was found that the orthodiphenyl extract was repellent to the touch to *R. cerasi*, whereas reactions to soy-bean lecithin were at first olfactory and later gustatory and tactile; for this reason both substances prevented oviposition but only soy-bean lecithin prevented landing on treated domes or cherries. The orthodiphenyl extract was found to have no repellent effect on *Opius concolor* Szépl., a braconid parasite. (Review of Applied Entomology, A 65:6553)

_____. Control of Mediterranean fruit fly by sterile insect technique. Bollettino del Laboratorio di Entomologia Agraria 'Filippo Silvestri' 34:62-73. 1977. (082

In this review of the literature on the control of *Ceratitis capitata* (Wied.) by means of the sterile-insect technique, the ecological factors (effect of climate on released flies and the interaction between *C. capitata* and other elements of the ecosystem), the technological considerations (with regard to mass-rearing and release) and the operational costs are examined and discussed; the history of the application of this method in Italy and elsewhere is also summarised from published data. (Review of Applied Entomology, A 67:378)

_____. Field evaluation of the movement of *Ceratitis capitata*. Bull. SROP Int. Organ Biol. Control Noxious Anim. Plants West Palearctic Reg. Sec. 5: 45-46. 1977. (083

CIRIO, U. y CAPPARELLA, M. Valutazioni tecniche, ecologiche ed economiche sull'impiego della tecnica di lotta dell'insetto sterile contro la *Ceratitis capitata* Wied. nell'isola di Procida al termine dell'esperimento pilota di controllo. In Congresso Nazionale Italiano di Entomologia, 11., Portici-Sorrento, 1976. Atti. Napoli, 1978. pp. 349-358. (084

The results of the four-year pilot experiment on the Italian island of Procida for the control of *Ceratitis capitata* (Wied.) by the sterile-insect technique, which was terminated in 1975, are reviewed, and conclusions are drawn from them with regard to technological, ecological and economic considerations. While techniques of mass-rearing, sterilisation and release of the insects were simplified and improved during the campaign, those of assessing the effectiveness of the radiosterilisation, the competitiveness of the sterile insects produced, and the number of insects required for release, still require improvement. Bearing in mind the agricultural system current on Procida, the ecological conditions and the performance of the insects releases, it is concluded that the eradication of C. *capitata* from this island requires weekly releases of about 10,000 sterile adults/ha. Since this technique, although rapid and effective, is too costly to appear economic, it should not be evaluated in isolation from the financial point of view but be considered as part of a general regional plant protection policy, involving many different crops. (Review of Applied Entomology, A 67:983)

COHEN, I. Centrally organised control of the Mediterranean fruit fly (*Ceratitis capitata* Wied. in *Citrus* groves in Israel. Tel-Aviv, Citrus Board of Israel, 1971. 3 p. (085

In further work on the control of *Ceratitis capitata* (Wied.) on *Citrus* in Israel, the ultra-low-volume concentrate method of applying protein-malathion bait-sprays was adopted in all *Citrus* groves and gave excellent results during the 1968-69 and 1969-70 seasons. Grapefruit left on the trees until July to extend the marketing season remained free of fruit-fly infestation. Successful results were obtained in field experiments on extending fruit-fly control by treating food-plants other than *Citrus*, by disseminating suitable parasites in areas containing wild alternative food-plants and by annihilating males by means of bait-sprays fortified with a male lure. (Review of Applied Entomology, A 61:2380)

* CONTROL DE las moscas del fruto en durazno. Noticias Agrícolas (Venezuela) 5(18):70-72. 1969. (086

Destacan la importancia de las moscas del fruto, como plagas que atacan los durazneros. Establecen las diferencias entre mosca del mediterráneo, *Ceratitis capitata* y la mosca del fruto, *Anastrepha fraterculus*; los daños que causan y la forma de obtener un buen control mediante medidas de prevención, prácticas agronómicas y el uso de insecticidas recomiendan dimetoato (Rogor L-40) o lebaycid (Lebaycid emulsión 50%). (CV)

CONTROLLING FRUIT flies by the sterile-insect technique. In Panel and Research Co-ordination Meeting on the Sterile-Male Technique for Control of Fruit Flies, Vienna, 1973. Proceedings. Roma, FAO/International Atomic Energy Agency, 1975. 175 p. (IAEA-STI/PUB-392) (087

These proceedings (mainly 12 papers and 8 progress reports) deal with problems of the mass production and release of sterile insects of the desired quality, and also describe the present situation and prospects with regard to the control of several fruit fly species in different countries; the Mediterranean fruit fly (*Ceratitis capitata*) in Italy, Spain, Israel, Cyprus, Central America, Peru, Argentina and Egypt; the olive fruit fly (*Dacus oleae*) in Greece and Yugoslavia; the oriental fruit fly (*Dacus dorsalis*) in the Philippines; the Mexican fruit fly (*Anastrepha ludens*) in Mexico; and other flies in Germany, Switzerland and the Netherlands. (Abstracts on Tropical Agriculture 2:11698)

* CORDES, R. E. Datos preliminares sobre marcación de mosca del mediterráneo, *Ceratitis capitata* (Wiedemann) con $^{32}P$. Revista de la Sociedad Entomológica Argentina 31(1-4):23-32. 1968. (088

The decay of the radioactivity incorporated in adults of *Ceratitis capitata* (Wiedemann) through nutrition is studied. The decrease of activity registered daily is significantly higher than the physical decay of the radioisotope. The loss takes place in excrements, spawning and other metabolites and is significantly larger in females. Furthermore, the activity was registered in eggs laid in different periods after ceasing nutrition with the radioactive element. It is established that the used radioisotope, as well as the selected activity, are adequate for the study of the biology of this species, because of its longevity and of the absence of secondary effects on the specimens.

* COSTILLA, M. A. Experiencias de control con melaza y parathion en la lucha contra las moscas de los frutos. In Jornadas sobre Moscas de los Frutos, Tucumán, Argentina, 1969. Documentos. Argentina. Estación Experimental Agrícola de Tucumán. Publicación miscelánea, no. 32. 1970. p. 5. (Sólo resumen) (089

El ensayo se llevó a cabo en la zona de Yerba Buena (Tucumán) en plantas de pomelo de cinco años de edad en 5 lotes de 10 plantas cada uno. Los testigos (6 plantas) estaban alejados de los lotes tratados a unos 200 m aproximadamente. Los productos y dosis utilizados fueron los siguientes: Parathión 50%... 200 cc; Melaza... 4 kg; Agua... 100 l. Dado a que los datos de mosqueros para los meses de octubre demostraron alta población de moscas, se convino iniciar los tratamientos de protección en la primera semana de enero, repitiéndose cada 7 a 10 días de acuerdo a las condiciones ambientales, especialmente en caso de lluvias. El gasto de la mezcla por planta fue de 1 litro y los tratamientos se hicieron utilizando una pulverizadora de 1.500 litros. El chorro fue dirigido al centro de la planta por considerar que los primeros ataques se producen en la zona más sombreada y más fresca en la época de verano. Se hicieron 15 tratamientos en el período enero-mayo. Los resultados promedios

de daños fueron los siguientes:

| | Plantas | Frutos caídos |
|---|---|---|
| Tratadas | 50 | 2,5% |
| Testigo | 6 | 98-100% |

La especie que ocasionó los daños fue la mosca del Mediterráneo *Ceratitis capitata* Wied. El costo por planta osciló para los 15 tratamientos entre $65 y $95, que corresponden a 5-19 pomelos aproximadamente para los precios de setiembre de 1969.

COSTILLA, M. A. Panorama actual de las moscas de los frutos en la Provincia de Tucumán. In Jornadas sobre Moscas de los Frutos, Tucumán, Argentina, 1969. Documentos. Argentina. Estación Experimental Agrícola de Tucumán. Publicación miscelánea, no. 32. 1970. pp. 3-4. (090

El autor hace un estudio de la situación fitosanitaria en la región frutícola de Tucumán, Argentina, en relación a las moscas de los frutos. Establece la fecha inicial de la plaga, las poblaciones predominantes en esos momentos de *Anastrepha fraterculus*; el predominio a partir de 1963-64 de *Ceratitis capitata*; hace también referencia al ciclo biológico de estas especies.

* _____ et al. Las moscas de la fruta y su control en quintas cítricas. Argentina. Estación Experimental Agrícola de Tucumán. Circular, no. 199. 1975. 9 p. (091

También en: Avance Rural (Argentina), no. 24:32-33. 1976.

Los autores establecen la existencia, en Tucumán, Argentina, de la mosca de la familia Trypetidae, importante plaga de la fruta. Establecen diferencias entre la mosca del mediterráneo *Ceratitis capitata* y la mosca sudamericana *Anastrepha fraterculus*, sus actividades biológicas, y los daños causados en la fruta. Indican formas de control; combate químico, los tipos de aplicación del cebo tóxico, formado por un insecticida y un atractivo y las medidas de prevención, eliminación de la fruta caída, en forma inmediata juntándola y enterrándola o si se deja mucho tiempo en el suelo, en el mismo lugar en que se encuentra, se debe pulverizar o espolvorear con productos clorados, para la eliminación de pupas y larvas. (CV)

_____ y BASCO, H. J. Comportamiento de cebos para el control de las moscas de la fruta en quintas cítricas. Revista Industrial y Agrícola de Tucumán (Argentina) 54(1):41-45. 1977. (092

Se ha realizado un ensayo con cebos tóxicos preparados en base a dos atractivos, "Melaza de caña" y "Proteína Hidrolizada" Nazimán y como insecticida Malathion 100. También se ha incorporado una variante en base a Malathion 100 sin atractivo. Se evaluó la acción de los cebos sobre las moscas de la fruta, *Anastrepha fraterculus* y *Ceratitis capitata*, determinándose a la vez cuál es la especie predominante.

Al mismo tiempo se ha observado la acción de los cebos tóxicos sobre los predatores de áfidos y cochinillas muy abundantes en la época en que se llevaron a cabo los ensayos.

* CUCCHI, N. J. A., PUIATTI, A. E. y GARCIA, M. F. Observaciones sobre la eficiencia de algunos atractivos para la mosca de los frutos en Mendoza. In Jornadas sobre Moscas de los Frutos, Tucumán, Argentina, 1969. Documentos. Argentina. Estación Experimental Agrícola de Tucumán. Publicación miscelánea, no. 32. 1970. pp. 17-28. (093

La incidencia económica de los daños producidos por la mosca de los frutos, en algunos años alcanza cifras importantes. De esto surgió la necesidad de ensayar diversas sustancias para seleccionar las más convenientes en las condiciones de la provincia de Mendoza, Argentina. Se realizaron varias pruebas en distintas localidades de la zona Norte y Este de la provincia, con varios atractivos y diversas especies frutales durante los años 1964-65-66-68 y 69. En montes frutales se colocaron grupos de mosqueros tipo "Portici" desde el comienzo de la temporada hasta la cosecha o hasta que cesaron las caídas. En algunos casos se instalaron en vez de mosqueros recipientes cilíndricos enlozados. Los recuentos de moscas atrapadas y la renovación de los atractivos, se realizó semanalmente, pero en algunos casos la revisión se hizo a diario. Los atractivos utilizados fueron: Acetato de terpinilo; extracto de levaduras de cerveza; extracto de malta; proteína hidrolizada de levaduras; proteína hidrolizada de soja; Trimedlure y vinagre de vino. De las experiencias realizadas se puede concluir, no obstante, las variaciones que se observan entre los años y entre las distintas localidades en que se colocaron los tramperos, que el atractivo más activo para la mosca de los frutos en mosqueros "Portici" resultó trimedlure, seguido por proteína hidrolizada de soja y extracto de levadura de cerveza. En los recipientes enlozados abiertos resultaron muy efectivos el acetato de terpinilo y extracto de malta. Es interesante notar que ambos atractivos en mosqueros "Portici" resultaron de eficacia mucho menor. El vinagre de vino en los mosqueros "Portici", se mostró en casi todos los casos, menos eficaz que los demás productos ensayados. En los muestreos de membrillos, los porcentajes de parasitismo debido a la mosca resultaron variables pero algo menores que los causados por "*Carpocapsa*" y "*Grapholita*". En las peras los daños se encontraron similares para ambos tipos de parásitos, en porcentajes relativamente bajos. En los duraznos, el porcentaje de daño causado por *Grapholita molesta* fue muy alto, mientras que no se detectó parasitismo debido a la mosca de los frutos.

CUCULIZA T., M. y TORRES V., E. Moscas de la fruta en las principales plantas hospederas del valle de Huánuca. Revista Peruana de Entomología 18(1): 76-79. 1975. (094

Fruits of guava, orange, cherimoya (*Annona cherimolia*), pacae (*Inga feuillei*) and coffee were collected throughout the year in the Huánuca Valley, Peru, to determine the species and abundance of the fruit-flies attacking them.

The most abundant species was *Anastrepha fraterculus* (Wied.), which was found with *Ceratitis capitata* (Wied.) on guava, orange and cherimoya. *A. distincta* Greene was found only in pacae, in association with *C. capitata*. Only *C. capitata* was found on coffee. All three fruit-flies were most abundant during the rainy season (October to March). Parasitism by *Opius* sp. was insignificant, not exceeding an average of 2.3%. (Review of Applied Entomology, A 66:2029)

CUNNINGHAM, R. T. et al. Mortality of male melon flies and male Mediterranean fruit flies treated with aerial sprays of lure and nales formulated with monoglyceride or siliceous extender. Journal of Economic Entomology 63(1): 106-110. 1970. (095

The following is based largely on the authors' abstract. During large plot experiments in Hawaii in 1965-66, foliar sprays of specific male attractants (cue-lure or medlure) and the toxicant naled with either Myverol (monoglycerides of lard) or CAB-O-SIL (superfine silica) as extenders of spray efficiency applied by aircraft showed that they may be effective in male annihilation programmes against *Dacus cucurbitae* Coq. and *Ceratitis capitata* (Wied.). When cue-lure with either of the extenders was applied at 1·2-1·4 kg per $km^2$ in flight lines 152 m apart to areas of wild bitter melon (*Momordica charantia*), tomato and cucumber in a planting of *Macadamia* (which is not infested by the fruit-fly), catches of males of *D. cucurbitae* in plastic bait traps were reduced by 99% for nine days after the spray treatment. Medlure applied with either of the extenders at 2·8-3·8 kg per $km^2$ in lines only 76 m apart to cultivated coffee gave short-lived reductions (lasting for less than one week) of 92-94% in the catches of males of *Ceratitis*. (Review of Applied Entomology, A 58:1952)

* _____ et al. Aerial broadcast of free-falling pupae of the Mediterranean fruit fly for sterile-release programs. Journal of Economic Entomology 64(4):948-950. 1971. (096

Free-falling pupae of *Ceratitis capitata* (Wiedemann) reached a constant terminal velocity of fall of 6 m/sex within the first 3 m of fall. The percentage eclosion of pupae recovered after falls of 60 m onto bare rocky ground, grassy fields, and forest cover was 41, 82, and 62%, respectively. Pupae dropped within two days of eclosion were less injured than younger pupae. The posteclosion mortality of flies dropped as pupae was 10-20% greater than that of the controls in the first week; thereafter, the mortality rate of flies dropped as pupae was less than or equal to that of the controls. In a 5-$km^2$ plot about twice as many flies were recovered from those dropped 90 m as bagged young adults as from those dropped as free-falling pupae.

* CUNNINGHAM, R. T. et al. Reproduction in the Mediterranean fruit fly: depletion of stored sperm in females. Annals of the Entomological Society of America 64(1):312-317. 1971. (097

The present paper reports a test conducted to determine whether large changes occur in the quantity of sperm stored in the spermathecae of female Mediterranean fruit flies and whether egg laying or lack of egg laying influences the rate of disappearance of the sperm.

* _____ et al. Tephritid fruit fly trapping: liquid food baits in high and low rainfall climates. Journal of Economic Entomology 71(5):762-763. 1978. (098

Proteinaceous food baits in water traps were 20X more efficient in trapping oriental fruit flies, *Dacus dorsalis* Hendel, in a dry climate (less than 25 cm avg annual rainfall) than in a wet climate (400 cm). Greater efficiency also was observed in a dry climate with the melon fly, *D. cucurbitae* Coquillett, and the Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann).

CYPRUS. AGRICULTURAL RESEARCH INSTITUTE. Annual report for 1972. Nicosia, 1973. 128 p. (099

_____. Annual report for 1973. Nicosia, 1974. 102 p. (100

Among others, a progress report is included on the control of Mediterranean fruit fly (*Ceratitis capitata*) by the sterile insect release method. (Horticultural Abstracts 45:6840)

_____. Annual report for 1974. Nicosia, 1975. 95 p. (101

Among others, includes studies on the behaviour and control of *Ceratitis capitata*. (Horticultural Abstracts 46:6348)

_____. Annual report for 1975. Nicosia, 1976. 90 p. (102

This report on agricultural research in Cyprus in 1975, includes, among others, a section on entomology in relation to plant protection, in which details are given of laboratory investigations on the sterile-insect method for the control of the Mediterranean fruit fly (*Ceratitis capitata* (Wied)). (Review of Applied Entomology, A 65:2548)

_____. Annual report for 1976. Nicosia, 1977. 111 p. (103

This annual report from Cyprus includes a section on entomology in relation to plant protection (pp. 40-47), in which the results are presented of various control measures against Mediterranean fruit fly (*Ceratitis capitata* (Wied.)). (Review of Applied Entomology, A 66:2945)

* DAOUD, D. S. y SEHNAL, F. Effects of juvenoids on the Mediterranean fruit fly, *Ceratitis capitata* (Wied.) (Diptera, Tephritidae). Bulletin of Entomological Research 64(4):643-651. 1974. (104

Screening of 38 selected juvenoids on *Ceratitis capitata* (Wied.) revealed that several aromatic compounds, mostly ethers of 6,7-epoxygeraniol and of 6,7-epoxycitronellol, inhibited hatching when administered to freshly laid eggs as 0·1% acetone solution. Application of juvenoids within 24 h before and after puparium formation caused disturbances in imaginal differentiation. Treated insects developed either into pupa-adult intermediates failing to emerge or into defective adults whose fecundity was severly decreased. Both earlier and later applications of juvenoids were less effective. The most active compound in topical assay on fully grown larvae was ethyl 10,11-epoxy-5-oxa-3,7,11-trimethyl-2-dodecenoate, which inhibited emergence of 50% of treated insects at 0·01 µg/specimen and caused external deformities in 50% of emerged adults of 0·00001 µg/specimen. Four other aliphatic compounds (methyl 11-methoxy-3,7,11-trimethyl-2,6-dodecadienoate; ethyl 11-methoxy-3,7,11-trimethyl-2-dodecenoate; isopropyl 3,7,11-trimethyl-2,4-dodecadienoate; and isopropyl 11-methoxy-3,7,11-trimethyl-2,4-dodecadienoate) and 1-ethyl-4 /(6,7-epoxy-3,7-dimethyloctyl)oxy/ benzene were about five times less active. A concentration of 33 parts/$10^6$ of ethyl 10,11-epoxy-5-oxa-3,7,11-trimethyl-2-dodecenoate in larval food cuased deformities in 60% of emerged adults.

* DAXL, R. Ecología de la mosca mediterránea de la fruta en Nicaragua y una propuesta de control integrado. Boletín Fitosanitario de la FAO 26(4):150-157. 1979. (105

También en inglés y francés.

Con el presente trabajo se pretende ofrecer en forma concisa los resultados de estudios sobre ecología de la población de la moscamed, reunidos en el período 1970-71 y archivados en la FAO como informes mensuales, y analizarlos con el fin de desarrollar con estos resultados un sistema de control integrado.

* DEBOUZIE, D. Analyse de la variabilité de la productivité d'une population d'insectes isolée aux ressources limitées. Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, D 279(8):679-682. 1974. (106

Des dissections du milieu et des repiquages des larves récupérées permettent d'attribuer à l'importance de la ponte une part de la variabilité de la productivité d'une population de Cératites élevées sur milieu non renouvelé. La nourriture interviendrait d'abord par sa limitation en réduisant la stimulation de ponte, ensuite par les caractéristiques de sa décomposition.

* DEBOUZIE, D. Effect of initial population size on *Ceratitis* productivity under limited food conditions. Annales de Zoologie, Ecologie Animale 9(3):367-381. 1977. (107

The laboratory study of the evolution of *Ceratitis capitata* populations reared on natural non-renewed food allows us to approach the problem of the continuous evolution of supply in field conditions. The purpose of this study is to seek the mechanisms responsible for the composition of the progeny population. In this paper, the increase in initial population size (from 20 to 500 pairs per cage) allows us to compare the influence of adult and larval competition and of food quality transformation. Pupal and adult progeny numbers, biomass, and duration of development all peak at density 100. Pupal mortality increases with parental density (up to 58 p. 100 mortality at density 500). The pupating and emergence dates and progeny weights give information on the effective population size (in the physiological meaning of this term). Overall progeny weight decreased during the experiment but increased at the very end; an interpretation of this rebound effect is given. Two ecological problems related to these results are discussed: first, interference between females, the short period of attractivity of fruit and non-dispersive movements may limit the females egg laying activity; then we tried to assess the magnitude of competition in the regulation of *Ceratitis* populations.

_____. Study of competition among *Ceratitis capitata* larvae (Diptera, Trypetidae). Archives de Zoologie Expérimentale Générale 18(3):315-334. 1977. (108

* _____. Variabilité à l'intérieur d'une population de *Ceratitis capitata* élevée sur un milieu naturel non renouvelé (Diptera, Trypetidae). Annales de Zoologie, Ecologie Animale 10(3):515-524. 1978. (109

Dans un premier temps nous simulons au laboratoire le développement, sur une génération, d'une population aux ressources limitées et non renouvelées. Nous laissons pondre cinquante femelles de la mouche méditerranéenne des fruits dans une banane tant que celle-ci demeure attractive. L'étalement du dépôt des oeufs et la transformation (biochimique et microbiologique) du milieu au cours de l'expérience entraînent une forte dispersion des émergences. Dans un second temps nous comparons les adultes obtenus selon leur date d'apparition en les nourrissant de milieu artificiel. Les premières et les dernières femelles qui émergent ont une longévité et une fécondité inférieures à celles des autres femelles. Par contre la longévité et le pouvoir inséminateur des mâles ne dépendent pas de la date d'émergence. La longévité des femelles et leur fécondité sont indépendantes du poids des pupes. Ces résultats sont interprétés par une auto-transformation du milieu d'abord bénéfique pour les larvas puis désavantageuse. Nous tentons enfin une extrapolation de nos résultats aux conditions naturelles.

* DEDORDY, J. et al. Aporte al estudio bio-ecológico de *Ceratitis capitata* (Wied.) en Venezuela. In Jornadas Agronómicas, 7a., Acarigua, Venezuela, 1969. Memorias. Caracas, Venezuela, 1970. v.4, pp. 1-6. (Trabajo no. 73). (110

Los autores presentan las distintas fechas y lugares donde fue reportada la plaga en Venezuela, así como las nuevas hospederas. Establecen que la aparición de la mosca del mediterráneo en el Estado de Zulia, importante zona frutícola y en el Estado de Carabobo, región productora de cítricos, debe llamar a la reflexión ya que la peligrosidad de esta plaga, es una amenaza seria al desarrollo frutícola de Venezuela. Para la obtención de datos de dinámica de población desde 1966 se intensificó el trampeo en las localidades de Maracay, Ocumare de la Costa, Cata y Choroní, empleándose trampas Steiner que se revisan cada 15 días. Con estos datos se elaboraron curvas de incidencia en los años 1966, 67 y 68. Se compararon factores climáticos de humedad relativa, pluviosidad y temperatura con la incidencia de población de Ocumare de la Costa y se pudo establecer en líneas generales, con relación a la pluviosidad, dos épocas de gran incidencia que corresponden a los meses de abril y agosto; la temperatura y la humedad relativa no ejercen influencia. Otro aspecto estudiado es la determinación del porcentaje de frutos infectados por *Ceratitis capitata* a través del año, para hacer un estimado del tamaño de la población en una localidad conocida. (CV)

* _____, SEMIDEY, P. y ANGELES, N. de J. Resultados del uso de insecticidas para el control de la mosca del mediterráneo. In Jornadas Agronómicas, 7a., Acarigua, Venezuela, 1969. Memorias. Caracas, Venezuela, 1970. v. 4, pp. 107. (Trabajo no. 76). (111

Durante estudios realizados en 1968 sobre las moscas que atacan durazneros, en la Colonia Tovar del Estado de Aragua en Venezuela, se encontró que *Ceratitis capitata* era dañino y requería de control químico. Se aplicaron tres aspersiones con intervalos de 15 días, comenzando 14 semanas después de la poda, momento en que los primeros frutos se habían desarrollado y terminando dos semanas antes de la cosecha. Se ensayaron las siguientes mezclas insecticida-atrayente: Lebaycid 50 0,2% + Nasiman 73 1%; Malathion 57 0,5% + Nasiman 73 1%; Malathion 57 0,3% + Nasiman 73 1%; Dipterex 80 P.S. 0,5% + Nasiman 73 1%. También se hicieron tratamientos con Malathion 57 al 1% y al 0,5% sin atrayentes. Es necesario continuar con las observaciones fenológicas sobre las plantas, a fin de saber exactamente el tiempo a esperar para hacer las aspersiones según el mes en que se haga la poda, ya que árboles podados en los meses de verano, alargan el período en la producción de frutos hasta la cosecha. (CV)

* DEL RIVERO, J. M. y PLANES GARCIA, S. Algunos problemas sobre plagas y plaguicidas en fruticultura en España. Anales del Instituto Nacional de Investigaciones Agronómicas 18(2):215-239. 1969. (112

Los autores se ocupan de revisar los problemas relacionados con algunas plagas de los frutales en España y los originados por el empleo y aplicación de ciertos plaguicidas, dando las explicaciones de las causas de los mismos en algunos casos y destacando

el interés de que se realicen investigaciones en relación con algunas de las cuestiones tratadas. Se consideran solamente los frutales de hueso y pepita clásicos y el avellano. Los pulgones constituyen una plaga importante que se controla bien, pero hay casos en que se ha hablado de resistencia especialmente del *Myzus persicae*. Sin negar la posibilidad de que haya casos de resistencia, los que se han estudiado en este Centro se han debido realmente a condiciones climatológicas y fisiológicas del melocotonero poco favorables al empleo de los fosforados sistémicos sobre todo. Los ácaros representan una plaga importante. Aquí existen problemas de resistencia sin duda, y por la facilidad con la que ésta pueda producirse debe considerarse, al igual que en otros países, como uno de los problemas más graves que tiene planteada la fruticultura en España. En el avellano, contra el eriófido de las yemas, se han obtenido buenos resultados con varios productos, algunos de ellos no utilizados como acaricidas, resolviendo esta importante plaga. La mosca se la fruta causa graves daños en los melocotoneros no tempranos y a veces también en peras, manzanas, etc., pero se combate perfectamente, bien en pulverización total, bien en pulverización-cebo, esta última en tratamientos aéreos o de tierra. El piojo de San José se puede combatir satisfactoriamente, pero hay casos en que los resultados son defectuosos. En el supuesto de que los productos y las épocas de aplicación hayan sido bien escogidos, consideramos que los fracasos se deben a una falta de presión al pulverizar. Los minadores de las hojas se extienden con la propagación de las variedades frutales modernas o poco conocidos en España, especialmente en los manzanos del grupo 'Red Delicious'. También se lucha, en general, ventajosamente contra ellos. La pequeña minadora (*Anarsia lineatella*) llegó a constituir un serio problema al principio, pero después ha disminuido con la acertada aplicación de los insecticidas. Uno de los graves problemas con que se enfrenta la fruticultura española es con los casos que se registran de fitotoxicidad en los plaguicidas en general. Son frecuentes las defoliaciones y síntomas fitotóxicos a continuación del empleo de insecticidas y fungicidas sobre todo, existiendo lo que podría decirse hasta una sensibilidad varietal, y no hay que descartar también la climatología, formulación y técnicas de aplicación. Este problema es importante, porque en algunos casos puede llegar a producir graves daños económicos, cual ocurre, por ejemplo, con el empleo del azufre en determinado momento del desarrollo vegetativo de ciertas variedades de albaricoquero, que produce un desprendimiento de fruto que puede llegar a ser del 100 por 100.

DELANGUE, P. y PRALAVORIO, R. Besoins en eau comparés de *Ceratitis capitata* Wied. (Diptère Trypetidae) et de son parasite interne *Opius concolor* Szépl. (Hyménoptère Braconidae) durant la phase pupale de l'hôte. Revue de Zoologie Agricole et de Pathologie Végétale 76(1):1-6. 1977. (113

Owing to the difficulties of mass-rearing *Opius concolor* Szépl., a pupal parasite of *Ceratitis capitata* (Wied.) in the laboratory, the water requirements of these two species and the importance of relative humidity were investigated in the laboratory in France. It was found that, while environmental humidity was very important for the larval

development of the parasite and the adult emergence rate increased with increasing soil humidity, it was less important for the development of pupae of C. *capitata* that had not been parasitised. The implications for modifying rearing methods are discussed. It is also suggested that variation in soil humidity may account for population fluctuations of *O. concolor* in the field. (Review of Applied Entomology, A 66:73)

DELRIO, G. y CAVALLORO, R. Semi-sterility in the Mediterranean fruit fly, *Ceratitis capitata* Wiedemann. Genetica Agraria 30(1):61-74. 1976. (114

DELRIO, G. y PROTA, R. Osservazioni sulla dinamica delle popolazioni di *Ceratitis capitata* Wied. in alcuni pescheti ed agrumeti della Sardegna. Informatore Fitopatologico 27(6/7):59-60. 1977. (115

The extension of fruit-growing from a domestic to a commercial scale in Sardinia over the past 20 years has resulted in increased incidence of *Ceratitis capitata* (Wied.), which has been further favoured by the predominance of mixed fruit orchards containing a number of food-plants of this fruit-fly, and by unwise cultural techniques and chemical control measures against this and other pests. As a result of surveys carried out since 1973 over the island by the Istituto di Entomologia Agraria di Sassari and the Centro Regionale Antinsetti della Sardegna, information is given on the varying incidence of C. *capitata* in different regions, the type of fruit tree affected, and the chemical treatments currently applied. In general, the pest was found to be most abundant in southern Sardinia, where the climate is subtropical and a great variety of fruits is grown; smaller populations were found in temperate coastal regions of the north and centre of the island. Peach and citrus were the fruits most severely attacked, especially if grown together, but apricot, fig, apple and pear also suffered heavy losses in some years. Dimethoate was the insecticide most commonly used, and in some places frequent applications in citrus orchards resulted in outbreaks of scale insects and aleyrodids because of the killing of their natural enemies. It is recommended that some or all of these dimethoate sprays should be replaced by protein bait-sprays in citrus orchards. On peach, which is even more susceptible to C. *capitata*, the practical results of bait-sprays have not been sufficiently tested for this method of control to be recommended, and the possibility of combining chemical control with releases of sterile males is suggested. (Review of Applied Entomology, A 66:4569)

DENMARK, H. A. The banded greenhouse thrips, *Hercinothrips femoralis* (O. M. Reuter) in Florida (Thysanoptera: Thripidae). Florida. Department of Agriculture and Consumer Services. Circular, no. 172. 1976. 2 p. (116

*Hercinothrips femoralis* Reut., which attackes various ornamental plants in the greenhouse but is also found in the open air in tropical and subtropical regions, was reduced below the economic threshold for several years in Florida following the spray campaign against the Mediterranean fruit fly in 1956-58

but is now increasing in numbers in central and southern Florida, especially under greenhouse conditions. Notes are given on its life history, distribution, food-plants (of which the main ones in Florida are *Syngonium podophyllum*, *Philodendron selloum*, *Brassaia actinophylla*, *Crinum* sp. and *Peperomia* sp.), adult morphology and control (for which malathion, γ-BHC (lindane), dimethoate and oxydemeton-methyl (Metasystox R) are recommended, in two applications 7-10 days apart). (Review of Applied Entomology, A 65:4555)

DISENFESTATION OF fruit by irradiation. In Panel on the Use of Irradiation to Solve Quarantine Problems in the International Fruit Trade, Honolulu, Hawaii, 1970. Proceedings. Vienna, International Atomic Energy Agency, 1971. 177 p. (117

The international fruit trade, particularly that in tropical and subtropical fruits, is considerably hampered by plant-quarantine restrictions designed to prevent the spread of pests, mainly insects. Disinfestation of food commodities by irradiation has certain advantages, such as uniformity of treatment in sealed containers, over conventional methods of disinfestation by fumigation and heat treatment and offers the additional advantage that the ripening processes of some fruits are delayed. A meeting was held in Hawaii in 1970 to collate existing knowledge of irradiation techniques for disinfestation and to decide upon future activities to overcome quarantine barriers by the use of this method. This booklet contains the texts of the 15 scientific papers that were read. Many of these were concerned with tropical and subtropical fruits infested by fruit-flies. Studies have indicated that treatment by exposure to γ-radiation from a radioactive cobalt ($^{60}$Co) source would satisfactorily disinfest fruits infested by the three fruit-flies present in Hawaii (*Dacus dorsalis* Hend., *D. cucurbitae* Coq. and *Ceratitis capitata* (Wied.)). There is also evidence that γ-radiation would control fruit-flies in Australia and Mexico. Studies in Hawaii have shown that a dose of 25 krad applied to eggs or larvae within fruits will prevent the emergence of adults, though it was made clear that exposure of immature insects to γ-radiation does not result in immediate death. Present quarantine regulations require that all living stages of pest species found in fruit must be killed, and it will be necessary to demonstrate to quarantine officials that living insects found in fruits that have been irradiated will not complete their development. Preliminary studies in Hawaii on a semi-commercial scale have shown that the type of packaging used for commercial shipment must be taken into consideration when the minimum radiation dose is calculated, since the effectiveness of the treatment could be affected by factors such as the presence of oxygen, carbon dioxide or water. Further research is needed to accumulate the entomological data required to establish the general application of such quarantine treatment for other pests in fruit, but it can be concluded that it is effective for papayas infested by the species of fruit-flies found in Hawaii. Much information was presented on the tolerance of numerous species of tropical and subtropical fruits to the doses of γ-radiation likely to prove acceptable for quarantine purposes. (Review of Applied Entomology, A 60:2782)

DRESNER, E. A sticky trap for Mediterranean fruit fly survey. Journal of Economic Entomology 63(6):1813-1816. 1970. (118

The following is based partly on the authors' abstract. Following a programme to eradicate *Ceratitis capitata* (Wied.) from Nicaragua in 1967-68, tests were carried out to compare the effectiveness of various types of sticky trap with that of the Steiner trap. The best type of sticky trap consisted of a light plywood panel (8 x 5 in.) (suspended so as to hang vertically) covered with adhesive on one or on both sides and with a 1-in. length of dental wick saturated with trimedlure inserted through a hole in the centre. This trap was more sensitive to low populations and more suitable for regular field distribution (as it could be left unguarded) than the Steiner trap. The latter is more suited for use in areas of sterile-fly release where catches are large and the flies collected must be examined in the laboratory for colour marking, whereas the former appears better suited for surveys of infestation or of the final stages of a programme of eradication. (Review of Applied Entomology, A 59:1709)

DREW, R. A. I., HOOPER, G. H. S. y BATEMAN, M. A. Economic fruit flies of the South Pacific Region. Canberra, Australia, Oriental Fruit Fly Working Party, Standing Committee on Agriculture, 1978. 137 p. (119

This booklet contains summaries of the material that was presented at a workshop on the identification, monitoring and eradication of fruit-flies, held at Indooroopilly, Queensland, in July 1976, and is intended to provide a permanent text on Australian Dacinae and potentially important exotic species, especially those in the South Pacific region. A section on taxonomy includes notes on the preparation of material for taxonomic studies, an illustrated description of the morphology of a dacine tephritid, and descriptions (with line drawings) and notes on the distribution and actual or potential economic importance of one species of *Callantra* and 14 of *Dacus* in Australia and 12 species of *Dacus* outside the country. A key to the Australian Dacinae is provided. Further sections of the booklet are devoted to the sterile insect release method, to chemical methods for suppression or eradication, and to collecting methods for fruit-flies. A preface to the booklet (by T. Passlow) includes notes on the status in Australia of *D. tryoni* (Frogg.) (which is the primary fruit-fly pest there), *D. frauenfeldi* Schin. and *Ceratitis capitata* (Wied.). (Review of Applied Entomology, A 66:6073)

DURON AVILES, E. Review of work to combat the Mediterranean fruit fly carried out in Central America and Panama. In Panel on the Practical Use of the Sterile-Male Technique for Insect Control, Vienna, 1972. Proceedings. Vienna, International Atomic Energy Agency, 1974. pp. 17-20. (120

The author reviews work on the control of *Ceratitis capitata* (Wied.) by the sterile-male technique carried out in Central America and Panama under the auspices of the Regional International Organisation for Plant Protection and Animal Health

(OIRSA). When the fly was first reported from Costa Rica in 1955, studies showed that no other country in the area was affected and investigations were begun on the best methods for eradication. A project on the use of the sterile-male technique was begun in 1962. When infestation spread to Nicaragua and Panama, the experience gained in Costa Rica was used in the organisation of large-scale releases in both countries. Though these were initially very effective in reducing populations of the fly and the damage it was causing, reinfestation occurred subsequently when the withdrawal of technical and financial assistance curtailed the project. It is estimated that in the countries of the OIRSA region, the fruit-fly now causes direct losses of 50% or more of the mandarin crop, about 22 and 24% of the sweet orange and grapefruit crops, 2% of other fruit crops and 1% of the coffee crop. The author discusses the cost of an eradication programme based on the sterile-insect release method; although initially the costs would be greater than those of a programme based on the use of insecicides, they should be recovered within six years, with the added advantage of no major ecological disturbance. Notes are given on tests in which the fly was eradicated from orchards in the districts of Jinotega and San Rafael del Norte in the Department of Matagalpa, Nicaragua, following the application at weekly intervals in April, May and June of bait-sprays containing about 0.25% fention (Lebaycid) or 0.35% malathion with the addition of an attractant. All the fallen fruits, whether infested or not, were buried. Special attention has been paid to quarantine measures at Tipitapa, 22 km from Managua, Nicaragua, to reduce the likelihood of the fly being exported. (Review of Applied Entomology, A 63:3336)

EL-GAZZAR, L. M. Induced sterility in the Mediterranean fruit fly using heat treatments. Zeitschrift für Angewandte Entomologie 88(4):436-439. 1979. (121

Laboratory studies carried out in Egypt showed that continuous exposure of 3-, 4- and 5-day-old pupae of *Ceratitis capitata* (Wied.) to a temperature of 34°C was highly effective in sterilising the resulting adults; the younger the pupae at the beginning of the exposure period, the greater was the rate of induced sterility. A pronounced reduction in adult emergence and life-span was also observed in the treated pupae, and when the exposure to 34°C started when the pupae were only 1 or 2 days old only 0 and 8% adult emergence, respectively, occurred. (Review of Applied Entomology, A 68:2229)

EL-MINIAWI, S. F. A new method for tagging Dipterous flies via ingestion for ecological studies. Agricultural Research Review 48(1):75-76. 1970. (122

Studies in Egypt showed that when newly emerged adults of *Megaselia scalaris* (Lw.), *Dacus ciliatus* Lw. and *Ceratitis capitata* (Wied.) were allowed to feed for at least 60 h on a mixture of honey and protein hydrolysate (1:1) to which a powdered red dye (Rhodamine B base dye SPS 7019) had been added, the abdomens of the flies became pink

through the staining of the alimentary tract. When such flies were released in orchards, they were recaptured (in traps containing a 3% solution of diammonium phosphate) up to 18 days after release and could be instantly identified by their pinkish abdomens. (Review of Applied Entomology, A 63:797)

EL-MINIAWI, S. F. y EZZAT, M. A. Population estimation of wild individuals of the Medfly, *Ceratitis capitata* (Wied.), for overflooding infested orchards by flies sterilized by $Co^{60}$ gamma radiation. Agricultural Research Review 48(1):86-91. 1970. (123

In connection with studies on the use of the sterile-male technique for the control of *Ceratitis capitata* (Wied.) in Egypt, the size of wild populations of the flies was estimated in four orchards in Wadi El-Natroun between mid-September and early October (when guavas were ripe), between 21st October and 11th November (when sweet oranges were almost ripe) and between 26th November and mid-December (when olives were virtually the only fruits present). On the three occasions, the populations were estimated to average about 38,600, 148,300 and 9800 flies/$km^2$, respectively. It was calculated that to overflood the wild population with sterile flies at a rate of 10:1 it would be necessary to release 1.5 million, 0.4 million and 10,000/$km^2$, respectively, or 1600, 6000 and 400/feddan /0,42 ha/. The numbers needed for each orchard within the area should be calculated separately since population densities varied considerably between orchards. (Review of Applied Entomology, A 63:1219)

EL SALVADOR. MINISTERIO DE AGRICULTURA Y GANADERIA. La mosca del mediterráneo; su aparecimiento y control en El Salvador. Síntesis histórica. San Salvador, MAG, 1975. p. irr. (124

EL TAHIR, E. T. y VENKATRAMAN, T. V. Responses of fruit flies (Tephritidae) to synthetic chemical attractants in Sudan. Sudan Agricultural Journal 5(1):60-62. 1970. (125

In field tests with traps baited with cue-lure, trimedlure and methyl eugenol in the Sudan, cue-lure was found to be attractive to males of *Dacus ciliatus* Lw. but not to those of *D. vertebratus* Bez. Trimedlure attracted males of *Ceratitis capitata* (Wied.) but failed to attract *Pardalaspis quinaria* Bez. (Review of Applied Entomology, A 62:4671)

ESCRIBANO CERVANTES, J. A. Flies and Botrytis. Agricultura 42(494):343-344. 1973. (126

ETIENNE, J. Lutte biologique contre les mouches des fruits. In Institut de Recherches Agronomiques Tropicales et des Cultures Vivrières, Réunion. Rapport Annuel 1971. Saint Denis, Réunion, 1972. pp. 131-144. (127

The author reviews work in Réunion in 1971 on the Tephritids attacking fruit and vegetables there and on their biological

control. Some seven million of *Opius concolor* Szépl., five million of *Pachycrepoideus vindemiae* (Rond.) and small numbers of *O. longicaudatus* var. *taiensis* Fullaway, all of which had been reared in the laboratory on *Ceratitis capitata* (Wied.), were released in the field. Mass-rearing of *C. rosa* Karsch was successfully accomplished for the first time, and details are given of the rearing method. Five species of Tephritidae are now being maintained in the laboratory for tests on the host specificity of the introduced parasites. (Review of Applied Entomology, A 61:5058)

* ETIENNE, J. Lutte biologique et aperçu sur les études entomologiques diverses effectuées ces dernières années a La Réunion. Agronomie Tropicale 28(6/7): 683-687. 1973. (128

Un historique de l'entomologie à La Réunion et un inventaire de la faune des insectes de cette île ont fait l'objet, en 1957, du tome VIII (série E) des Mémoires de l'Institut Scientifique de Madagascar. Intervenant à la suite de la Mission franco-mauricienne de 1955, l'ensemble des données, regroupé dans ce volume sous la plume d'éminents spécialistes, constitue un ouvrage de base de tout premier ordre pour l'entomologie réunionnaise. Les travaux présentés ci-après, diffèrent de ceux évoqués précédemment puisqui'ils traitent plus particulièrement de la lutte biologique. Celle-ci a pu être abordée à l'IRAT-Réunion avec la mise en service, en 1965, d'un laboratoire d'entomologie spécialisé dans ce domaine et destiné à lutter contre les principaux ravageurs des cultures. Par ailleurs, seront également mentionnés divers travaux d'entomologie qui ont pu être réalisés depuis cette date et en particulier ceux qui contribuent à améliorer nos connaissances sur l'entomofaune réunionnaise.

EVERS, C. La mosca del Mediterráneo. Apuntes Agrícolas (Honduras) 5(32):25-26. 1975. (129

* EZEQUIEL RODRIGUEZ, E. Porcentaje de infertilidad de huevos obtenidos según dosis de rayos gamma aplicada en machos de la Mosca del Mediterráneo, *Ceratitis capitata* Wied. IDIA (Argentina), no. 298:70-73. 1972. (130

El objetivo del presente trabajo fue el de analizar el porcentaje de esterilidad real que se consigue combinando machos tratados en proporción 10:1:1 con respecto a machos y hembras normales y determinar la dosis óptima en la cual la acción de los machos tratados se ve afectada en menor grado por las radiaciones nucleares.

EZZAT, M. A. y EL-MINIAWI, S. F. On the flight range and flight activity of the Med fly *Ceratitis capitata* (Wied.) in U. A. R. Agricultural Research Review 48(1):77-85. 1970. (131

Studies carried out at three sites in Egypt (semi-isolated areas at Fayoum and Ismalia and a completely isolated area at Wadi El-Natroun) showed that adults of *Ceratitis capitata*

(Wied.) did not fly more than 1.25 km from the release point. Temperature appeared to be the major factor influencing flight activity; the flies dispersed 1.25 km in 10.5 days at 27°C and in 12 days at 25°C. Wind direction and wind speed appeared to play a minor part in dispersal. The flies sheltered on the lower surface of leaves when the winds were strong and raised their wings to a perpendicular position, allowing the wind to pass between them. (Review of Applied Entomology, A 63:756)

FARES, F. y AWADALLAH, A. Evaluation of certain organo-phosphorous insecticides for the control of the Mediterranean fruit fly, *Ceratitis capitata* (Wied.), on peaches. Agricultural Research Review 48(1):71-74. 1970. (132

In a test carried out in Egypt in 1965-66 on the control of *Ceratitis capitata* (Wied.) on peaches, the results obtained with sprays containing 0.15% of an emulsion concentrate containing 25% formothion (Anthio), 0.15% of a soluble powder containing 50% endothion (Endocide) or 0.18% of an emulsion concentrate containing 20% Vel 88 /an organophosphorus compound of unstated composition/ were as satisfactory as those given by the recommended spray of 0.03% dimethoate (Roxion). All compounds retained their effectiveness for at least three weeks, and two applications should afford adequate protection against attack. The first spray should be applied two weeks before ripening and the second after a further three weeks. (Review of Applied Entomology, A 63:1068)

_____. The effect of cold storage on the hatchability of the Mediterranean fruit fly eggs. Agricultural Research Review 51(1):57-58. 1973. (133

Laboratory tests in Egypt on the effect of cold storage on eggs of *Ceratitis capitata* (Wied.) showed that exposure to 0°C for 10 days resulted in complete mortality. (Review of Applied Entomology, A 63:2227)

_____ y AWADALLAH, A. Effect of irradiation with cobalt 60 on the medfly pupae at different ages. Agricultural Research Review 51(1):59-62. 1973. (134

The effect of exposing pupae of *Ceratitis capitata* (Wied.) 1-9 days old to γ-radiation from radioactive cobalt ($^{60}Co$) at a dose of 10 krad on the duration of the pupal period and on adult emergence, life span and reproduction was determined in laboratory studies at 26°C and a 65-70% R.H. in Egypt. The percentage of adults emerging completely averaged 0, 5, 29.7 and 73.7-77.5 for pupae treated at 1-3, 4, 5 and 6-9 days of age, respectively. Adult life span following treatment of pupae 4 and 5-9 days old was 1.1 and 10.3-12.2, respectively, for males and 1.5 and 22.5-31.8 for females. Mating occurred normally following treatment of pupae 7-9 days old, but was adversely affected by treatment of pupae 1-6 days old. Treatment at all ages prevented oviposition. (Review of Applied Entomology, A 63:2963)

FARIAS, G. J. y NAKAGAWA, S. Host vs. nonhost plants as sites for baited traps for Mediterranean fruit flies. Journal of Economic Entomology 63(2):662-663. 1970. (135

Field tests were carried out in Hawaii in 1963-65 to determine the most effective positioning of traps baited with trimedlure to catch adults of *Ceratitis capitata* (Wied.). Traps hung on host trees (trees that produce fruit in which the larvae can develop) were found to be significantly more effective than those hung on trees that are not hosts. Generally, more flies were caught in host trees without fruit than in those with. (Review of Applied Entomology, A 58:2702)

_____, CUNNINGHAM, R. T. y NAKAGAWA, S. Reproduction in the Mediterranean fruit fly; abundance of stored sperm affected by duration of copulation, and affecting egg hatch. Journal of Economic Entomology 65(3):914-915. 1972. (136

Laboratory studies were carried out in Hawaii in 1966 on the relation between the amount of sperm stored in the spermatheca of females of *Ceratitis capitata* (Wied.) and the length of prior copulation and the rate of subsequent egg hatch. It was found that the amount of sperm transferred increased as the length of copulation increased (up to about 90 min.); a minimum time of more than 4 min. was required for the transfer of any sperm. The percentage of eggs that hatched significantly increased as the abundance of sperm increased. (Review of Applied Entomology, A 60:5072)

* FERNANDEZ SANCHEZ DE LA NIETA, J. M. et al. Estudio del vuelo de la *Ceratitis capitata* Wied. (mosca de las frutas). Boletín Informativo de Plagas, no. 95:3-5. 1972. (137

Con motivo de la Campaña Nacional Obligatoria contra la *Ceratitis capitata* Wied., que se desarrolló en la provincia de Lérida durante la campaña 1971, se estudió el vuelo de dicho díptero, para detectar su presencia y dar comienzo a los tratamientos preventivos.

FERNANDEZ-SOUSA, J. M. Automatic determination of N-terminal sequence of cytochrome (from insect *Ceratitis capitata*). FEBS Letters 41(2):315-316. 1974. (138

_____ y MICHELSON, A. M. Variation of superoxide dismutases during the development of the fruit fly *Ceratitis capitata* L. Biochemical and Biophysical Research Communications 73(2):217-223. 1976. (139

_____ et al. Lysozyme from the insect *Ceratitis capitata* eggs. European Journal of Biochemistry 72(1):24-33. 1977. (140

FERNANDEZ-SOUSA, J. M. et al. L-glycerol-3-phosphate dehydrogenase from the insect *Ceratitis capitata*. Purification, physiochemical and enzymic properties. Biochimica et Biophysica Acta 481(1):6-24. 1977. (141

_____ et al. D-fructose 1,6-biphosphate aldolase from the dipteran *Ceratitis capitata*; purification, physicochemical and enzymic properties. Archives of Biochemistry and Biophysics 188(2):456-465. 1978. (142

_____ et al. A method for the isolation of triose phosphate isomerase, L-glycerol 3-phosphate dehydrogenase, D-fructose, 1,6-bisphosphate aldolase and cytochrome c from a single extract of *Ceratitis capitata* flies. Insect Biochemistry 9(2):177-182. 1979. (143

> The isolation of homogenous preparations of four proteins in high yields from a single extract of *Ceratitis capitata* (Wied.) is described. The four proteins are: triose phosphate isomerase (EC 5.3.1.1), L-glycerol 3-phosphate dehydrogenase (EC 1.1.1.8), D-fructose 1,6-bisphosphate aldolase (EC 4.1.2.13) and cytochrome C. L-Glycerol 3-phosphate dehydrogenase is obtained in preparative amounts in homogenous form with a specific activity similar to that previously described. Triose phosphate isomerase and D-fructose 1,5-bisphosphate aldolase from C. *capitata* obtained in this way show amino acid composition comparable to those known for the enzymes from other sources. (Review of Applied Entomology, A 67:4733)

FERON, M. Etudes sur la mouche mediterranéenne des fruits en Tunisie. In Panel on Insect Ecology as related to Control Noxious Insects by the Sterile-Male Technique, 1967. Proceedings. Vienna, 1969. pp. 83-85. (144

FIMIANI, P. y TRANSFAGLIA, A. Influenza della condizioni climatiche sull'attività moltiplicativa della *Ceratitis capitata* Wied. Annali della Facoltà di Scienze Agrarie della Università di Napoli, Portici 6:190-199. 1972. (145

> While ecological observations were being carried out on *Ceratitis capitata* (Wied.) in coastal areas near Naples in 1968-69, two sets of cultures of this fruit-fly were set up at Portici, one in controlled laboratory conditions and one out of doors, but protected from rain by a roof, in order to determine the degree to which development and multiplication were affected by climate. The cages were large, with some sides of glass, two of wire mesh and one of transparent plastic; the larvae were reared on a medium containing powdered carrot and brewers' yeast (which was also used as an attractant inside the perforated plastic oranges provided for oviposition), and the adults were offered solutions containing honey, hydrolysed yeast and benzoic and citric acid. In the laboratory, the temperature was kept at about 25°C and the relative humidity at about 80% and light was continuous, which were considered to be the optimum rearing conditions. Both sets of cultures were maintained from January to December 1968. In the laboratory, 13 overlapping generations were reared, the first eggs being laid in January; in the open, where conditions were optimum only in April-June and definitely unfavourable in December and January owing to cold and in August owing to dry

heat, only six generations developed, the first eggs being laid in March (many of which failed to hatch) and the last at the end of October. The total number of eggs collected in one generation varied from 12 159 to 14 586 in the laboratory and from 246 to 356 541 in the open air, according to the time of year; in the open air, fecundity increased rapidly as the number of adults/cage increased in late summer; this is consonant with the large numbers of adults trapped in late summer and autumn round the Gulf of Naples, where the climate is similar. (Review of Applied Entomology, A 63:3462)

FIMIANI, P. Osservazioni bioecologiche sulla mosca della frutta (*Ceratitis capitata* Wied.) effettuate nella zona di Monte di Procida (Napoli) negli anni 1968-1969. Bollettino del Laboratorio di Entomologia Agraria 'Filippo Silvestri' 30:71-87. 1973. (146

Observations were made in 1968-69, by means of about 30 Nadel traps containing trimedlure and dichlorvos (DDVP), in five different localities, on fluctuations in the adult population of *Ceratitis capitata* (Wied.) on various types of fruit trees along the coast of the Gulf of Naples. Both the trap-catches and the high rate of damage on medlars, apricots, pears, apples, figs, persimmons and oranges in the different months indicated great abundance of the fruit-fly in the area. Flies were caught from June to December but mostly in August-November. In some places they caused 80-100% infestation, especially on apricots, peaches and persimmons. Oranges were punctured heavily, but the greatest losses occurred not from larval damage but from premature fall and decline in market value of fruits disfigured by the punctures. The type of fruit cultivation in the region, which to a great extent consists of small private orchards of mixed fruit trees, limits the possibilities of chemical treatment and appears to afford conditions favourable for the undisturbed development of *C. capitata*. (Review of Applied Entomology, A 63:770)

_____. Seasonal variation in populations of *Ceratitis capitata* on Flegrean coast. Informatore Fitopatologico 23(6):13-16. 1973. (147

_____. Fertilità delle uova in *Ceratitis capitata* Wied. (Diptera Trypetidae). Bollettino del Laboratorio di Entomologia Agraria 'Filippo Silvestri' 34: 150-163. 1977. (148

Investigations were carried out in the laboratory to determine the natural hatching rate of eggs of *Ceratitis capitata* (Wied.) in order to obtain a standard against which to check the effectiveness of the sterile-male control technique. Egg samples from peaches, persimmons and oranges collected in July-March from heavily infested areas of the Campania region in Italy were kept on wet cloth in petri dishes at suitable temperatures in the laboratory. The average hatching rate of the several thousands of eggs observed was over 82%. No differences were observed between the hatching rates in different fruits, except for orange, which had a consistently unfavourable effect on the viability of eggs and larvae. Comparison of the field-

collected eggs with eggs from laboratory strains of C. *capitata* reared in optimum conditions revealed comparably high fertility rates, and attention is drawn to the high biotic potential of this species in the favourable climatic conditions of the Mediterranean region. (Review of Applied Entomology, A 67:206)

* FONTEMACHI, E. C. Evaluación de la población de moscas de los frutos en San Juan; estimación de daño. In Jornadas sobre Moscas de los Frutos, Tucumán, Argentina, 1969. Documentos. Argentina. Estación Experimental Agrícola de Tucumán. Publicación miscelánea, no. 32. 1970. pp. 13-16. (149

De acuerdo al plan elaborado en 1966, se prosiguió este período con el estudio de población de moscas de los frutos en San Juan, estimación de los daños ocasionados por la plaga, ensayo de atractivos y determinación de las principales especies que son atacadas.

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS. Report to the Government of Cyprus on Mediterranean fruit fly control. Rome, Italy, FAO/IAEA, 1973. 11 p. (150

At the request of the Government of Cyprus, D. A. Lindquist and E. J. Buyckx visited the island in March 1972 to review the work currently undertaken there for the control of *Ceratitis capitata* (Wied.) on *Citrus*, to advise on future programmes of research and to assist in the preparation of a comprehensive programme of control. The chemical measures being applied against the fruit-fly and other arthropod pests of *Citrus* are outlined and preliminary work on the possibility of using the sterile-male technique for control or eradication is reviewed. Integrated control programmes should be developed for the major pests of *Citrus*, but it is pointed out that before such programmes can be worked out more detailed ecological studies are needed. Eradication of *Ceratitis capitata* by means of the release of sterile individuals appears to be possible, though the possibility of re-infestation from Turkey must be investigated. (Review of Applied Entomology, A 63:2632)

FOURCHE, J. Energy metabolism during metamorphosis of *Ceratitis capitata*: Thermogenetic respirations. Bulletin Biologique de la France et de la Belgique 108(1):97-102. 1974. (151

FRANCO, L., MONTERO, F. y RODRIGUEZ MOLINA, J. J. Purification of the histone H1 from the fruit fly *Ceratitis capitata*. Isolation of a high mobility group (HMG) nonhistone protein and aggregation of H1 through a disulphide bridge. FEBS Letters 78(2):317-320. 1977. (152

_____, NIETO-SANDOVAL, R. M. y PERERA, J. Histone H4 from the fruit fly *Ceratitis capitata*. Purification and characterization. Insect Biochemistry 9(1):31-38. 1979. (153

Histone H4 was isolated in a pure form from pharate adults of *Ceratitis capitata* (Wied.). Its molecular weight is very

similar to that of calf thymus H4 histone. The N-terminal residue is blocked and its amino acid composition is similar to that of homologous histones. Four peptides were isolated from C. *capitata* Histone H4 and characterised. Suggestions are made about possible regions in the total sequence that gave rise to them. (Review of Applied Entomology, A 67:2549)

* FUNDO DE PESQUISAS DO INSTITUTO BIOLOGICO, SAO PAULO. Relatório das actividades do Fundo de Pesquisas do Instituto. V. Frutíferas. Biológico (Brasil) 35(6):130-131. 1969. (154

El autor informa de los primeros resultados obtenidos en un ensayo realizado en María Salete en Sorocaba, Brasil, en una plantación de 40 árboles frutales atacados por moscas de los frutos. La plantación fue dividida en dos lotes, uno de 13 árboles (A) y otro de 12 árboles (B), separados por dos líneas de 7 plantas considerada barrera. Para el control de las moscas de los frutos, se utilizó el insecticida LVC-Malathion-Isca. El malathion utilizado tenía una pureza de 95% y el atractivo fue agua de maíz hidrolizada. El lote A recibió 20 ml de Malathion más 78 ml de atractivo. El lote B recibió 72 ml de atractivo. Se realizaron 13 aplicaciones. Los datos obtenidos muestra que el lote tratado con Malathion siempre presentó una población significativamente menor que el lote B (testigo). (CV)

GAVILANES, J. G. et al. Circular dichroism studies of the fatty acid synthetase complex from the insect *Ceratitis capitata*. Biochemical and Biophysical Research Communications 83(3):998-1003. 1978. (155

GENDUSO, P. Attuale tecnica de allevamento dell'*Opius concolor* Szépl. *siculus* Mon. Bollettino dell'Istituto di Entomologia Agraria e dell'Osservatorio di Fitopatologia di Palermo 7:9-40. 1967-69. (156

The method used at the Palermo Institute of Agricultural Entomology for the mass rearing of *Opius concolor siculus* Monastero in larvae of *Ceratitis capitata* (Wied.) for purposes of biological control is described. *Ceratitis* adults are fed on sugar, dry hydrolysed proteins and water in large cages holding 40 000 flies each and with a wooden frame and bottom, three sides of metal or nylon mesh and one side and the top of transparent plastic; a perforated funnel, fitted into a circular hole in the top and connected to a plastic tube leading to the exterior from the lower part of the cage, is provided for oviposition and the eggs are flushed out periodically eith a jet of water. About 75 000 eggs are obtained daily for 15 days. The eggs are placed on metal trays full of larval rearing medium kept on metal shelving 5-8 tiers high, surrounded with polythene curtains, and with containers of sawdust below to receive the full-fed larvae as they leave the trays to pupate. The most effective diet proved to be one containing dried carrot powder, dry brewers' yeast, sugar, benzoic acid, minced straw and hydrochloric acid; the hatching rate was about 30%, and 15 000 *Ceratitis* larvae/kg medium were produced daily. Individuals that had already pupated when collected were sieved out of the sawdust and kept for rearing of further generations .

of *Ceratitis*, while those still in the larval stage were introduced at the rate of 12,000/cage into large cages containing 40,000 adults of *Opius*, for parasitism. Over 90% parasitism can be obtained by this method. Parasitised larvae may be kept for up to 30 days at 15°C in the refrigerator without increasing the normal mortality rate. A small collapsible cage comprising a nylon bag supported on brass rods is described, which is used for transporting *Opius* adults to the field for release. Adverse factors reducing the production of *Ceratitis* and *Opius* included the mite *Tyrophagus putrescentiae* (Schr.), a predator of *Ceratitis* pupae, *Drosophila* spp. and *Carpophilus hemipterus* (L.), which were in competition with *Ceratitis* for the larval rearing medium, *Megaselia scalaris* (Lw.), a Phorid that fed both on the rearing medium and on parasitised *Ceratitis* pupae, the fungus *Aspergillus flavus*, which attacks *Opius* larvae and pupae and *Proteus morgani*, a bacterium causing disease in *Ceratitis* larvae. (Review of Applied Entomology, A 63:1799)

GENDUSO, P. Influenza della temperatura sulla durata e sulla resistenza degli stadi preimmaginali dell'*Opius* c. *siculus* Mon. Bollettino dell'Istituto di Entomologia Agraria e dell'Osservatorio di Fitopatologia di Palermo 8:1-7. 1970/73. (157

*Opius concolor* Szépl. (*O. c/o̅ncolor/ siculus* Monastero) is reared in *Ceratitis capitata* (Wied.) for the biological control of *Dacus oleae* (Gmel.) on olive in Italy and Sicily. *Ceratitis* pupae parasitised by *Opius* were kept at different temperatures in order to determine the effect of these on parasite development. The temperatures at which complete development from egg to adult is possible were found to be 15-32°C, the optimum being 26°C and the sum of effective daily mean temperatures being 208°C. The parasite proved more resistant to temperatures below 15°C than to those above 32°C, becoming more cold-hardy as development progressed; it did not enter diapause at low temperatures or under short-day conditions but slowed down its development and general activity. In order to obtain large numbers of *Ceratitis* pupae containing *Opius* parasites of the same age ready for field releases against *Dacus*, the parasite should be allowed to develop normally up to the pupal stage and then be kept at a temperature of not more than 18°C. (Review of Applied Entomology, A 65:2501)

_____. Effetti di irraggiamento γ su femmine di *Opius concolor siculus* Mon. Bollettino dell'Istituto di Entomologia Agraria e dell'Osservatorio di Fitopatologia di Palermo 9:77-80. 1974-1976. (158

The effects of γ-radiation on *Opius concolor* Szépl. (*O. concolor siculus* Monastero), a parasite of *Dacus oleae* (Gmel.) usually reared in the laboratory on the replacement host *Ceratitis capitata* (Wied.), were studied in the laboratory at Palermo in Sicily, originally with a view to investigating the effects of oviposition punctures (even if sterile eggs were laid and no parasites hatched) by *O. concolor* on *C. capitata*. It was found that treatment with 10 krad or more caused total sterility in *Opius* females. In treatments administered during the immature stages, the early instars were more susceptible to γ-radiation than were the older ones. Exposure

to 2-5 krad blocked ovarian development at the stage that it had reached at the time of treatment. No damage could be observed under an optical microscope to the poison glands and the spermatheca after irradiation, even if the insects were treated during the early larval instars. (Review of Applied Entomology, A 66:1777)

GEORGALA, M. B. Recent results with fruit fly bait sprays. South African Citrus Journal, no. 436:3-5. 1970. (159

In bait spray evaluations dried fish solubles (6 lb./100 gal. water) and sugar (75 lb./100 gal.) were compared with the protein attractant Nasiman-73 at 3 and 9 pt./100 gal., in mixtures using Dipterex as the toxicant. The high initial attraction of protein bait and the uniform but low level attraction of sugar were confirmed. Fish solubles were preferred for efficiency and cheapness. All treatments attracted both *Pterandrus rosa* and *Ceratitis capitata*. The currently recommended baiting programme is set out, and growers are advised to use Israeli fruit fly traps for information purposes only as an indication of spray requirements. (Horticultural Abstracts 40:9230)

_____ et al. Recommendations for the control of major citrus pests and diseases on bearing trees during the 1975/76 season. II. Citrus and Subtropical Fruit Journal, no. 500:9, 11-13, 15-22. 1975. (160

Includes citrus thrips /*Scirtothrips aurantii*/, psylla (*Trioza erytreae*), aphids (*Toxoptera citricidus*), bollworm (*Helicoverpa armigera*), orange tortrix, mealybug (mainly *Planococcus citri*), mites (several species) and fruit fly (*Ceratitis capitata*). (Horticultural Abstracts 46:6192)

* GERINI, V. Contributo alla conoscenza dei principali insetti presenti sugli agrumi a Cipro. Rivista di Agricoltura Subtropicale e Tropicale 71(7/12): 147-159. 1977. (161

The author points out the presence in Cyprus of insect on citrus and describes their morphology, biology and control.

* GIBSON, A. Fruit fly damage in Kenya coffee and its possible effects on quality. Kenya Coffee 35(415):260-266. 1970. (162

Since a mixed population of fruit flies were derived from the pupae, the damage attributable to the larvae of these insects can be subdivided into two main categories. (a) Mediterranean Type Fruit Fly: (1) Attack on green berry before hardening - "berry drop" - G. M. Ong'ute. (2) A period from the bean hardening stage to the mature cherry stage when nothing is yet known about damage caused by the larvae. (3) Mature cherry, following picking and pulping, shows a continuation of the fruit fly life cycle on the fermenting coffee, subsequent damage to the embryo and the formation of "off flavours" being an automatic sequel. It is therefore apparent that any damage

caused by the Mediterranean type fruit fly larvae will be primarily concerned with the growth and maturation of the cherry. Most damage attributable to these larvae should have occurred at the picking stage and can only be exacerbated by any bad processing conditions which follow. (b) Drosophila Type Fruit Fly: (1) Prior to picking it appears that attack is only possible on damaged mature cherry or over-ripe cherry. (2) Main attack occurs as egg laying commences on the mucilage of freshly pulped coffee. (3) These species may complete their full life cycle within 6-10 days, with subsequent damage to the bean tissue and embryo. Hence, damage attributed to the Drosophila is purely restricted to the conditions pertaining, following picking and pulping, unless over-ripe or damaged cherry has been present prior to picking. If these defectives are absent then using the accepted, ideal processing conditions, viz, rapid fermentation, under water soaking, good drying conditions, negligible damage should arise even if considerable infestation occurred immediately following pulping. However, prolonged fermentation, inefficient under water soaking or washing, followed by very slow drying will give rise to very considerable damage.

* GIL CRIADO, A. y MUÑIZ DAZA, M. Aplicación del método de máxima verosimilitud al análisis cuantal. Anales del Instituto Nacional de Investigaciones Agrarias, Serie General 3:165-186. 1975. (163

Se han explicado detalladamente las bases de las técnicas empleadas en el tratamiento estadístico de la respuesta cuantal con el método de máxima verosimilitud, y su aplicación a un caso de efecto toxicológico de glucosa y cloruro potásico sobre huevos de *Dacus oleae* Gmel. y *Ceratitis capitata* Wied. Se ha elaborado un programa Probit-MV, procesado con la computadora I.B.M. 360/44 del Centro de Cálculo Electrónico del C.S.I.C. Como el método es muy adecuado para obtener información suficiente en estos estudios, hemos considerado muy interesante su exposición en castellano para los investigadores interesados en este campo.

GIRAY, H. A preliminary list of the fauna of Turkish Trypetidae (Diptera). Türkiye Bitki Koruma Dergisi 3(1):35-46. 1979. (164

A list is given of 51 species of Tephritidae from Turkey, with notes on their distribution, collection dates and food-plants. Some species of this family are serious pests of cultivated plants in Turkey, including *Ceratitis capitata* (Wied.) on various fruit trees, *Rhagoletis cerasi* (L.) on different kinds of cherry, *Myiopardalis pardalina* (Big.) on cucurbits, *Carpomyia vesuviana* Costa on *Ziziphus sativa*, and *Acanthiophilus helianthi* (Rossi) on safflower and the medicinal plant *Xanthium spinosum*. Other species recorded from economic plants in Turkey were *Dacus oleae* (Gmel.) on olive, *Urophora jaceana* (Her.) on sesame, *U. quadrifasciata* (Wied.) on lucerne, *U. stylata* (F.), *Paroxyna lingens* (Lw.) and *Camaromyia bullans* (Wied.) on *X. spinosum*, *Terellia fuscicornis* (Lw.) on globe artichoke and *Trupanea amoena* (Frnf.) on lettuce. The list also includes three species new to Turkey. (Review of Applied Entomology, A 68:1311)

GIROLAMI, V. Reperti morfo-istologici sulle batteriosimbiosi del *Dacus oleae* Gmelin e di altri Ditteri Tripetidi, in natura e negli allevamenti su substrati artificiali. Redia 54:269-294. 1973. (165

Tephritids such as *Rhagoletis cerasi* (L.) and especially *Dacus oleae* (Gmel.) have proved difficult to rear in the laboratory on artificial media, because the addition of antiseptics to the diets in order to prevent the development of harmful bacteria results in the elimination of essential symbionts from the population; this is not so, however, when *Ceratitis capitata* (Wied.) is reared on aseptic diets. As part of an investigation of this problem, morphological and histological studies were made in Italy of living and preserved Tephritids from various countries, comprising eight species of Dacinae (including *D. oleae*), five of Trypetinae (including *R. cerasi* and *C. capitata*) and seven of Tephritinae. In all species a pharyngeal diverticulum or cephalic organ was found; in the first two subfamilies bacteria were observed moving from this into the mid-gut and forming small compact masses, whereas in the third subfamily both organ and gut were often empty of symbionts. Details are given of the three different types of diverticulum found in *D. oleae*, in other Dacinae and Trypetinae, and in Tephritinae, respectively. There were indications of an endocellular stage in the transmission cycle of symbiotic bacteria, which was thus more complex than had been supposed; this might explain why antiseptics used in the egg-collecting solution and in the larval diet resulted in the elimination of symbionts from the immature stages even of *C. capitata* but permitted their subsequent reappearance in the adults of this species. (Review of Applied Entomology, A 63:2908)

* GONÇALVES, W., PARO, L. A. y NAKANO, O. Observações sobre a infestação das "moscas das frutas" em cafeeiros. Revista de Agricultura (Brasil) 51(1): 41-45. 1976. (166

This experiment was carried out with the objective of observing "fruit fly" distribution in a coffee plantation. Analysis of the variance applied to obtained data showed that regarding the quadrants (North, South, East and West), they did not differ as to infestation. As to coffee plant heights (skirt, median, top), it was observed that the lower regions (skirt) were the most infested. Three species of "fruit flies" were found attacking coffee: *Anastrepha fratercula*, *Ceratitis capitata* and *Silba pendula*.

GONZALEZ, R. H. Integrated pest control in orchards in Chile and perspectives in South America. In Groupe de Travail pour la Lutte Intégrée en Arboriculture. Comptes rendus du 5ème symposium sur la lutte intégrée en vergers. Bolzano, 1974. Wageningen, The Netherlands, Section Régionale Ouest Paléarctique, Organisation Internationale de Lutte Biologique contre les Animaux et les Plantes Nuisibles, 1975. pp. 135-145. (167

Major pest problems affecting deciduous fruit crops in South America are reviewed, and it is reported that in non-temperate areas, *Ceratitis capitata* (Wied.) and *Anastrepha* spp. are

limiting factors in the practical implementation of pest-management programmes. However, the sterile-male technique is likely to be adopted soon in Peru against C. *capitata* in the context of integrated control. In temperate areas, integrated control programmes have been developed on apples and pears in Chile. The strategies include preventive sprays for the control of *Quadraspidiotus perniciosus* (Comst.) and spider mites, monitoring systems for *Cydia pomonella* (L.) (*Laspeyresia pomonella*), the establishment of economic thresholds for *Panonychus ulmi* (Koch) and *Tetranychus urticae* Koch, and the selection of pesticides that safeguard existing mite predators. (Review of Appled Entomology, A 64:7544)

* GONZALEZ, R. H. Plant protection in Latin America. PANS 22(1):26-34. 1976. (168

The main phytosanitary problems affecting crop production in Latin America are reviewed. The use of pesticides, their availability and sources of supply in the region, demand, and major problems derived from their application are analysed. Excessive and/or indiscriminate use of insecticides is causing great concern in the region, and government agencies, universities and grower associations are developing new control strategies aimed at reducing the use of pesticides. Information is also presented on pesticide contamination of the environment, development of resistance in arthropod and non-arthropod pests and other secondary unwanted effects of chemical application. Alternative control methods, namely biological and integrated pest control, are discussed in the light of research and field programmes conducted. The major introduced pests and diseases which are spreading in the region are listed. It is concluded that Mediterranean fruitfly and coffee rust disease are the major pest problems of quarantine significance at present. The role of national and regional plant quarantine services and organisations in prevention and eradication of exotic pests and diseases is emphasised. It is concluded that most of the national plant protection services lack technical support and post-entry quarantine facilities for effective quarantine action.

* _____. Introducción y dispersión de plagas agrícolas en América Latina: análisis y perspectivas. Boletín Fitosanitario de la FAO 26(2):41-52. 1978. (169

En el presente trabajo se estudia el origen de las principales plagas agrícolas en América Latina, especialmente aquelas de más reciente introducción en la región, sus procedencias, grado de dispersión, métodos de prospección y casos selectos de impacto socioeconómico derivado de su introducción o diseminación.

* GONZALEZ A., T. Control de la mosca del mediterráneo y *Anastrepha* spp. en Costa Rica por medio de enemigos naturales. Agroindustria (Costa Rica) 5(24):14. 1975. (170

El artículo informa sobre la liberación de los himenópteros *Opius longicaudatus* Ashm, *O. concolor* var. *siculus*, *Syntomosphyrum indicum* Silv. y *Pachycrepoideus vindemiae* Rond., enemigos naturales de las moscas de las frutas en distintas zonas de Costa Rica. La producción de parásitos en laboratorio, en 1974, alcanzó en conjunto cerca de 300 millones de especímenes. En Costa Rica se ha liberado entre un 20 y 50% de la producción y se ha enviado parásitos a Nicaragua y Panamá. En los primeros lugares donde la liberación de parásitos se realizó, por ejemplo, el Valle de Santa Ana, ésta se ha reducido al grado que resulta difícil detectar el daño causado por la mosca del mediterráneo. (CV)

* _____. La mosca del mediterráneo en Costa Rica y sus implicaciones en el desarrollo citrícola del país. Agroindustria (Costa Rica) 5(24):18, 24. 1975. (171

Se informa sobre: a) la aparición de la mosca del mediterráneo en Costa Rica, en 1955 y las medidas que promulgó el Gobierno para establecer la cuarentena interna; b) la dispersión de la plaga hacia Nicaragua y Panamá; c) los esfuerzos realizados por OIRSA durante 1963-1974, que permitieron la ampliación del Programa Cooperativo de Investigaciones sobre la mosca del mediterráneo, extremar medidas de prevención; construir el laboratorio de Investigaciones de la Mosca del Mediterráneo en San José, Costa Rica, dando como resultado que por 14 años la plaga quedará confinada en Nicaragua. En abril y mayo de 1975 se detectó la plaga en las Repúblicas de El Salvador, Honduras y Guatemala. En 1975 en el Cantón de Acosta el OIRSA y la Agencia de Extensión Agrícola de Acosta liberaron moscas estériles y las evaluaciones realizadas demostraron las ventajas de este método. Se establece que si se desea implementar la fruticultura en Costa Rica, se deben preparar medidas de control integrado en divulgación del peligro, prácticas agronómicas de cultivo, uso de insecticidas y control biológico. (CV)

* GOTHILF, S., GALUN, R. y BAR-ZEEV, M. Taste reception in the Mediterranean fruit fly; electrophysiological and behavioural studies. Journal of Insect Physiology 17(7):1371-1384. 1971. (172

The effect of various salts and sugars on the taste receptors of Mediterranean fruit fly females was studied by recording electrical discharge of stimulated labellar sensilla, proboscis extension, food consumption, and survival. Contact of a stimulating sugar solution with the tip of one sense hair is sufficient to cause proboscis extension. Stimulation by either sugars or salts results in an immediate high frequency electrical discharge; adaptation is rapid during the first 3 to 5 sec. Among sugars the highest frequency was recorded with sucrose, fructose, or glucose. Stimulation was less marked with galactose, D-arabinose, and maltose,

whereas a low response was elicited by mannose and L-arabinose. There was no response to lactose. Of the two sugar alcohols tested, inositol was stimulatory whereas mannitol was not. Dominant activity of one cell receptor was recorded in response to the more stimulatory sugars. With the other sugars, a mixed response of more than one cell was evident. Consumption and survival was generally positively correlated to electrical response to the sugars; there were, however, a few exceptions, e.g. some consumption of lactose and mannitol, with the latter being utilized, and high mortality in D-arabinose and inositol-fed flies. Consumption of sucrose - on a dry weight basis - rose with increase in its concentration, but the volume of the ingested solution decreased. A significant electrical response of a single cell was recorded following stimulation by sodium and potassium chloride. Divalent cations were less stimulatory. An inhibitory effect of calcium on the sugar receptor was demonstrated.

GUZMAN, M. A. La mosca del mediterráneo (*Ceratitis capitata* Wied.): un problema serio para la fruticultura nacional. Flora y Fauna (El Salvador) 2(3):32-34. 1977. (173

HAFEZ, M. y SHOUKRY, A. Effect of irradiation on adult fecundity and longevity of the Mediterranean fruit fly *Ceratitis capitata* Wied. in Egypt (Diptera: Tephritidae). Zeitschrift für Angewandte Entomologie 72(1):59-66. 1972. (174

The sterilising effect of γ-radiation from a $^{60}Co$ source applied to pupae of *Ceratitis capitata* (Wied.) 2-3 days before adult emergence was investigated in the laboratory in Egypt. It was found that the number of eggs produced decreased from 771.3/female at 500 R to 0 at 3500 R, as compared with 825.54-972.75/female for no treatment, and that the rate of hatching fell from 49.30% at 500 to 13.65-24.14% at 2000-3000 R, as compared with 83.08-83.78%. The length of adult life increased in females given doses up to 10 000 R and decreased in males given doses exceeding 4000 R. (Review of Applied Entomology,A 63:1924)

_____ et al. Studies on some ecological factors affecting the control of the Mediterranean fruit fly *Ceratitis capitata* Wied. in Egypt by the use of the sterile male technique. Zeitschrift fur Angewandte Entomologie 73(3):230-238. 1973. (175

Ecological factors affecting control of *Ceratitis capitata* (Wied.) with the aid of the sterile-male technique were investigated in an isolated farm of *Citrus*, guava, olive and palm in a semiarid area of Egypt in 1965-67. The seasonal abundance of the adults is described from captures in traps baited with trimedlure and diammonium phosphate, there being a peak in November, no captures in July and very few in August-September. The order of decreasing attractiveness of fruits (as indicated by infestation rates and place of capture) was guava, mandarin orange, navel orange and

sour orange. Of the factors temperature, relative humidity and rainfall, the last was the only one significantly related (positively) to the number of captures. The dispersal, flight range and duration of life of sterile adults was investigated by subjecting pupae to γ-radiation, marking them with fluorescent pigments and distributing them in paper bags in the field and subsequently recapturing marked adults in trimedlure traps. Adults lived for up to 25 days and travelled up to 500 m., often against the wind and towards guava trees. It is concluded that sterile-insect release should be begun in the second half of July or early August and continued at intervals of up to 10 days during the cold months and 15 days during the hot months. The distance between release sites should not exceed 500 m. (Review of Applied Entomology, A 63:3743)

HAFLIGER, E. ed. Citrus. Basle, Switzerland, Ciba-Geiby, 1975. 88 p. (176

This monograph contains chapters by various authors who deal in some detail with the origin, distribution, taxonomy, genetics, agronomy, cropping, pests and diseases (including weeds), harvesting, marketing and use of citrus. In the sections on arthropod pests (pp. 21-41), tables are presented showing the world distribution and local importance of all the major citrus pests, spraying procedures to control pests are reviewed and discussed, pest problems on citrus in the USA are outlined (together with the recommended pest control programmes), and the biological and integrated control of citrus pests in Israel is discussed. The sections on disease (pp. 45-54), include information on diseases caused by viruses, virus-like and mycoplasma-like organisms, some of which are transmitted by arthropods. There is also a section (pp. 81-88) in which residues of pesticides (including insecticides) in citrus are discussed. Four loose-leaf supplements include a tabular and pictorial survey of scale insects and whiteflies that attack citrus fruits, and a reproduction of a water-colour of an adult of *Ceratitis capitata* (Wied.). (Review of Applied Entomology, A 65: 5555)

HARAMOTO, F. H. y BESS, H. A. Recent studies on the abundance of the Oriental and Mediterranean fruit flies and the status of their parasites. Proceedings of the Hawaiian Entomological Society 20(3):551-566. 1970. (177

During 1966-68, data were obtained from collections of guava fruits on all six of the major islands of Hawaii to establish the status of *Dacus dorsalis* Hend. and *Ceratitis capitata* (Wied.) and their introduced parasites. These data were compared with corresponding information obtained during 1949-56. In addition, supplementary data were obtained from field observations, catches of males of *D. dorsalis* in traps and miscellaneous fruit collections. It was found that the prevalence of both flies and their parasites during 1966-68 was much lower than before 1950, but essentially the same as during 1952-56. The infestation in guava fruits during 1966-68 varied with year,

season and locality. It averaged 99.4 Tephritid larvae/20-fruit sample for the summer collections and only 5.6 for the winter collections. Infestation in summer was almost exclusively by *D. dorsalis*, but in a few localities, especially in higher and cooler situations, *C. capitata* was present. During the winter, when infestation was at a much lower level than in summer, *C. capitata* outnumbered *D. dorsalis*. The combined infestation by the two Tephritids during 1966-68 was considerably lower than by *C. capitata* alone prior to the establishment of *D. dorsalis* in 1946 and the subsequent establishment of additional Tephritid parasites. Parasitisation during the 1966-68 period, as determined from rearing the larval samples obtained from guava and coffee fruits, was about 65-70%, which was approximately the same as during 1952-56. This parasitisation was due primarly to *Opius oophilus* Fullaway, but some individuals of *O. longicaudatus* (Ashm.) and *O. persulcatus* (Silv.) were also reared from the larvae, while *O. incisi* Silv., *O. tryoni* Cam. and *Biosteres* (*O.*) *fullawayi* (Silvestri), which are also known to parasitise Tephritid larvae, were seen in the field. (Review of Applied Entomology, A 62:3660)

HARPAZ, I. Regulatory measures adopted in Israel regarding the screening and field application of pesticides within the context of integrated control. International Pest Control 21(2):28-30. 1979. (178

The 'pesticide treadmill' became apparent in Israel as early as the mid-1950s. This involves pests becoming increasingly resistant to often-used chemicals, while previously harmeless species multiply to damaging population levels with the destruction of their natural predators by injudicious use of pesticides. In this paper, the author describes how the concept of integrated pest control has been implemented as a way out of such an impasse. Special reference is made to the citrus pests *Chrysomphalus aonidum* (L.), *Ceratitis capitata* (Wied.) and *Phyllocoptruta oleivora* (Ashm.) and their introduced parasite *Aphytis holoxanthus* DeBach, and to the avocado pest *Pseudococcus longispinus* (Targ.) and its introduced parasites *Hungariella peregrina* (Comp.) and *Anagyrus fusciventris* (Gir.). (Review of Applied Entomology, A 67:4991)

HARRIS, E. J. et al. Mortality of Tephritids attracted to guava foliage treated with either malathion or naled plus protein-hydrolysate bait. Journal of Economic Entomology 64(5):1213-1216. 1971. (179

The following is substantially the authors' abstract. When combinations of undiluted protein hydrolysate (PIB-7) and either technical malathion or naled were applied to the foliage of guava trees in small plots on Oahu, Hawaii, in 1967-69 to control native and released laboratory-reared (sterile) adults of *Dacus dorsalis* Hend., *Ceratitis capitata* (Wied.) and *D. cucurbitae* Coq., naled caused greater initial mortality, whereas malathion had a greater long-term effectiveness. The effectiveness of malathion was directly proportional to the ratio of the concentrations of toxicant to PIB-7 (when the total amount remained the

same), a ratio of 4:1 being the most effective followed by 16:1, 64:1, 256:1, 1230:1 and 2460:1. Similar results were obtained whether native and laboratory-reared flies had free access to the exposed baits or whether known numbers of laboratory-reared flies were confined in cages over the baits. (Review of Applied Entomology, A 60:1173)

* HARRIS, E. J., NAKAGAWA, S. y URAGO, T. Sticky traps for detection and survey of three Tephritids. Journal of Economic Entomology 64(1):62-65. 1971. (180

Five types of experimental sticky traps caught more native Mediterranean fruit flies (medflies), *Ceratitis capitata* (Wiedemann), than a standard 0.95-liter plastic trap when placed in cool leeward areas of Hawaii at an elevation of 366 m. A trap made of a rectangular board (hung vertically) covered with Stikem and baited with two small separate squares of cane fiberboard impregnated with trimedlure or with a layer of trimedlure applied under the Stikem was the most effective. When the traps were placed at windward sea-level sites, three of the experimental traps were equal or superior to the standard in five tests made with released sterile medflies. Generally, the number of medflies caught was proportional to the rate of volatilization of the trimedlure. With melon flies, *Dacus cucurbitae* Coquillet, three of the experimental sticky traps (baited with cue-lure plus naled as the toxicant) caught more flies than the standard, but two (the coffee can and the V-shaped trap) were inferior. With a large population of oriental fruit flies, *D. dorsalis* Hendel, the same two traps and also the rectangular trap (baited with methyl eugenol plus naled) caught fewer flies than the standard, but two, the milk carton and the paired boards, caught as many as the standard.

_____. Hawaiian Fruit Flies Laboratory, U.S. Department of Agriculture, Agricultural Research Service-Western Region, California-Hawaii-Nevada Area. Hawaii University Cooperative Extension Service. Miscellaneous Publication, no. 136:36-37. 1976. (181

_____. Program evaluation using ratio tests and recovery data. Bull. SROP Int. Organ. Biol. Control Noxious Anim. Plants West Palearctic Reg. Section 5:20-21. 1977. (182

_____. The threat of the Mediterranean fruit fly to American agriculture and efforts being made to counter this threat. Proceedings of the Hawaiian Entomological Society 22(3):475-480. 1977. (183

The biology, distribution, injuriousness and control of *Ceratitis capitata* (Wied.) are reviewed, with special reference to the infestation of various fruits in the USA, including Hawaii, which is the only area of the USA where *C. capitata* is well established. Sterile-insect release methods against the tephritid on guava on Lanai in 1974-75 caused 99% suppression for 6 months despite the fact that gravid females

were being blown over to Lanai from Maui. Methods that were developed for eradicating *C. capitata* on Lanai were modified and applied for eradicating the tephritid from California. (Review of Applied Entomology, A 67:630)

* HARRIS, E. J. Recent advances in research on the Mediterranean fruit fly and implications for improving control programs. Folia Entomológica Mexicana, no. 39-40:177-178. 1978. (184

The melon fly, *Dacus cucurbitae* Coquillett, the Mediterranean fruit fly (medfly), *Ceratitis capitata* (Wiedemann), and the oriental fruit fly, *D. dorsalis* Hendel, were established in Hawaii in 1895, 1910 and 1944, respectively. These tephritids gave Hawaii the dubious distinction of having three of the world's most destructive fruit insects. Their presence has had an adverse impact on fruit crop production in Hawaii and they pose a constant threat of introduction into the continental U. S. To counter this threat and use presence of the Hawaiian tephritids to advantage, the U. S. Department of Agriculture established the Hawaiian Fruit Flies Laboratory to conduct research to develop: a) quarantine treatments for disinsectization of fresh commodities; b) basic information of biology and ecology; c) methods for detection and monitoring with attractants and lures, and d) methods for large-area suppression and eradication. Research from this laboratory has provided new and improved quarantine treatments and development of mass-rearing methods; development and improvement of food-bait spray formulations for area control; discovery of specific male lures such as trimedlure for the medfly, cue-lure for the melon fly, and methyl eugenol for the oriental fruit fly, and development of these lures for use in Steiner, Jackson, McPhail and tub traps to detect and monitor tephritid fruit flies that occasionally penetrate quarantines and gain entry into the mainland United States. From 1956 through 1977 the attractants combined with toxicants in food-bait or male-annihilation formulations (male lure plus a toxicant) have been used successfully to eradicate incipient outbreaks of tephritid fruit flies from the U.S. at a cost from $200,000 to $20 million for each infestation. In a pilot test on the island of Lanai, using the sterile-insect release technique against the medfly, along with an ongoing survey program for basic ecological information, efficient, environmentally safe methods were developed for bulk handling, irradiation, and distribution of laboratory-reared medflies whose competitiveness under field conditions was enhanced by laboratory handling. The medfly was eradicated from Lanai for two months and was suppressed by 99% for four months through use of these methods. In 1975-76, the methods developed on Lanai proved to be efficient and flexible enough to be easily modified for use to eradicate a medfly infestation from the cool climate of Los Angeles. This technology is currently under consideration or further development, modification, and application to eradicate the medfly from Mexico and contain it in Central America. The essential prerequisite for applying this technology is the establishment of an ongoing survey program to provide base-line information on fruit fly

ecology and population dynamics. An integrated control program combined with sterile-medfly releases is perhaps the most efficient and potentially successful large-area suppresion program that can be implemented with minimal effect on nontarget organisms.

HART, W. G. et al. Bioassays of Mexican fruit flies to determine residual effectiveness of Mediterranean fruit fly bait sprays in southern Texas. Journal of Economic Entomology 60(5):1264-1265. 1967. (185

* _____, INGLE, S. J. y DAVIS, M. R. La identificación de las plantas hospederas de la mosca del mediterráneo con el uso de fotografía de color al infrarrojo. Folia Entomológica Mexicana, no. 39-40:98. 1978. (186

La fotografía aérea al infrarrojo proporciona una manera rápida y de poco costo para determinar la densidad y distribución de plantas hospederas de la mosca del mediterráneo. Con este método se puede obtener información detallada sobre áreas específicas las cuales son frecuentemente inaccesibles por tierra. También permite un registro permanente que se puede usar más tarde para comparar los cambios que pudieran influenciar en el éxito de un programa a larga escala. Este procedimiento ofrece la oportunidad de concentrarse en las áreas más susceptibles de ser atacadas ayudando a la vez a la colocación de las trampas y a la iniciación de las medidas de control.

HERNANDEZ ALBARRAN, M. Mediterranean fruit fly. Mexico-United States Cooperative Program. Cooperative Plant Pest Report 1(13):127-129. 1976. (187

*Ceratitis capitata* (Wied.) has not so far been recorded in Mexico but presents a constant threat to its fruit-and vegetable-growing industries since it is found in neighbouring areas such as California and Central America; monetary losses resulting from its damage to *Citrus* in Costa Rica, Panama and Nicaragua are given, and also estimated losses in Honduras, El Salvador and Guatemala. As a result of the discovery of the fruit-fly in Guatemala, the Mexican government has been negotiating with the Guatemalan government and the United States Department of Agriculture, with a view to cooperation in finance, exchange of personnel, development of inspection and eradication programmes in Central America, intensification of inspection programmes in Mexico and the control of *C. capitata* in Mexico if it spreads into that country. (Review of Applied Entomology, A 65:668)

HERRERA A., J. M. y VIÑAS V., L. E. 'Moscas de la fruta' (Dipt.: Tephritidae) en mangos de Chulucanas, Piura. Revista Peruana de Entomología 20(1): 107-114. 1977. (188

The results are presented of detailed studies in Chulucanas, Piura, Peru, on the fruit-flies attacking mango there. Populations were sampled weekly by means of McPhail traps. Ten of the 12 species taken were in the genus *Anastrepha*, *A. fraterculus* (Wied.) being the most important, followed

by A. *distincta* Greene. The next most abundant species was *Ceratitis capitata* (Wied.). All three species were abundant, density being positively correlated with temperature and negatively correlated with relative humidity. Development was continuous throughout the year because fruits other than mango were available in all months. Populations tended to be largest in spring (September-November), reach a peak in summer (January-February) and decrease in March. Maximum catches of the three species were 28.5, 11 and 9 adults/trap in a single week, respectively. Mango fruits ripen in about 24 weeks, attaining a sugar content of 20.8%. Fruit-fly damage was found to begin on fruits 14 weeks after the start of flowering (average length 68 mm and 8% sugar content), and control measures against A. *fraterculus* must begin slightly before that time, when the trap catches average two adults/trap in a week. A. *teli* Stone is recorded for the first time from Peru, and *Pseudodacus daciformis* (Bez.) for the first time from Piura. (Review of Applied Entomology, A 67:1123)

* HERRERA AUTER, S. Current fruit fly situation in Chile. FAO Plant Protection Bulletin 25(3):118-119. 1977. (189

The author gives an account of the past and present situation regarding fruit flies in Chile. He concludes that eradication measures had succeeded in removing *Dacus tryoni* (Frogg.) from Easter Island and in confining *Ceratitis capitata* (Wied.) to Region I, Tarapacá, and Region II, Antofagasta, 2300 km away from the central part of the country where fruit is grown for export. There was no current fruit-fly infestation in central Chile where industrial orchards of fruit, both for export and domestic consumption, were located. During the last decade, no examples of C. *capitata* had been captured south of Serena; the zone of fruit orchards and table grape production was consequently considered free of this pest and other fruit-fly species. (Review of Applied Entomology, A 66:4420)

HOLBROOK, F. R. y FUJIMOTO, M. S. Mediterranean fruit flies and melon flies trapped at various heights with synthetic lures. Journal of Economic Entomology 62(4):962-963. 1969. (190

In tests in Hawaii in 1967, plastic traps baited with trimedlure were significantly more effective in catching males of *Ceratitis capitata* (Wied.) at 6 and 15 ft. above ground-level than at 0.1-2 ft. When traps baited with cue-lure were tested in pairs at two different heights, those that were closest to the ground were the most attractive to males of *Dacus cucurbitae* Coq. (Review of Applied Entomology, A 58:142)

_____, STEINER, L. F. y FUJIMOTO, M. S. Holding containers for melon flies and Mediterranean fruit flies for use in sterile fly aerial releases. Journal of Economic Entomology 63(3):908-910. 1970. (191

The following is virtually the authors' abstract. Tests were carried out in Hawaii in 1967-68 to evaluate various methods

of packaging sterile adults of *Ceratitis capitata* (Wied.) or *Dacus cucurbitae* Coq. for aerial release. After the containers had been dropped from a height of 2.5 m, opened in an upright position on the ground, and exposed to north-easterly trade winds and sunshine, as many sterile adults of both species were found to escape (following emergence from 3,000 pupae) within 30 min. from Kraft paper bags containing X-shaped cardboard inserts and a diet of sugar cubes as from the more expensive compartmented and ventilated cardboard boxes containing a diet of sugar and water used previously. Fewer adults of either species escaped from bags containing excelsior or X-shaped inserts with diets of sugar solution. Greater percentages of flies of either species escaped from containers holding 3,000 pupae than from those holding 5,000. Generally adults of *Dacus* escaped twice as quickly as those of *Ceratitis*. Sunny or calm conditions (or both) permitted greater egress of both species than cloudy or windy conditions. (Review of Applied Entomology, A 58:3254)

HOLBROOK, F. R., STEINER, L. F. y FUJIMOTO, M. S. Mating competitiveness of Mediterranean fruit flies marked with fluorescent powders. Journal of Economic Entomology 63(2):454-455. 1970. (192

The following is virtually the authors' abstract. During tests in outdoor screen cages in Hawaii in 1968, the mating competitiveness of laboratory-reared adults of *Ceratitis capitata* (Wied.) was not altered by external marking with orange, yellow or green fluorescent powders (Day-glo). Adults of both sexes marked with red powder showed an increased mating response. Most mating in the cages took place in the downwind corners and on the wooden supports rather than on the wire screen. (Review of Applied Entomology, A 58:2644)

_____ y FUJIMOTO, M. S. Mating competitiveness of unirradiated and irradiated Mediterranean fruit flies. Journal of Economic Entomology 63(4):1175-1176. 1970. (193

The following is virtually the authors' abstract. In tests in large field cages in Hawaii in 1968, the mating competitiveness of laboratory-reared males of *Ceratitis capitata* (Wied.) that had been treated with γ-radiation from a $^{60}Co$ source at a rate of 10,000 rad as pupae two days before adult emergence was reduced by 50%. Females treated in the same way were not affected. Sterilised males initially responded to mating stimuli later in the normal daily mating cycle than did normal males, and the time of peak mating activity was delayed in both treated sexes. (Review of Applied Entomology, A 59:148)

HOOPER, G. H. S. Use of carbon dioxide, nitrogen and cold to immobilize adults of the Mediterranean fruit fly. Journal of Economic Entomology 63(6): 1962-1963. 1970. (194

In laboratory tests in Austria, anaesthesia induced by exposure to carbon dioxide for 30 min. (but not for 15 min.) had a

significant adverse effect on the survival, fecundity and viability of the eggs of adults of *Ceratitis capitata* (Wied.); anaesthesia induced by exposure to nitrogen for 15 or 30 min., or immobilisation induced by exposure to cold for 15, 30 or 60 min., had no significant deleterious effect. (Review of Applied Entomology, A 59:1751)

HOOPER, G. H. S. y KATIYAR, K. P. Competitiveness of gamma-sterilized males of the Mediterranean fruit fly. Journal of Economic Entomology 64(5):1068-1071. 1971. (195

The following is virtually the authors' abstract. In laboratory tests in Austria and Costa Rica, adult males of *Ceratitis capitata* (Wied.) that had been exposed as pupae (2 days before adult emergence) to γ-radiation from a $^{60}Co$ source at a dose of 1-17 krad were confined with untreated males and females, respectively, in ratios of 5:1:1, 9:1:1 and 19:1:1. With the first two ratios, the subsequent egg hatch in tests in which males treated with 5, 7, 9 or 11 krad were used was not significantly different, despite an increase in male sterility from about 89% to more than 99%. With the highest ration, the egg hatch was lowest in tests in which males treated with 7 krad were used, the percentage being significantly lower than in tests with males treated with 11 krad. Based on a comparison of observed and expected egg hatch, males exposed to doses above 3 krad were less competitive than untreated males. When the competitiveness of treated males was measured, it was apparent that male competitiveness decreased as the dose increased. (Review of Applied Entomology, A 60:1146)

_____. Competitiveness of gamma-sterilized males of the Mediterranean fruit fly; effect of irradiating pupal or adult stage and of irradiating pupae in nitrogen. Journal of Economic Entomology 64(6):1364-1368. 1971. (196

The following is substantially the author's abstract. The sterilising effect of γ-radiation from a $^{60}Co$ source at doses of 1-13 krad on adults of *Ceratitis capitata* (Wied.) 2-6 h old was determined in the laboratory at Seibersdorf, Austria. Male sterility increased with increasing dose to reach 98.5% at 9 krad and 99.8% at 13 krad. Males irradiated as pupae two days before adult emergence showed a similar relation between sterility and dose. At doses above 3 krad, females laid eggs for a week, the number decreasing as the dose increased, and became infecund thereafter. When males that had been treated with 5, 7, 9 or 11 krad two days before emergence or 2-6 h after emergence were kept with pairs of untreated males and females in a ratio of 3:1:1, hatching of the eggs was reduced by similar amounts. When males were irradiated in nitrogen two days before adult emergence, the dose had to be increased by about 2.5 krad to achieve a level of sterility comparable to that obtained in air. However, the mating competitiveness of males irradiated in nitrogen to give 98% sterility was three times as great as that of males irradiated in air. (Review of Applied Entomology, A 60:1689)

HOOPER, G. H. S. Sterilization and competitiveness of the Mediterranean fruit fly after irradiation of pupae with fast neutrons. Journal of Economic Entomology 64(6):1369-1372. 1971. (197

The following is based partly on the author's abstract. Laboratory tests were carried out at Seibersdorf, Austria, to determine the effect of irradiation of mature pupae of *Ceratitis capitata* (Wied.) with fast neutrons in a swimming-pool-type reactor on the fertility of the subsequent adults (which emerged 24-48 h later). Fast neutrons have been shown to be more effective than X-rays or γ-radiation in producing both recessive mutations and dominant lethal mutations in insects, possibly because of the high rate of transfer of linear energy (LET). The doses absorbed by the pupae (which are given in CH (carbon hydrogen) rad because of the composition of the ionisation chambers) were checked by means of barley-seed germination and sulphur-pellet dosimetry. Irradiation at doses up to 1.9 krad did not adversely affect adult emergence and at 1.1 and 1.9 krad did not significantly reduce the survival of males and females, respectively, after 21 days. Females became infecund after treatment at 0.7-1.1 krad and males 98% sterile at 1.9 krad. From comparison with data for γ-radiation, the RBE (relative biological effectiveness) of the fast neutrons was 3-4 for female infecundity and 4-5 for male sterility. Data from competitive mating experiments in which γ-radiation was compared with fast-neutron radiation indicated that fast neutrons affected male competitiveness less than did γ-radiation. (Review of Applied Entomology, A 60:1690)

_____. Sterilization of the Mediterranean fruit fly with gamma radiation; effect on male competitiveness and change in fertility of females alternately mated with irradiated and untreated males. Journal of Economic Entomology 65(1):1-6. 1972. (198

The following is virtually the authors' abstract. The mating competitiveness of adult males of *Ceratitis capitata* (Wied.) that had been exposed to γ-radiation from radioactive cobalt ($^{60}Co$) at a dose of 5-11 krad as mature pupae was evaluated in laboratory test at Seibersdorf in Austria from the hatching of the eggs laid when irradiated males were kept in various ratios with untreated pairs of males and females. Competitiveness was found to decrease as the dose was increased. This counteracted the increased degree of sterility induced by increased dose, so that similar reductions in egg hatch were produced by doses of 5-11 krad. With increased replication, it was possible to distinguish between the degrees of control produced when males were treated with 5, 7 or 9 krad; treatment with 9 krad gave the poorest results. Although a dose of 7 krad resulted in a slightly higher level of fertility in males than did one of 9 krad (the percentages being 5 and 1-2, respectively), the data indicated that the use of 7 krad should be considered in eradication programmes. It appeared that the presence of sterile females neither augmented nor detracted from the degree of control afforded by treated males. The rate of egg hatching of females confined with treated males after an initial mating with untreated males became lower (to a small extent) as the dose administered

to the treated males was increased from 5 to 11 krad. With the reverse mating sequence, the increase in egg hatch became greater as the dose was increased. (Review of Applied Entomology, A 60:2470)

HOOPER, G. H. S. Effects of larval rearing temperature on the development of the Mediterranean fruit fly, *Ceratitis capitata*. Entomologia Experimentalis et Applicata 23(3):222-226. 1978. (199

As the temperature at which larvae of *Ceratitis capitata* (Wied.) were reared decreased from 30 to 25 to 20°C, the yield of pupae from eggs increased from 15 to 25 to 30% and the mean weight of pupae decreased. At each temperature, the weight of pupae produced on successive days declined and the fat content of the pupae varied. (Review of Applied Entomology, A 67:433)

* HOWELL, J. F., CHEIKH, M. y HARRIS, E. J. Comparison of the efficiency of three traps for the Mediterranean fruit fly baited with minimum amounts of trimedlure. Journal of Economic Entomology 68(2):277-279. 1975. (200

The McPhail, Nadel, Steiner, and various sticky traps were tested for comparative efficiency in trapping the Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann), by Dresner, Harris et al, and Nakagawa et al. A new sticky trap, the Howell trap, was used in Tunisia and is compared here with the Steiner and Nadel traps.

* _____ et al. Mediterranean fruit fly: control in Tunisia by strip treatment with a bait spray of technical malathion and protein-hydrolyzate. Journal of Economic Entomology 68(2):247-249. 1975. (201

Infestations of *Ceratitis capitata* (Wiedemann) in summer fruits in Tunisia were reduced 80-100% when treatments of technical (95%) malathion and PIB-7 (protein hydrolyzate) were applied by air at a rate of 300 cc toxicant and 1200 cc protein/ha to strips 50 m wide that were alternated with untreated strips 200 m wide. Also, treatments reduced the population of adult flies 84.9% (range 54.8-94.6%) on the basis of trap catches. When the untreated strips were 450 m wide, the population was reduced 68.4% on the basis of trap catches and 80.1% on the basis of the number of larvae found in figs. Treatments were begun in July during the initial buildup of the population and were continued throught September. Nevertheless, 33-50% less toxicant was used than is used for the standard full-coverage fall applications used to protect citrus crops, and all susceptible crops received protection, not just citrus.

* HOWELL, J. F. et al. Suppression of Mediterranean fruit fly in Tunisia; a new method for aerial distribution of sterile flies from fixed wing aircraft. Journal of Economic Entomology 68(2):244-246. 1975. (202

Paper tubes, each containing 20,000 sterile Mediterranean fruit flies, *Ceratitis capitata* (Wiedemann), were designed so they would open automatically some distance from the aircraft from which they were released. The flies were not damaged by the acceleration or by the turbulent air currents caused by the aircraft. This new compact packaging makes it possible for small aircraft to carry large numbers of the flies. Also, there was an increase in the trap catch of these aerially released flies compared with the catch of similar ground-released flies (0.059 vs. 0.027% recovery) and a 20% more uniform catch/trap. The improved distribution may have accounted for the higher trap catches. The paper tubes are simple, economical, and seem applicable to a wide range of insects.

HUGHES, I. W. Mediterranean fruit fly: first record in 10 years. Bermuda Department of Agriculture and Fisheries. Monthly Bulletin 43(1):2-3. 1973. (203

HUSSEIN, E. M. K. Biological observations on the Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann), given hempa to larvae. Zeitschrift fur Angewandte Entomologie 81(3):310-314. 1976. (204

When first-instar larvae of *Ceratitis capitata* (Wied.) were provided with an artificial diet into which a 1% solution of hempa had been incorporated, none survived to the second instar. When 0.25-0.5% hempa was used, a few larvae reached the pupal stage but none gave rise to adults. With 0.0001-0.1% hempa, the percentage adult emergence varied from 48.39 to 13.15, some adults being deformed. Except for treatment at the lowest concentration, no eggs were laid. The duration of adult life in untreated examples was almost three times that of treated ones. (Review of Applied Entomology, A 65: 1825)

INSECTICIDES, STERILE males combat Medflies. Agrichem Age 19(6):20. 1976.(205

* IOANNOU, Y. M. Laboratory evaluation of three insecticides for control of Mediterranean fruit fly. International Pest Control 16(1):13-14. 1974. (206

The Mediterranean fruit fly, *Ceratitis capitata* (Wied.) (Diptera: Tephritidae) is a very serious pest of citrus, peaches, apricots, figs and other fruits in Cyprus, and crop losses are extremely high when no control measures are applied. Satisfactory control has been obtained mainly in citrus groves, with the use of malathion baits. However, the continuous use of the same insecticide is not desirable since there is always the possibility that the pest might develop resistance to the insecticide and the crops might be left unprotected in the future. Fenthion (Lebaycid) has been reported by many investigators to

control efficiently the mediterranean fruit fly on citrus, peaches and other fruits as cover or bait spray. The purpose of this study was to assess the effectiveness of three organophosphorus insecticides (malathion, fenthion and pirimiphos-methyl) in the laboratory as sprays for the control of adult mediterranean fruit flies.

* ITO, P. J., KUNIMOTO, R. y KO, W. H. Transmission of mucor rot of guava fruits by three species of fruit flies. Tropical Agriculture (Trinidad) 56(1): 49-52. 1979. (207

Mucor rot was transmitted from diseased to healthy guava fruits by three species of fruit flies commonly occurring in Hawaii. Mature flies were more efficient in transmitting this disease than immature flies. Sanitation greatly reduced the percentage of fruits infected with Mucor rot in six of eight cultivars tested.

* IZAGUIRRE TEJEDA, R. Evaluación de tres pegamentos puros y mezclados usados en trampas en actividades de detección de la mosca del mediterráneo (*Ceratitis capitata*, Wied.) en Guatemala. Tesis Ing. Agr. Guatemala, Universidad de San Carlos de Guatemala, Facultad de Agronomía, 1978. 39 p. (208

Evaluar la efectividad de los pegamentos, puros y en mezcla, en diferentes proporciones y en condiciones de campo, con la finalidad de encontrar el pegamento o mezcla que sea más efectiva para la actividad de detección, fue el objeto de este trabajo de tesis. El experimento se realizó en plantaciones cítricas de las fincas Morena, Chanteros y El Prado en el Departamento de Santa Rosa, Guatemala, y tuvo una duración de cinco semanas. El diseño experimental utilizado fue de bloques al azar, el número de repeticiones fue de dos y el número de tratamiento fue de 16 y la revisión de los tratamientos se hizo cada semana. Los datos obtenidos fueron tabulados y transformados, utilizando la raíz cuadrada del dato + 0.5. Con los nuevos datos obtenidos, se llevaron a cabo los análisis de varianza individuales habiendo llegado a los siguientes resultados: a) No se encontró diferencia significativa entre tratamientos, en cuanto al número de moscas atrapadas durante las cinco semanas que duró el experimento en cada una de las fincas; b) Para completar la información, se llevó a cabo un análisis estadístico, combinado con los datos de moscas atrapadas entre las fincas Chanteros y La Morena. En los análisis de varianza combinados, se encontró diferencia significativa entre localidades, a pesar de encontrarse en la misma zona ecológica, el comportamiento de la plaga fue diferente entre cada finca. Posiblemente este hecho se debió al tipo de vegetación adyacente al área del experimento en cada finca. (CV)

JACOBSON, M. et al. Insect sex attractants. XIII. Isolation, identification, and synthesis of sex pheromones of the male Mediterranean fruit fly. Journal of Medicinal Chemistry 16(3):248-251. 1973. (209

The sex pheromones produced by the males of *Ceratitis capitata* (Wied.) were collected by air condensation, separated in

pure form and identified as methyl (E)-6-nonenoate and (E)-6-nonen-1-ol. Both pheromones were synthesised and shown separately to be attractive and sexually excitatory to females in the laboratory. Field-cage attraction required a combination of both pheromones and certain acids also produced by the males. (Review of Applied Entomology, A 62:2566)

* JACOBSON, M. et al. Impurities in cue-lure attractive to female Tephritidae. Journal of Agricultural and Food Chemistry 24(4):782-783. 1976. (210

Acetic acid and acetic anhydride were identified as the contaminants in commercial cue-lure that are responsible for its transient attraction to female Mediterranean fruit flies and female melon flies. In addition, 4-(*p*-hydroxyphenyl)-3-buten-2-one, an intermediate in the commercial manufacture of cue-lure, was separated into its Z and E isomers. The Z isomer, which could be elaidinized to the E isomer, was attractive to the females of both species. The E isomer occurred in colorless and yellow crystalline forms which attracted mainly female Mediterranean fruit flies.

* _____ et al. Indian calamus root oil: attractiveness of the constituents to oriental fruit flies, melon flies, and Mediterranean fruit flies. Lloydia 39(6):412-415. 1976. (211

A distillate of the essential oil of the roots of Indian calamus, *Acorus calamus* L., was highly attractive to female Mediterranean fruit flies, *Ceratitis capitata* (Wiedemann), female melon flies, *Dacus cucurbitae* Coquillett, and male and female oriental fruit flies, *D. dorsalis* Hendel. The active components isolated from the distillate were identified as β-asarone /(Z)-2,4,5-trimethoxypropenylbenzene/, acoragermacrone, and asarylaldehyde (2,4,5-trimethoxybenzaldehyde). β-Asarone was very attractive to male oriental fruit flies, acoragermacrone was attractive to female melon flies, and asarylaldehyde was attractive to male and female Mediterranean fruit flies and female oriental fruit flies. Of the 3 positional isomers of asarylaldehyde, only the 3,4,5-isomer showed activity: it was attractive to female melon flies; the 2,3,4-isomer may be repellent to all three species of flies. Calamus oil of European origin was attractive to male and female oriental fruit flies.

JARRAYA, A. Etat phytosanitaire des agrumes de Tunisie et perspectives de lutte contre leurs principaux ravageurs. Awamia, no. 37:85-89. 1970. (212

The most important citrus pests are *Ceratitis capitata* and *Saissetia oleae*. Repeated chemical treatments have not given satisfactory control. An autocidal method of control is being considered for *C. capitata* and a biological control method for *S. oleae*. (Horticultural Abstracts 44:8012)

JERMY, T., NAGY, B. y BALAZS, K. A study on the economic aspects of sterile insect release methods with special regard to the codling moth. Növényvédelmi Kutató Intézet Evkönyve 14:79-94. 1976. (213

The authors review the economics of the sterile insect release method in comparison with traditional (chemical) control methods. The analysis is based mainly on data from the literature on *Cydia pomonella* (L.) (*Laspeyresia pomonella*), *Cochliomyia hominivorax* (Coquerel) and fruit flies (*Dacus cucurbitae* Coq., *D. dorsalis* Hend. and *Ceratitis capitata* (Wied.)). (Review of Applied Entomology, A 66:448)

JIMENEZ, C., MUNICIO, A. M. y SUAREZ, A. Methylating activity of (Methyl-14C)-S-adenosylmethionine by microsomes of the insect *Ceratitis capitata*. Lipids 10(9):532-534. 1975. (214

* JIMENEZ ALVAREZ, A. Contribución al estudio de la cría masiva artificial de *Opius concolor* Szépl., parásito de *Dacus oleae* Gmel. Anales del Instituto Nacional de Investigaciones Agrarias. Protección Vegetal, no. 7:197-214. 1977. (215

En la cría masiva artificial de *Opius concolor* Szepl. utilizando como huésped *Ceratitis capitata* Wied., se obtiene un mayor número de *O. concolor* Szepl. cuando las larvas huéspedes son expuestas durante cuatro horas y media a la acción parasitaria del bracónido con edad comprendida entre los 4 y 7 días. En las anteriores condiciones el efecto acumulativo - producción de *O. concolor* Szepl. y pupas que no originan adultos - es superior al 92%. La producción de adultos de *O. concolor* Szepl. aumenta rápidamente en los dos primeros días, alcanza el máximo en los tres días siguientes para descender posteriormente. El parasitismo es mayor entre las 11 y 17 horas del día. En la cría masiva artificial se obtiene mayor número de machos que de hembras.

JOEL, D. M. The secretory ducts of mango fruits; a defense system effective against the Mediterranean fruit fly. Israel Journal of Botany 27(1): 44-45. 1978. (216

A 3-dimensional reconstruction of the duct system of mango fruit exocarp showed a netwoek of ducts, branching and anastromosing in all directions. The duct contents were irritant. Only mango cvs with poorly developed duct systems are attacked by *Ceratitis capitata*, and it is suggested that the duct system has a defensive function. In studies on 18 cvs, including three susceptible to attack, the mean number of ducts crossed by a random line in a transverse section of the exocarp was found to be larger than 1 in the resistant varieties, and smaller than 1 in the susceptible varieties. This fact can be used as a simple criterion to distinguish between resistant and non-resistant fruits. (Horticultural Abstracts 49:3865)

KALMOUKOS, P. E. y ORPHANIDIS, P. S. Relative residual insecticidal action of organophosphates and carbamates applied as bait-sprays. Annales de l'Institut Phytopathologique Benaki 10(3):236-247. 1972. (217

The toxicity of residues of various insecticides that are applied in bait-sprays for the control of *Dacus oleae* (Gmel.) on olive was studied in the laboratory in Greece by assay with adults of *Drosophila melanogaster* Mg. and *Ceratitis capitata* (Wied.). The leaves used were taken after various intervals from trees that had been sprayed once to run-off with a bait-spray containing 0.3% of the test insecticide and 5% hydrolysed protein bait. The test insects were kept in contact with the treated leaves for 24 h. The results obtained indicated that the eight insecticides could be classified into three groups. The first comprised bromophos and tetrachlorvinphos, residues of which persisted for very long periods (47.5% mortality of *D. melanogaster* being obtained after 266 days with leaves bearing residues of bromophos). The second group, of intermediate persistence, comprised dimethoate, fenthion and malathion, and the third group comprised phosphamidon, dimetilan and trichlorphon, residues of which were present for only relatively short periods. The results provide an explanation for the superiority of the results obtained with bait-sprays containing dimethoate and fenthion over those obtained with similar sprays containing phosphamidon and trichlorphon and suggest that bromophos may be of interest for use in this connection. (Review of Applied Entomology, A 63:1086)

KAMASAKI, H. Some pathogens and pests associated with Tephritid flies in the laboratory. Journal of Economic Entomology 63(4):1353-1355. 1970. (218

The author reviews, mainly from the literature, the viruses, bacteria, fungi, Protozoa, nematodes, mites and insects that interfere with laboratory cultures of fruit-flies and gives a table showing that *Ceratitis capitata* (Wied.) reared in Hawaii, Costa Rica, Israel and other localities and *Dacus cucurbitae* Coq. reared in Hawaii are attacked by the bacterium *Serratia marcescens*, the fungus *Beauveria bassiana* and the Protozoan *Nosema* sp., *D. dorsalis* Hend. in Hawaii by *S. marcescens*, *B. bassiana*, *Nosema* sp., the nematode *Rhabditis* sp. and insect parasites; *Anastrepha ludens* (Lw.) in Mexico by *S. marcescens* and fungi; *D. oleae* (Gmel.) in Greece, Israel and other localities by mites; and *A. mombinpraeoptans* Seín in Mexico by fungi. (Review of Applied Entomology, A 59:207)

KAMBUROV, S. S. Artificial infestation of citrus fruits with the Mediterranean fruit fly. Annals of the Entomological Society of America 65(5):1238-1239. 1972. (219

A method of infesting *Citrus* fruits with *Ceratitis capitata* (Wied.) was developed in Israel for testing ethylene-dibromide fumigation procedures, naturally infested fruits having become scarce as a result of the use of bait-sprays. Eggs obtained from laboratory-reared flies were injected

with a fungicide in an aqueous solution into *Citrus* fruits, and the hole was then plugged. At 29-30° and 85-90% R.H., development was normal, and the larvae reached the third instar 8-10 days after injection of the eggs. The method was also successful with avocados and guavas. (Review of Applied Entomology, A 61:1654)

* KATIYAR, K. P. Comparación de dietas de zanahoria y de bagazo para la cría de larvas de mosca del mediterráneo. Turrialba (Costa Rica) 20(2):217-222. 1970. (220

Performance of a new larval diet called bagasse diet was compared with standard carrot medium for rearing the Mediterranean fruit fly larvae. Larval density of 8 to 10 per milliliter of diet was found optimum for both kinds of diet. Larvae reared at these densities produced normal weight pupae and gave high pupal yield. Larval density of 10 gave 84.3% and 75.1% pupal recovery on carrot and bagasse diet, respectively. The weight of individual pupa at this density was 83.5 mg on carrot and 9.12 mg on bagasse diet. Higher larval densities of 12 and 14 larvae in bagasse medium produced normal weight pupae but per cent pupal recovery was slightly lowered. In carrot diet larval densities of 12 or 14 did not adversely affect the per cent pupal recovery but the pupal reared at these densities were of slightly inferior weight.

_____ y RAMIREZ, E. Mating frequency and fertility of Mediterranean fruit fly females alternately mated with normal and irradiate males. Journal of Economic Entomology 63(4):1247-1250. 1970. (221

The following is virtually the authors' abstract of this account of laboratory investigations in Costa Rica. When females of *Ceratitis capitata* (Wied.) that had initially mated with males that were normal or had been exposed to γ-radiation from a $^{60}Co$ source at a dose of 10 krad were allowed to mate again when they were 11-22 days old with males that had been irradiated with a dose of 10 krad or that were normal, respectively, the total percentages of females that did so were 26.7 and 41.3, respectively. The effect of the second mating on female fertility was independent of the time interval between the first and second matings. Fertility of females alternately mated to both types of males increased by 68.2% when the last mating was with a normal male and decreased by 43.4% when it was with an irradiated one. The fertility of females that did not re-mate within seven days was only slightly affected when they were caged for two weeks with males that were the reverse of the type employed in the initial mating. (Review of Applied Entomology, A 59: 166)

* KATIYAR, K. P. Sterilization of the Mediterranean fruit fly and its application to fly eradication (further studies on mating competitiveness of Medfly males irradicated during pupal or adult stage). In Instituto Interamericano de Ciencias Agrícolas. The application of nuclear energy to agriculture. Turrialba, Costa Rica, 1972. pp. 23-31. (Annual report to the U.S. Atomic Energy Commission AT(11-1)-3217) (222

Irradiation of mature medfly pupae (1-3 days before adult emergence) with 10 krad, induces more than 99% sterility in the treated males. Sterilization seems to reduce the mating competitiveness of treated males. Author reported previously that the mating vigor (insemination efficiency) of 10 krad irradiated males is affected by the pupal stage at which irradiation is applied. The closer to adult emergence that the pupae are irradiated, the higher the insemination efficiency. It was also found that males irradiated 24-48 hr after emergence inseminated more females than those irradiated as pupae (24 hr before emergence). However, when mating competitiveness of males irradiated during pupal or adult stage was evaluated by caging mixed populations of sterile males, normal males and normal females, only a slightly increased mating competitiveness of males irradiated was found, as 24-48 hr after emergence compared to those irradiated 24 hr before emergence.

* _____ y RAMIREZ, E. Suppression of the reproductive potential of a wild strain Mediterranean fruit fly by gamma irradiated males in caged coffee trees. Turrialba (Costa Rica) 22(2):156-159. 1972. (223

En el IICA-CTEI, Turrialba, Costa Rica, en 1968 y 1969, se hicieron estudios para determinar la competencia sexual de moscas del Mediterráneo de laboratorio, irradiadas con 7 a 10 kr, con respecto a moscas silvestres sin tratar. Los estudios se hicieron en jaulas de cedazo de 3,6 m x 3,6 m x 2,4 m, instaladas en el campo cubriendo plantas de café con frutos. Se liberaron moscas estériles sin sexar, obtenidas por medio de irradiación de pupas, 1 a 2 días antes de la eclosión. Las moscas silvestres sin tratar se colectaron en el estado pupal de frutos infestados del almendro tropical (*Terminalia catapa*). La viabilidad de huevos de poblaciones mixtas de moscas estériles y normales fueron estudiadas en proporciones de 20:1, 40:1, 80:1 y 120:1 (estéril: normal) durante 12 a 17 semanas. La oviposición de las hembras en los frutos de café fue baja y errática en ambas pruebas. Basados en las medias de los datos de eclosión, la competencia sexual de los machos irradiados con los normales se redujo aproximadamente 1/6 a 1/5 en las poblaciones mixtas basta la proporción de 80:1. La liberación de moscas estériles y normales en una proporción de 120:1 fue la más eficaz en inhibir el potencial reproductivo de las moscas normales. Esta población mixta produjo un promedio de 1,0% de huevos viables en un período de 17 semanas.

* KATIYAR, K. P. Mating competitiveness and rate of sexual maturity of gamma-sterile Mediterranean fruit fly males. Turrialba (Costa Rica) 23(2):216-221. 1973. (224

Para determinar los efectos de la esterilización gamma con 6, 8 o 10 kr sobre la tasa de maduración sexual y la competitividad en la copulación de los machos de la mosca del mediterráneo (*Ceratitis capitata* Wied., Diptera: Tephritidae), se llevaron a cabo estudios en el laboratorio y en el campo del IICA-CTEI, Turrialba, Costa Rica. Quinientos machos marcados con polvo fluorescente (125 en cada tratamiento) se enjaularon con 250 hembras vírgenes de la misma edad. En el campo, adultos de dos días de edad se liberaron en jaulas de 9x9x7 pies que cubrían 2 o 3 plantas de café en producción. En el laboratorio, adultos recién nacidos (menos de 12 horas de edad) se pusieron en jaulas de 1 pie cúbico. Las moscas en cópula se colectaron constantemente en frascos pequeños (shell vials) entre las 7 y 16 horas, durante los tres días siguientes a la liberación en las jaulas. La hora de la cópula se anotó en cada pareja. Los resultados demostraron que la irradiación reduce la competitividad en la copulación de los machos tratados con cualquiera de las dosis probadas. Los datos no mostraron ningún atraso en la tasa de maduración sexual de los machos estériles. La frecuencia de copulación, registrada cada hora, fue similar en los machos tratados y en los normales durante el período experimental. El primer pico de copulación ocurrió entre las 11 y 12 horas en los machos de dos días de edad en el laboratorio, y cerca de las 9 horas en los machos de tres días de edad en el campo.

* _____. Insemination capacity of gamma-sterilized Mediterranean fruit fly males irradiated during the pupal stage. Turrialba (Costa Rica) 23(1): 48-51. 1973. (225

Se hizo un estudio de la frecuencia de inseminación de machos de mosca del Mediterráneo, *Ceratitis capitata* (Wiedemann), normales y esterilizados con irradiaciones gamma. Las pupas fueron irradiadas con 10 kr a las 0, 24, 48 o 72 horas antes de la eclosión. A partir del quinto día, los machos recibieron hembras vírgenes (proporción de 1 macho a 3 hembras), cada dos días hasta el día 27 de la vida de los machos. La esterilización redujo la capacidad de inseminación de los machos tratados. Cuando más cercana se hizo la irradiación a la fecha de eclosión, la eficiencia de inseminación fue más alta en los machos tratados. Durante un período de cuatro semanas en la vida de un adulto, un macho normal inseminó un promedio de 14,6 veces comparado con 9,8; 7,6; 4,0 y 1,5 veces, respectivamente, para los machos irradiados en estado de pupa a 0, 24, 48 o 72 horas antes de la eclosión.

* _____ y RAMIREZ, E. Mating duration of gamma irradiated Mediterranean fruit fly males. Turrialba (Costa Rica) 23(4):471-472. 1973. (226

Para determinar la duración promedio en la copulación de machos irradiados con 6, 8 y 10 kr y de machos normales de la mosca del Mediterráneo, se llevaron a cabo estudios en el laboratorio

en frascos de 4 onzas. Los resultados indican que la esterilización no redujo la duración de cópula en los machos irradiados. Tiempo promedio de duración de cópula para machos esterilizados con 10 kr fue de 140 minutos en comparación con 153 minutos de machos normales.

* KATIYAR, K. P. y RAMIREZ, E. Sperm transferability of gamma sterilized Mediterranean fruit fly males. Turrialba (Costa Rica) 23(3):324-326. 1973. (227

En el laboratorio se estudió la receptividad de la mosca del Mediterráneo hacia una segunda copulación. Hembras vírgenes de tres a seis días de edad fueron puestas a copular con machos jóvenes irradiados con 10 kr o normales, sexualmente maduros, entre las 7:00 y 16:00 horas. Se encontró que tanto los machos estériles como los normales transferían una buena çantidad de esperma en casi todos los apareamientos. La receptividad de las hembras hacia la segunda copulación no se correlacionó con la cantidad disminuida de esperma que se transfirió después del primer apareamiento, a lo menos en el período de un día.

* _____. Sterilization of the Mediterranean fruit fly and its application to fly eradication. In Instituto Interamericano de Ciencias Agrícolas. The application of nuclear energy to agriculture. Turrialba, Costa Rica, 1973. pp. 15-22. (Annual report to the U.S. Atomic Energy Commission AT(30-1)-2043). (228

The experiment was carried out in the laboratory in 1 $ft^3$ wooden framed cages to determine the mating competitiveness of medfly males irradiated as pupae (2-1 days before emergence) or as adults (1-2 days after emergence). The results indicated that males irradiated during adult stage produced more competitive males compared to those irradiated at pupal stage (2 days before emergence). The following year experiments were carried out in outdoor cages approaching more natural conditions, to evaluate the mating competitiveness of sterile males when both sexes of irradiated flies were released with normal flies.

_____ y LABRADOR, J. R. La técnica de cría masal de mosca del mediterráneo, *Ceratitis capitata* (Wiedemann). In Sociedad Venezolana de Entomología, Maracaibo. Memoria. Maracaibo, 1978. v.2, pp. II-26-(1-18). (229

* KEISER, I., STEINER, L. F. y KAMASAKI, H. Effect of chemosterilants against the oriental fruit fly, melon fly, and Mediterranean fruit fly. Journal of Economic Entomology 58(4):682-685. 1969. (230

In tests conducted in Hawaii from 1959 to 1964 both sexes of one or more of three species of tephritid flies were sterilized without toxic effects by treating food and water with tepa, metepa, apholate, or tretamine, applying these materials topically to pupae or adults, or exposing adults to deposits of the chemosterilants. Methotrexate, aminopterin, colchicine, and 5-fluorouracil treatments sterilized

females only. Tepa, apholate, and tretamine sterilized as effectively and efficiently as ionizing radiation. Tepa showed promise for field applications in combination with attractive protein hydrolyzates. In general, males were sterilized at lower concentrations than females; the melon fly, *Dacus cucurbitae* Coquillett, was the most susceptible; the oriental fruit fly, *D. dorsalis* Hendel, intermediate; and the Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann), the least susceptible to test materials. Treatments were most effective against newly emerged flies, but deposition of hatchable eggs in old gravid fertile females was inhibited within 24-48 hr after treatment.

KEISER, I. y TOMIKAWA, I. Species-specific toxicity of certain insecticides to Tephritids in Hawaii suggested by unusual susceptibility relationships among oriental fruit flies, melon flies, and Mediterranean fruit flies. Journal of Economic Entomology 63(6):1746-1748. 1970. (231

The following is based partly on the authors' abstract. During laboratory evaluations over 17 years of the topical or residual toxicity of insecticides to *Dacus dorsalis* Hend., *D. cucurbitae* Coq. and *Ceratitis capitata* (Wied.) in Hawaii, interspecific toxicity relations (similar to those observed for malathion) were noted. Thirteen exceptions were observed, and these are reported. Bayer 22408 (O,O-diethyl O-naphthalimido phosphorothioate) was equal to malathion in toxicity to *C. capitata*, but was much less toxic than malathion to *Dacus* spp. Conversely, Bayer 19596 (O,O-diethyl S-ethoxycarbonylcarbamoylmethyl phosphorodithioate) and Pyrolan were equal to malathion in toxicity to *Dacus* spp., but were much less toxic than malathion to *C. capitata*. Azinphos-methyl, carbaryl, Monsanto CP-7769 (hexaethyl ethylthiomethylidynetriphosphonate) and ethyl-DDD (Perthane) were less toxic to *D. dorsalis*, Am. Cyanamid 12415 (O,O-diethyl phosphorothioate O-ester with 6-hydroxy-3(2H)-pyridazinone), Bayer 16948 (O,O-diethyl O-2-(sec.-butoxymethylthio)ethyl phosphorothioate), coumithoate (Dition), endosulfan and Monsanto CP-8574 (tetramethyl (dithiodimethylene)diphosphonate) were more toxic to *D. cucurbitae*, and DDT was less toxic to *D. cucurbitae*. The closely related insecticides methyl-parathion, dicapthon and Chlorthion were progressively less toxic to all three Tephritids. *D. cucurbitae* showed an increasingly greater degree of resistance to these three insecticides (in the order listed) than did the other two species. (Review of Applied Entomology, A 59:1694)

_____, SCHNEIDER, E. L. y TOMIKAWA, I. Species specificity among oriental fruit flies, melon flies, and Mediterranean fruit flies in susceptibility to insecticides at several loci. Journal of Economic Entomology 64(3): 606-610. 1971. (232

The following is substantially the authors' abstract. DDT, methoxy-DDT (methoxychlor) and malathion were applied topically in Hawaii in 1957 and 1967 to the thoracic mesonotum and mesosternum, the abdominal mid-dorsum and mid-venter, and the verto-occipital and oral regions of adults of *Dacus dorsalis* Hend., *D. cucurbitae* Coq. and *Ceratitis capitata* (Wied.)

Specific differences between species in susceptibility to the same insecticides on identical loci were noted. The thoracic mesonotum of *Dacus* spp. was the least susceptible of the application sites to DDT or methoxy-DDT, while the thoracic mesonotum of *C. capitata* was the most susceptible to these compounds. The application of methoxy-DDT to the oral region was at least 200 and 2 times as effective in the cases of *D. cucurbitae* and *C. capitata*, respectively, as application to the thoracic mesonotum. Locus-specific differences in susceptibility to different insecticides in the same species were also noted. DDT and methoxy-DDT were least effective when applied to the thoracic mesonotum of *Dacus* spp., while malathion was the most effective when applied to this region of *Dacus*. (Review of Applied Entomology, A 59:3217)

KEISER, I., CHAMBERS, D. L. y SCHNEIDER, E. L. Modified commercial containers as laboratory cages, watering devices, and egging receptacles for fruit flies. Journal of Economic Entomology 65(5):1514-1516. 1972. (233

A small laboratory cage ( 7 cm high outside diameters of 9.2 cm at the top and 7.4 cm at the bottom), with modifications for watering and collecting eggs, a watering device for use in medium-sized (30.5 x 30.5 x 30.5 cm) and large (2.74 x 27.4 x 2.74 m) cages and olfactomers, and a plastic receptable for collecting eggs were developed from commercial containers for use with *Dacus dorsalis* Hend., *D. cucurbitae* Coq. and *Ceratitis capitata* (Wied.) in laboratory studies in Hawaii in 1952-72. (Review of Applied Entomology, A 61:1534)

* _____ et al. Laboratory assessment of 73 insecticides against the oriental fruit fly, melon fly, and Mediterranean fruit fly. Journal of Economic Entomology 66(4):837-839. 1973. (234

From 1952 to 1968, several hundred insecticides were assayed in the laboratory (by topical applications to the thoracic mesonotum) for toxicity to the three species of tephritids found in Hawaii: oriental fruit flies, *Dacus dorsalis* Hendel; melon flies, *D. cucurbitae* Coquillett; and Mediterranean fruit flies, *Ceratitis capitata* (Wiedemann). The results with 73 insecticides are reported by computed dose-mortality curves, $LD_{50}$ levels in µg toxicant/fly, the upper and lower limits at the 95% confidence level, and the slopes. Malathion was the standard for comparison. $LD_{50}$'s were not established for chlorobenzilate, dicofol, Zinophos (O,O-diethyl O-pyrazinyl phosphorothioate), and tetradifon. At any dose tested, no $LD_{50}$ against oriental fruit flies was established for carbaryl; no $LD_{50}$ against the melon fly was established for DDT, methoxychlor, and Pyrazoxon (diethyl 3-methylpyrazol-5-yl phosphate); and no $LD_{50}$ against oriental fruit flies and melon flies was established for Terbeno (polychlorinated terpene). Dimethoate and nales were generally the most toxic of the insecticides against all three species when they were applied in this manner.

* KEISER, I. et al. Relation of sexual dimorphism in the wings, potential stridulation, and illumination to mating of oriental fruit flies, melon flies, and Mediterranean fruit flies in Hawaii. Annales of the Entomological Society of America 66(5):937-941. 1973. (235

The wings of male oriental fruit flies, *Dacus dorsalis* Hendel; melon flies, *D. cucurbitae* Coquillett; and Mediterranean fruit flies, *Ceratitis capitata* (Wiedemann), all have deeper and more sharply incised wing margins at the distal tip of $Cu_1$ + 1A than the females. However, the difference is most evident in melon flies and least evident in Mediterranean fruit flies. In addition, the male Mediterranean fruit fly has an emargination at the terminus of $M_3$ + $M_4$ that is not found in the female. Any supposed mating call of male oriental fruit flies or melon flies resulting from stridulation of the wings on the abdominal cilia (or produced in any other manner) was not necessary for mating and insemination, judged from the percentages of egg hatch for females paired in an ambient laboratory environment with males with the wings removed. Male Mediterranean fruit flies do not have abdominal cilia.

* _____. Suppression of Mediterranean fruit flies by oriental fruit flies in mixed infestations in guava. Journal of Economic Entomology 67(3):355-360. 1974. (236

With superimposed oviposition of oriental fruit flies, *Dacus dorsalis* Hendel, or Mediterranean fruit flies, *Ceratitis capitata* (Wiedemann), in either sequence in fresh guava fruit in the laboratory, following oviposition by the other species, oriental fruit flies completely or almost completely suppressed the development of Mediterranean fruit flies. When oviposition in the same guava was not superimposed but limited to separate areas for each of the two species, suppression of Mediterranean fruit flies by oriental fruit flies also was manifested, albeit not as drastically. This suppression generally was not demonstrated when eggs of both species were seeded simultaneously on artificial larval medium.

* _____ et al. Survival of oriental fruit flies, melon flies, and Mediterranean fruit flies after immersion in alcohol or acetone as larvae. Journal of Economic Entomology 67(2):303-304. 1974. (237

Immersion in 95% ethanol and 100% acetone for up to 2 h 8 min. has been used in the laboratory in Hawaii as a quick method of evaluating the effects of hormonal agents on mature (third instar) larvae of *Dacus dorsalis* Hend., *D. cucurbitae* Coq. and *Ceratitis capitata* (Wied.). Studies were carried out to determine the effects of such immersion for longer periods. Larval survival was 10% following immersion periods in ethanol and acetone of 7.47 and 4.63 h, respectively, for *D. dorsalis*, 1.87 and 0.25 h for *D. cucurbitae*, and 5.63 and 3.77 h for *C. capitata*. Adults resulting from larvae surviving treatment were not adversely affected. The data indicated that all three Tephritids could withstand long periods of immersion in either solvent. (Review of Applied Entomology, A 63:1084)

* KEISER, I. et al. Attraction of ethyl ether extracts of 232 botanicals to oriental fruit flies, melon flies, and Mediterranean fruit flies. Lloydia 38(2): 141-152. 1975. (238

The Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann), the melon fly, *Dacus cucurbitae* Coquillett, and the oriental fruit fly, *D. dorsalis* Hendel, three Hawaiian tephritids of economic importance, were exposed to traps each containing one of 232 ethyl ether extracts of air-dried botanicals. The principal concern was to establish which extracts were attractive judged on the basis of an index determined by the number of times more flies were attracted to the trap baited with water and extract than were attracted to traps baited with water only. Female Mediterranean fruit flies were attracted to 61 extracts and melon fly females to 31 extracts. Female oriental fruit flies were not much attracted. Many extracts were attractive to males of the three species. The extract of *Coffea robusta* Linden (Family Rubiaceae) was the only material attractive to both sexes of all three species.

* _____. Mediterranean fruit fly; attraction of females to acetic acid and acetic anhydride, to two chemical intermediates in the manufacture of cue-lure, and to decaying Hawaiian tephritids. Journal of Economic Entomology 69(4):517-520. 1976. (239

Acetic acid and acetic anhydride, two highly volatile impurities of cue-lure, an attractant for male melon flies, *Dacus cucurbitae* Coquillett, were found to be attractive to female Mediterranean fruit flies, *Ceratitis capitata* (Wiedemann), in the laboratory. Also, the crude condensation product resulting from the reaction between p-hydroxybenzaldehyde and acetone during the manufacture of cue-lure was attractive as was (to a lesser degree) the spent charcoal used to decolorize and purify the crude product. When dead flies of each sex of the three Hawaiian tephritids were exposed in traps in the field, female Mediterranean fruit flies were most attracted to dead male oriental fruit flies, *D. dorsalis* Hendel. Moreover, in the laboratory, three chromatographic fractions of ether extracts of dead oriental fruit flies of mixed sex that had decomposed for 196 h were attractive to female Mediterranean fruit flies and also to female melon flies.

KENYA. COFFEE RESEARCH FOUNDATION. Annual report 1971/72. Ruiru, 1972. 111 p. (240

_____. Annual report 1973/74. Ruiru, 1975. 82 p. (241

*Ceratitis capitata*: pp. 21-39.

_____. Annual report 1974/1975. Ruiru, 1976. 149 p. (242

* KOPPELBERG, B. y CRAMER, H. H. Control of Mediterranean fruit fly, *Ceratitis capitata* Wied. in Spain. Methods and economic importance. Pflanzenschutz-Nachrichten Bayer 22(1):157-167. 1969. (243

* LABRADOR, J. R. Contribución al conocimiento del área productora de nísperos de la altiplanicie de Maracaibo y su situación en relación a las moscas de las frutas con especial referencia a estudios sobre la mosca del Mediterráneo (*Ceratitis capitata* Wiedemann). Tesis Prof. Maracaibo, Venezuela, Universidad del Zulia, Facultad de Agronomía, 1977. 138 p. (244

El presente trabajo tiene por objetivo presentar un panorama del área frutícola de la región norte del Estado Zulia, que permita observar su importancia económica actual, su potencial futuro así como exponer los conocimientos de estudios realizados, sobre la mosca del mediterráneo (*Ceratitis capitata* Wiedemann), que afecta la producción de nísperos (*Achras zapota* L.), frutal de importancia económica en la región. El autor dividió el trabajo en tres capítulos: A. Estudios relativos al área, donde hace una descripción condensada del área; trata las condiciones de ubicación topográfica, clima, suelos, vegetación y su uso agrícola. Expone cuáles son las características típicas de las granjas nispereras, analiza los factores más importantes que modelan las condiciones de producción y desarrollo, señala los insectos perjudiciales y establece que las moscas del fruto, forman un complejo de especies de las cuales la mosca del mediterráneo causa una significativa merma de la producción. B. Estudio sobre la mosca del mediterráneo engloba los conocimientos obtenidos a través del trabajo de investigación sobre bio-ecología e importancia de la mosca del mediterráneo, utilización de trampas, dinámica de población, plantas hospederas, biología y observaciones ecológicas. C. Discusión, conclusiones, recomendaciones y anexos. Los diversos aspectos tratados en la discusión son el resultado de un trabajo de investigación realizado en laboratorio y campo, que permitieron obtener experiencia y un buen conocimiento de la mosca del mediterráneo a nivel local, información necesaria para la planificación de futuros programas de combate. Fue también necesario elaborar un mapa de ubicación de franjas. (CV)

_____ y KATIYAR, K. Medios de combate para las moscas de las frutas con especial referencia sobre observaciones bioecológicas de la Mosca del Mediterráneo (*Ceratitis capitata* Wied.) en Venezuela. Maracaibo, Universidad del Zulia, Facultad de Agronomía. Boletín Técnico, no. 1. 1977. 52 p. (245

LANGLEY, P. A. y MALY, H. Control of the Mediterranean fruit fly (*Ceratitis capitata*) using sterile males; effects of nitrogen and chilling during gamma-irradiation of puparia. Entomologia Experimentalis et Applicata 14(2):137-146. 1971. (246

The following is substantially the authors' abstract. Nitrogen has proved effective in protecting the pupae of *Ceratitis capitata* (Wied.) from damage caused by γ-irradiation, since it increases the percentage of adults emerging from early irradiated puparia, adult male survival and male fertility. The

opposite effect was produced when puparia were chilled to 4°C during irradiation, and it is concluded that the extent of damage that can be altered by these treatments is due to the oxygen-dependent effects of irradiation. Increased fertility after irradiation in nitrogen may be due to increased sexual vigour rather than to a reduction in the amount of damage to genetic material, but this has not been proved. The effects on the percentage of adult emergence, survival and fertility are probably manifestations of the same phenomenon of irradiation-induced lethargy. It is considered that the effect of treatment with nitrogen at 25°C or chilling to 4°C in air during irradiation may be of value in increasing the flexibility of a large-scale campaign to control *C. capitata* by the release of sterile individuals. Adults of *C. capitata* that emerge from puparia exposed to γ-radiation survive the longest when the exposure occurs late in the pupal stage. This finding greatly affects the logistics of any large-scale sterilisation programme. The authors therefore attempted to separate the genetic and somatic effects of irradiation on pupae of *C. capitata*. If the somatic effects could be lessened without affecting the degree of sterility induced by a given dose, the age-range of pupae that could be successfully sterilised might be increased, thus allowing greater flexibility in the development of a control programme. The results of the irradiation of puparia in nitrogen at 21°C or in air at 4°C show that some protection from lethal somatic effects is possible (Review of Applied Entomology, A 60:3313)

LANGLEY, P. A., MALY, H. y RUHM, F. Application of the sterility principle for the control of the Mediterranean fruit fly (*Ceratitis capitata*); pupal metabolism in relation to mass-rearing techniques. Entomologia Experimentalis et Applicata 15(1):23-34. 1972. (247

Some of the information in this account of studies in Austria on effects of the laboratory environment on the development of puparia of *Ceratitis capitata* (Wied.) has already been noticed. The normal handling and transportation procedures for the puparia (or mechanical vibration) appeared to have no adverse effects on the percentage emergence of the adults or on their length of life. The optimum conditions for pupal development were between 20 and 25°C and between 75 and 90% R.H. Combinations of low temperature and low humidity or of high temperature and high humidity were deleterious. The rate of water-loss by puparia was greatest during the first three days of development, but fat was consumed throughout the pupal stage. Mean temperatures for pupal development above 25°C did not alter the length of the pupal stage greatly or predictably but reduced the fat reserves of the adults to which pupae kept at these temperatures gave rise. The starvation of adult males from the time they emerged resulted in a decrease of fat reserves; access to water did not significantly prolong life. Access to carbohydrate or carbohydrate and protein food resulted in the maintenance of high fat reserves in adult males. Hence, it is concluded that fat reserves are of significance in the nutrition of the adult males. These results are discussed in terms of a definition of optimum conditions for the handling of puparia

in a mass-rearing programme to produce adults with maximum nutritional reserves for field release after sterilisation. (Review of Applied Entomology, A 61:3699)

* LARA, F. M., BORTOLI, S. A. DE. y OLIVEIRA, E. A. Atratividade de cores a alguns insetos associados ao *Citrus* sp. Anais da Sociedade Entomológica do Brasil 5(2):157-163. 1976. (248

The influence of colours on collecting of *Astylus variegatus*, *Ceratitis capitata*, *Chrysopa sp.*, *Cycloneda sanguinea*, *Diabrotica speciosa*, and *Toxoptera citricidus* were investigated by means of water traps. The following colours were tested: black, blue, green, red, yellow and white. In general, the data showed that yellow and white colours were the most attractive for all species.

* _____, BORTOLI, S. A. DE. y OLIVEIRA, E. A. Flutuaçoes populacionais de alguns insetos associados ao *Citrus* sp. e suas correlaçoes com fatores meteorológicos. Científica (Brasil) 5(2):134-143. 1977. (249

The population fluctuation of some insects in a *Citrus* orchard in Jaboticabal, SP, Brazil, were investigated by means of water-traps. The major peak population were observed at: February - for *Diabrotica speciosa*; May - for *Astylus variegatus*; August - for *Cycloneda sanguinea*, *Toxoptera citricidus*, and *Chrysopa* sp.; September - for *Ceratitis capitata*. At the meteorological factors the temperature and relative humidity presented some influence on the population of the different insect species studied.

LE CHANCE, L. E. Problems and programs in the application of the sterility principle for the control of *Ceratitis capitata* Wied. Bulletin EPPO, no. 6:55-62. 1972. (250

In spite of good results obtained in the control of *Ceratitis capitata* (Wied.) under field conditions on the Italian islands of Capri and Procida in Nicaragua and in the Murcia area of Spain, several problems connected with the sterile male technique still have to be solved. Mass rearing of the insects must be improved. Perhaps, total sterility of the males is not required and the necessary dose of radiation must be studied in relation to its effect on their competitiveness in the field. In checking the efficacy of field operations, the recapture of marked individuals will have to be supplemented or gradually replaced by the time-consuming assessment of egg-hatching and fruit-damage. Studies of the influence of environmental factors on population densities must be intensified. (Review of Applied Entomology, A 61:3066)

* LEMAITRE, C. Modifications provoquées par des irradiations X sur l'évolution pondérale et la teneur en eau de *Ceratitis capitata* au cours de la vie intrapupariale. Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, D 276(16):2419-2422. 1973. (251

L'étude des modifications provoquées par les rayons X au niveau de la thermogenèse relative de *Ceratitis capitata*, pour les stades se déroulant à l'intérieur du puparium, nous a conduit à examiner les conséquences de ce traitement au niveau pondéral. En effet, l'évolution du poids relatif au cours de cette période subit des perturbations plus ou moins profones, selon la dose administrée et le moment de l'irradiation; nous avons amorcé l'analyse de ces modifications par l'étude de la teneur en eau.

LICONA MANDUJANO, J. E. Campaña de la mosca del Mediterráneo en la región centro occidental de Honduras. Tesis Ing. Agr. Tegucigalpa, Universidad Nacional Autónoma de Honduras, Carrera de Ciencias Agrícolas, 1976. 39 p. (252

LIEBE, E. On the rearing of *Ceratitis capitata* (Diptera: Trypetidae) on semi-synthetic diets. Nachrichtenblatt des Deutschen Pflanzenschutzdienstes 24(3):42. 1972. (253

*Ceratitis capitata* (Wied.) has been reared in the laboratory in Germany for about 130 generations in ten years on semi-synthetic diets containing dried yeast, bezoic acid and hydrochloric acid with the addition of powdered carrot, powdered celery or powdered fodder beet. Strains reared on the three media have been strictly isolated from one another, but no nutritional biotypes developed. Crosses made in 1971 between the three stocks in all possible combinations all proved fertile, indicating the continued absence of any behavioural or genetic barriers between strains. (Review of Applied Entomology, A 63:3418)

* LIMON DE LA OLIVA, F. et al. Ciclos biológicos de algunas plagas y enfermedades del naranjo. Boletín Informativo de Plagas, no. 98:19-40. 1972. (254

The information in this paper on the seasonal development of arthropod pests in *Citrus* groves in Castellón de la Plana, Spain, was collected to enable advice to be given to growers on treatment dates. The species dealt with include *Cacoecimorpha* (*Cacoecia*) *pronubana* (Hb.), *Saissetia* (Coccus) *oleae* (Ol.), *Planococcus* (*Pseudococcus*) *citri* (Risso), *Ceratitis capitata* (Wied.), *Ectomyelois* (*Myelois*) *ceratoniae* (Zell.), spider mites and aphids. (Review of Applied Entomology, A 62:4311)

* _____ et al. Experiencia del tratamiento de la mosca de la fruta con Gardona, por medio de avioneta - Año 1971. Boletín Informativo de Plagas, no. 106:83-95. 1973. (255

In the Spanish Province of Castellón de la Plana, bait-sprays containing tetrachlorvinphos (Gardona) and protein bait (Buminal) were applied in 1971 from aircraft to some

750 h in the Castellón district, 860 h in the Oropesa-Cabanes district and 950 ha in the district of Torreblanca and Alcalá for the control of the fruit fly /*Ceratitis capitata* (Wied.)/. The sprays were applied mainly to *Citrus* groves and vineyards and most treatments were first applied towards early October. Some areas were sprayed a second time in late October or early November. Infestation proved to be only light near Castellón and the results obtained were discounted. Counts of the flies taken in traps in the other treated areas indicated that the first application reduced populations by 33.3-65.6% and the second by 72-80%. In another part of the Province treated similarly with fenthion (Lebaycid), reductions of 31.3-66.6 and 93.6-96.8% were obtained after the first and second applications, respectively. (Review of Applied Entomology, A 63:1064)

* LIMON DE LA OLIVA, F. et al. Experiencia del tratamiento de la mosca de la fruta con Gardona, por medio de avioneta - Año 1972. Boletín Informativo de Plagas, no. 106:67-81. 1973. (256

Further tests were carried out in 1972 in the Spanish Province of Castellón de la Plana on the effectiveness of bait-sprays containing tetrachlorvinphos (Gardona) applied from aircraft against the fruit-fly /*Ceratitis capitata* (Wied.)/. The true effect of the treatments were somewhat obscured by rain during the treatment period, but tetrachlorvinphos appeared as effective as fenthion (Lebaycid), both compounds affording up to 84% reduction in population. (Review of Applied Entomology, A 63:1065)

LINDQUIST, D. A. y BUYCKX, E. J. Report to the government of Cyprus on Mediterranean fruit fly control. Rome, Italy. United Nations Development Programme. Report no. TA 3207. 1973. 15 p. (257

Emphasis should be given to ecological investigations, to the sterile male technique for medfly control, and to biological and cultural control in combination with the use of pesticides. The average losses in potential yield are about 5% for citrus, 100% for apricots, 10% for peaches, 10% for figs. The problems caused by pests in citrus, one of the major export crops, should be considered as a whole, and their study should be based on an integrated control approach. (Abstracts on Tropical Agriculture 1:750193)

_____ y BUYCKX, E. J. Report to the government of Malta, on the control of insect pests of fruit trees by the sterile male technique. Roma, FAO, 1974. 17 p. (FAO-AGP-TA-3293). (258

Particular attention has been paid to the control of the Mediterranean fruit fly (*Ceratitis capitata*). It is recommended to change the present cover spray method of control to the more efficient bait spray method and to postpone a decision on the use of the steril male technique of control or eradication until more data are available on the ecology and population of the fly and on the economics of its damage. (Abstracts on Tropical Agriculture 2:08101)

LIOTTA, G. y MINEO, G. Lotta biologica artificiale contro la mosca delle olive a mezzo dell'*Opius concolor siculus* Mon. in Sicilia nel 1968. Bollettino dell'Istituto di Entomologia Agraria e dell'Osservatorio di Fitopatologia di Palermo 7:183-196. 1967-70. (259

Further releases of *Opius concolor siculus* Monastero for the control of *Dacus oleae* (Gmel.) on olive in Sicily were carried out in 1968 at 120 points in three of the five localities treated in 1967 (The Capaci, Torretta and Carini districts of the Province of Palermo). Although production of the laboratory host, *Ceratitis capitata* (Wied.), by the rearing method used previously was surplus to requirements, only 17% parasitism of this host by *Opius* was obtained in July-August owing to infestation of the laboratory culture by the Phorid *Megaselia scalaris* (Lw.). Over 16 million *Opius* adults were released in the three localities between mid-July and the end of October at the rate of about 66/tree, and over 11 million produced at the same time were sent to Puglia, on the mainland of Italy. As in 1967, attack by *D. oleae* was observed to begin in June in some coastal olive groves, and in the two test groves left untreated the infestation rate reached 100% in mid-September and at the end of October, respectively; in groves where *Opius* had been released, infestation began late, and at harvest (end of October) 45-70% of the olives had been lightly attacked but were commercially sound. Hot dry winds in July and August, which killed many of the newly hatched larvae of *D. oleae*, kept infestation low until late in the season, although comparatively few parasites were available for release during that period owing to the rearing difficulties mentioned. In the release areas, probably owing to the late infestation, about 30% of the olives had fallen before harvest, as compared with 90-100% in the untreated areas. In two of the localities the rates of parasitism by *Opius* were 78 and 97%, respectively, in September but fell to 40 and 60% in October, while in the third the rate was 85% in October. An unexpectedly high rate of parasitism occurred in the untreated areas, owing partly to migration from the release areas and partly to the survival and spread of parasites released in previous years. However, even in localities in which *Opius* had been released for three consecutive years, it was unable to keep the *Dacus* population below the economic level without further releases, and the need for continued annual releases is thus confirmed. Ectoparasites of the genera *Eupelmus* and *Eurytoma* were generally rare. (Review of Applied Entomology, A 63:1801)

* LITTLE, H. F. y CUNNINGHAM, R. T. Missing indirect flight muscles in the Mediterranean fruit fly with droopy wing syndrome. Annals of the Entomological Society of America 71(4):517-518. 1978. (260

The droopy wing syndrome of tephritid fruit flies is presented, and the indirect flight muscles of the Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann), are described. The droopy wing syndrome of *Ceratitis* is shown to be accompanied by the lack of, or deficiency of, various of the indirect flight muscles.

LIZARBE, M. A. et al. Fatty acid synthetase content during development of the fly, *Ceratitis capitata*. Insect Biochemistry 7(5/6):415-418. 1977. (261

Immunochemical titrations of different enzyme preparations from larvae, pharate adults and emerged adults of *Ceratitis capitata* (Wied.) indicated that the changes in fatty acid synthetase activity during development of the insect are not related entirely to changes in the content of the enzyme. Changes in catalytic efficiency during larval and pharate adult development were clearly paralleled by the amounts of immunoprecipitate; however, the changes of enzyme activity with adult age were not correlated with the changes of enzyme content. Dietary manipulations of the larvae showed the adaptive nature of the fatty acid synthetase. Fasting produced a clear decrease of activity and level of the enzyme from the larvae, and refeeding restored values practically to normal. (Review of Applied Entomology, A 66:2493)

LOPEZ MATORRAS, O. A. Ensayo en mosca del Mediterráneo (*Ceratitis capitata*) del quimio-esterilizante Hempa. Tesis Ing. Agr. Argentina, Universidad de Buenos Aires, Facultad de Agronomía, 1977. 17 p. (262

LOUSKAS, C. y LAUDEHO, Y. Phénomènes d'arrêt de développement de la larve de 5ème stade d'*Eupelmus urozonus* chez un hôte expérimental: *Ceratitis capitata*. Entomologia Experimentalis et Applicata 22(3):243-250. 1977. (263

In Greece, *Eupelmus urozonus* Dalm., a parasite of *Dacus oleae* (Gmel.), hibernates in the fifth-larval instar in winter. A preliminary study of this was made in the laboratory. At 20°C and 8 h light, more than 99% of the parasites ceased development, but with 16 h light, the insects developed directly without any break in morphogenesis. Exposure to a range of intermediate photoperiods confirmed that photoperiod was the most important determinant of the type of development cycle. The development of sensitive larvae ceased immediately on exposure to short photoperiod, and they could then be kept in this state for several months. Reactivation occurred with long photoperiods. This arrest of development presents many characteristics of an oligopause. (Review of Applied Entomology, A 66:3883)

LOWER, H. F. Identification of species of fruit fly. Specific determination from fruit-fly larvae. Expl. Rec. Dep. Agric. S. Aust., no. 5:5-8. 1970. (264

The following is virtually the author's summary. Larvae of *Dacus tryoni* (Frogg.), *Ceratitis capitata* (Wied.) and other Australian fruit-flies can be identified positively and rapidly by microscopic examination of the skeletal structure of larval heads. The differences are described. The only limit to application of the method is imposed by the receipt of larvae of a species which the would-be identifier has not previously seen and whose determining characters are therefore unknown to him. (Review of Applied Entomology, A 58:3620)

MADARIAGA, M. A., MUNICIO, A. M. y RIBERA, A. Biochemistry of development of insect *Ceratitis capitata*; evolution of fatty acid composition of different lipid classes. Comparative Biochemistry and Physiology 36(2):271-278. 1970. (265

_____, MUNICIO, A. M. y RIBERA, A. Fasting and cold-exposure effects on fatty acid composition of *Ceratitis capitata* adults. Comparative Biochemistry and Physiology 35(1):63-68. 1970. (266

_____ et al. Changes in the fatty acid patterns of glycerolipids of *Dacus oleae* during metamorphosis and development. Insect Biochemistry 4(2): 151-160. 1973. (267

Fatty acid compositions of triglycerides, free fatty acids, total phospholipids, ethanolamine and choline phosphoglycerides were investigated during the metamorphosis and adult development of *Dacus oleae* (Gmel.). Remarkable differences were observed in the fatty acid patterns of triglycerides and phospholipids. Upon adult ageing, triglycerides showed a rise in the palmitoleic and palmitic acid contents that was counterbalanced by a decrease in oleic and linoleic levels. The most salient difference shown by the fatty acid composition of phospholipid classes was the high level of 18:3 in phosphatidylethanolamine in relation to phospatidylcholine. Palmitoleic acid exhibited a discrepancy in both phosphoglyceride distributions compared to previous findings with *Ceratitis capitata* (Wied.). Fatty acid positional distributions in phosphatidylethanolamine and phosphatidylcholine were investigated during pharate adult development and the emerged adult life of *D. oleae*. The most remarkable feature observed was the tendency to a random distribution of the unsaturated fatty acids, mainly in the choline phosphoglycerides, during adult development. (Review of Applied Entomology, A 62:4599)

* MANCIA, J. E. La mosca del mediterráneo (*Ceratitis capitata*). SIADES (El Salvador) 4(1):34-35. 1975. (268

El artículo informa sobre la presencia de la mosca del mediterráneo (*Ceratitis capitata*) en El Salvador. Da su descripción y su ciclo biológico. Señala algunos de los hospederos preferidos. (CV)

* MARIN ACOSTA, J. C. Lista preliminar de plagas de *Annonaceae*, níspero (*Achras zapota* L.) y guayaba (*Psidium guajava* L.) en Venezuela. Agronomía Tropical (Venezuela) 23(2):205-216. 1973. (269

Se presenta una lista preliminar sobre plagas que atacan Annonaceae cultivadas, *Achras zapota* y *Psidium guajava* en Venezuela. Las familias citadas en relación a Annonaceae corresponden a Aphididae, Coccidae, Diaspididae, Pseudococcidae, Membracidae, Aethalionidae, Tingitidae, Pentatomidae, Eucleidae, Lycaenidae, Megalopygidae, Grapholitidae, Saturniiidae, Sphingidae, Stenomidae, Alticidae, Curculionidae y Eurytomidae, comprendiendo un total de 27 especies, destacándose

como importantes los siguientes: *Cerconota anonella*, *Bephrata cubensis* y *B. maculicollis*. Las familias citadas en relación a *Achras zapota* corresponden a Termitidae, Aphididae, Coccidae, Diaspididae, Bostrichidae, Cerambycidae,, Chrysomelidae Phycitidae, Sphingidae, Thyrididae, Trypetidae y Formicidae, comprendiendo un total de 16 especies dañinas, destacándose como importantes *Anastrepha serpentina* y *Ceratitis capitata*. Las familias citadas en relación a *Psidium guajava* comprenden a Aphididae, Aleyrodidae, Coccidae, Diaspididae, Coreidae, Hesperiidae, Lacosomidae, Megalopygidae, Noctuidae, Psychidae, Anthribidae, Cerambycidae, Curculionidae, Eumolpidae, Trypetidae, comprendiendo un total de 33 especies dañinas, destacándose como importantes *Conotrachelus psidii*, *Anastrepha striata*, *A. fraterculus* y *Ceratitis capitata*.

* MARTINEZ PARDO, R., RIBO, J. y VERDU, M. J. Actividad de algunos miméticos de la hormona juvenil sobre *Ceratitis capitata* (Wied.). Revista de Agroquímica y Tecnología de Alimentos 14(4):595-601. 1974. (270

Se han estudiado los efectos de algunos miméticos de la hormona juvenil sobre la metamórfosis del insecto *Ceratitis capitata* (Wied.). Paralelamente, dichos productos se han ensayado sobre *Tenebrio molitor* L. y *Tribolium castaneum* (Herbst). Con el objeto de determinar el período más adecuado de ensayo sobre *Ceratitis capitata* (Wied.), se ha determinado la actividad juvenilizante en prepupas, pupas de cero a cuatro horas y pupas de cuatro a diez horas. Los resultados obtenidos indican que la mayor actividad corresponde al período de pupa de cuatro a diez horas. La actividad de algunos hormonomiméticos es considerable en dichos insectos. Destacan por su actividad en *Ceratitis capitata* la hormona juvenil de Roller y el compuesto de Romanuk. Por otra parte, existen grandes diferencias de actividad en algunos hormonomiméticos según el insecto estudiado, lo que sugiere la posibilidad de obtener productos con elevada actividad y especificidad para cada especie.

* _____, RIBO, J. y PRIMO-YUFERA, E. Activity of juvenile hormone mimics against the Mediterranean fruit fly. Journal of Economic Entomology 72(3):437-440. 1979. (271

Nine well known juvenoids were tested against all developmental stages of *Ceratitis capitata* (Wiedemann) to investigate the potential of hormonal methods for its control. Compounds containing aromatic structures were of significant ovicidal activity while open chain compounds were more active in morphogenetic tests. Both types of juvenoids showed similar gonadotropic activity.

* MARTINEZ SANCHEZ, J., GONZALEZ SANCHEZ-DIEDMA, J. M. Experiencia sobre eficacia en la lucha contra la mosca de la fruta (*Ceratitis capitata* Wied.) con atractivo sexual. Boletín Informativo de Plagas, no. 102:35-52. 1973. (272

El objetivo del experimento fue estudiar la duración del poder atrayente del Trimedlure y la posible utilización de cápsulas de Trimedlure sin vapona, en el control de la

*Ceratitis capitata*. La investigación se llevó a cabo en Murcia. Se emplearon 192 mosqueros (64 para cada tipo de cápsula - Trimedlure y Vapona procedente de la campaña de 1970-1971; Trimedlure y Vapona procedente de la campaña 1971-1972; Trimedlure sólo). De los resultados obtenidos se pudieron extraer las siguientes consecuencias: - las cápsulas conteniendo solamente Trimedlure resultaron las más eficaces; - a mayor antiguedad de la mezcla Trimedlure + Vapona, menor poder atractivo; - para un mismo tipo de cápsulas no parece que existan diferencias notables entre las medias de capturas del total de mosqueros considerados y la media de los mosqueros contados siempre; no se aprecia una influencia clara de la temperatura en el grado de ataque; - a igual de población total y demás variables, la insolación aumenta la movilidad de la mosca, y en consecuencia, el número de capturas guarda cierta proporcionalidad con el de las horas de sol; - la selectividad del poder atractivo del Trimedlure es muy acusada: el porcentaje de machos contados en las capturas ha sido del 98-99%. (CV)

MAYAS, I. A. Effects du fractionnement de la dose sterilisante de rayons gamma sur l'emergence, la fertilité et la competitivité de la mouche Mediterraneene des fruits, *Ceratitis capitata* Wied. In Symposium on the Sterility Principle for Insect Control, Innsbruck, 1974. Proceedings. Viena, International Atomic Energy Agency, 1975. pp. 229-236. (FAO-ACCESS, no. 29074) (273

MAYER, K. Die Mittelmeerfruchtfliege *Ceratitis capitata* Wied., ein gefährlicher Quarantäneschädling. Zeitschrift fur Angewandte Entomologie 65(3):357-363. 1970. (274

The author briefly reviews from the literature the world distribution and principal host fruits of *Ceratitis capitata* (Wied.) and discusses its ecological requirements for development, with particular reference to conditions in Germany. It is primarily a pest of warm countries, but, when imported into those with a temperate climate, the fly is able to produce 1-2 summer generations and to cause much damage to fruit. Quarantine regulations against *Ceratitis capitata* are therefore of importance. (Review of Applied Entomology, A 61: 647)

* MEDFLY ON the move. Citrograph 63(5):99-100, 114. 1978. (275

* MEDITERRANEAN FRUIT fly. FAO Plant Protection 23(6):198. 1975. (276

A limited infestation of *Ceratitis capitata* (Wied.) was discovered in a residential area of Venice, Los Angeles County, California, during September 1975. This is the first record of the fly west of the Rocky Mountains in the continental United States. It was hoped that a programme of intensive trapping and insecticide application would lead to eradication of the pest from the area and the revocation of Federal and State emergency quarantine regulations (brought in to regulate the movement of food-plant material) early in 1976. (Review of Applied Entomology, A 65:1867)

MEDITERRANEAN FRUIT fly, *Ceratitis capitata* (Wiedemann). Selected references 1929-1949. Cooperative Economic Insect Report 23(15):215-220. 1973. (277

MEDITERRANEAN FRUIT fly, *Ceratitis capitata* (Wiedemann). Selected references 1950-1955. Cooperative Economic Insect Report 22(46/48):769-774. 1972. (278

MEDITERRANEAN FRUIT fly, *Ceratitis capitata* (Wiedemann). Selected references 1956-1959. Cooperative Economic Insect Report 23(8):100-106. 1973. (279

MEDITERRANEAN FRUIT fly, *Ceratitis capitata* (Wiedemann). Selected references 1960-1966. Cooperative Economic Insect Report 22(43):729-734. 1972. (280

MEDITERRANEAN FRUIT fly, *Ceratitis capitata* (Wiedemann). Selected references 1967-1969. Cooperative Economic Insect Report 22(41):702-706. 1972. (281

MEDITERRANEAN FRUIT fly, *Ceratitis capitata* (Wiedemann). Selected references 1970-1971. Cooperative Economic Insect Report 22(44):743-746. 1972. (282

MEDITERRANEAN FRUIT fly control. Boletín - Organismo Internacional de Energía Atómica 16(5):53-55. 1974. (283

MEGIAS, A. et al. Biochemistry of development in insects. Triacylglycerol and phosphoglyceride biosynthesis by subcellular fractions. European Journal of Biochemistry 72(1):9-16. 1977. (284

MELIA, A. Causas que inciden en el destrío de los cítricos. Boletín del Servicio de Defensa contra Plagas e Inspección Fitopatológica 2(2):145-159. 1976. (285

The factors contributing to the wastage of citrus fruits in the Spanish Province of Castellón were studies in the 1975-76 season. Data on the numbers of unusable fruits arriving at four factories processing citrus for export were obtained and samples of the fruit were taken for examination. The total citrus harvest in the province was calculated to be 452,600 t and the weight of fruit classified as of no commercial value was calculated to be almost 100,000 kg. Six varieties of oranges and mandarins were considered and the results for each variety are shown in detail. Wastage was highest for Navel oranges (23.3%) and lowest for blood oranges (Sanguina) (9.4%). When all varieties were considered together, the highest percentage of wastage attributed to a single factor (22.43) was that resulting from attack by arthropods. The injurious species are listed as *Ceratitis capitata* (Wied.), *Ectomyelois ceratoniae* (Zell.), *Cryptoblabes gnidiella* (Mill.), *Heliothrips haemorrhoidalis* (Bch.), *Tetranychus urticae* Koch (*telarius* auct.), *Cacoecimorpha pronubana* (Hb.), *Lepidosaphes beckii* (Newm.), *Insulaspis gloverii* (Pack.) (*L. gloverii*), *Parlatoria*

*pergandii* Comst., *Chrysomphalus dictyospermi* (Morg.) and *Planococcus citri* (Risso). Other factors included adverse climatic conditions (20.52%), physiological disorders (11.77%) and poor handling either at picking or in storage. (Review of Applied Entomology, A 66:6106)

* MELLADO, L. Ensayos de lucha autocida contra *Ceratitis capitata* Wied. Programas realizados en 1969. Anales del Instituto Nacional de Investigaciones Agrarias. Protección Vegetal, no. 2:185-213. 1972. (286

En 1969 se continuó desarrollando el programa de lucha biológica contra *Ceratitis capitata* Wied., utilizando el método de 'machos estériles'. En el laboratorio se perfeccionaron las técnicas de cría artificial masiva, alcanzándose una producción total de más de 120 millones de pupas. Se realizaron también ensayos comparativos de dietas alimenticias. Se efectuaron ensayos de campo en una plantación regular de cítricos, albaricoque y melocotón, en la provincia de Murcia. El objetivo básico de estos ensayos consistía en tratar de eliminar la mosca en la zona experimental, empleando la suelta de insectos estériles como único método de control de plagas. Se utilizaron pupas de *Ceratitis* procedentes de los laboratorios de Madrid y Seibersdorf, esterilizadas todas ellas en la fuente de radiación gamma de Cs-137 del I.N.I.A., en 'El Encín' (Madrid), con una dosis de 9 krad. Desde marzo hasta agosto se soltaron insectos, en estado adulto, procedentes de un total de 32 millones de pupas. A pesar de no estar la zona experimental totalmente aislada, se logró mantener el ataque de *Ceratitis* a niveles inferiores al 1% (excepto en la última semana de julio, cuando ya quedaba muy poca fruta por recoger). Durante el mismo período, las zonas testigo adyacentes registraron ataques superiores al 60% en todas ellas. Simultáneamente, se hicieron ensayos de campo de carácter preliminar sobre dispersión y longevidad de insectos estériles, utilizando pupas marcadas. Los resultados muestran que una y otra son satisfactorias para la aplicación del método.

_____, ARROYO, M. y ROS, P. Control of *Ceratitis capitata* Wied. by the sterile-male technique in Spain. In Panel on the Practical Use of the Sterile-Male Technique for Insect Control, Vienna, 1972. Proceedings. Vienna, International Atomic Energy Agency, 1974. pp. 63-73. (IAEA-STI/PUB/364). (287

* MENDEZ VILLA, M. y GARCIA ARELLANO, P. Diagnóstico del material entomológico capturado en trampas y recolectado por el personal de los programas cooperativos México-Estados Unidos de América. Fitófilo 23(65):35-39. 1970. (288

Este trabajo contiene el resultado del estudio taxonómico del material entomológico que se captura o recolecta en los Programas Cooperativos que desarrollan la Dirección General de Sanidad Vegetal de la Secretaría de Agricultura y Ganadería y la División de Control de Plagas de las Plantas del Departamento de Agricultura de los Estados Unidos de Norteamérica. (Review of Applied Entomology, A 63:3979)

MERCK-LUENGO, J. G. A note on inhibition of enzyme cholinesterase from heads of fruit-fly (*Ceratitis capitata*) with trichlorfon. In Tahori, A. S., ed. Pesticide Chemistry. Proceedings of the Second International IUPAC Congress of Pesticide Chemistry. Volume IV. Methods in Residue Analysis. New York, Gordon and Breach, Science Publishers, 1971. pp. 233-236. (289

* METODOS RECOMENDADOS para la detección y medición de la resistencia de las plagas a los plaguicidas. Método para moscas de las frutas de la familia Tephrididae, método no. 20 de la FAO. Boletín Fitosanitario 27(2): 40-43. 1979. (290

Se inmovilizan moscas de frutas de susceptibilidad conocida con frío o con anestésicos y se tratan localmente con gotas de 1 µl de insecticidas en solución de acetona. Los porcentajes de mortalidad, determinados después de 24 horas a 25°C, se representan gráficamente, en función de la dosis, en papel logarítmico de probabilidad (log-probit). A partir de una línea de regresión calculada con esos datos, es posible estimar los valores de $LD_{50}$ (concentración letal) y de otras concentraciones de mortalidad, a fin de seleccionar las muestras de poblaciones susceptibles para calcular el grado de resistencia. La supervivencia de las moscas a la dosis de diagnóstico (de referencia) es una señal de alarma, que exige nuevos ensayos más extensivos para confirmar la resistencia y definir su grado.

MINEO, G. y VIGGIANI, G. Su un esperimento di lotta integrata negli agrumeti in Sicilia. Bollettino del Laboratorio de Entomologia Agraria 'Filippo Silvestri' 33:219-231. 1976. (291

An account is given of an integrated control experiment carried out in 1975 in a citrus grove in the Sicilian Province of Agrigento, in which releases of the encyrtid parasite *Leptomastix dactylopii* How. against *Planococcus citri* (Risso) were combined with a bait-spray for the control of *Ceratitis capitata* (Wied.). Plots in which *L. dactylopii* (at rates of 74 or 112 adults/tree) were the only means of control of *P. citri* were compared with others in which releases of the parasite (at 29, 33, 44 or 71 adults/tree) had been combined with three applications of parathion at 20, 50 and 50 g/100 litres, respectively; both sets of plots were also treated with a bait-spray of Buminal at 1.5 kg and fenthion at 100 g/100 litres. The results obtained at harvest, in terms of percentage of fruits infested, number of insects per fruit and percentage of commercially damaged fruits, were not significantly different between the plots receiving integrated control and those receiving biological control alone against *P. citri*. However, similar data from plots on which the normal programme of chemical treatments against *P. citri* and *C. capitata* had been carried out indicated that both integrated and biological control were far more effective than chemical control alone. (Review of Applied Entomology, A 66:246)

* MINEO, G. y VIGGIANI, G. Sur un essai de lutte intégrée en vergers de citrus en Sicile. Fruits 32(10):624-629. 1977. (292

Se ha realizado en 1975, en un huerto de agrios de la provincia de Agrigente, en Sicilia, un ensayo de lucha integrada basada particularmente en la utilización de Encyrtide *Leptomastix dactylopii* How. contra *Planococcus citri* (Risso) y de los cebos envenenados contra *Ceratitis capitata* Wied. Para la lucha contra *P. citri*, se han comparado parcelas biológicas (en que el número de adultos de *L. dactylopii* lanzados por árbol ha sido respectivamente de 74 y de 112) con otras, en que la acción de los parásitos (a razón de 29-33-44 y 71 adultos/árbol) ha sido asociada a la de tres tratamientos químicos (parathion a dosis de 20-50 y 50 gramos m. a/Hl respectivamente). Contra la Ceratite, se aplica un tratamiento por medio de cebos envenenados (Buminal, 1,5 kg + fenthion: 100 gr m.a./Hl). La comparación de los resultados obtenidos de la cosecha (porcentaje de frutos infestados: 2,5 - 5,1%; grado de infestación: 1,5 - 1,1%); porcentaje de los frutos presentando dificultades comerciales: 0,5 - 0,5%) no muestran diferencias netas entre las parcelas biológicas e integradas, pero estas diferencias aparecen claramente cuando se compara los resultados precedentes con los observados en tres huertos de citrus convecinos de las parcelas experimentales (porcentaje de frutos infestados: 25,3 - 31,1 - 47,0%; grado de infestación, 3-3-5 cochinilla/fruto; porcentaje de frutos que presentan dificultates comerciales: 6,5 - 16,5 - 16,6%) en que la lucha fitosanitaria había sido realizada por los arboricultores.

MONTY, J. Rearing the Natal fruit-fly *Ceratitis (Pterandrus) rosa* Karsch (Diptera, Trypetidae) in the laboratory. Revue Agricole et Sucrière de l'Île Maurice 52(3):133-135. 1973. (293

*Ceratitis rosa* Karsch is now the most injurious pest of fruits on Mauritius. Since attempts to control the fruit-fly by means of parasites have been unsuccessful, investigations are being carried out on the possibility of control by the sterile-male technique, and an account is given of a method developed for the mass-rearing of the fly in the laboratory. Rearing is carried out at 25-27°C and 70-80% R.H. under natural illumination (the photoperiod never being less than 11 h in Mauritius). The adults are kept in cylindrical muslin cages (30 cm in diameter and 1 m high) similar to those used by D. Nadel for rearing *C. capitata* (Wied.); each cage holds 10,000 flies. The adults are provided with protein hydrolysate and honey solution, which are supplied on foam pads, and cubes of sugar. The adults pair at dusk about five days after emergence and the females begin to oviposit on the seventh day. Oviposition continues for about a month and the females lay an average of 520 eggs each. The oviposition device consists of two plastic funnels joined at the rims. The sides are punctured to permit the insertion of the ovipositor. A piece of sponge soaked in honey solution and wrapped in khaki cloth is placed inside the funnels to maintain high humidity and to provide a substrate. It is important that the cloth should fit closely against the sides

of the funnels for, unlike C. *capitata*, C. *rosa* does not drop its eggs into empty spaces. The eggs are removed from the cloth by washing and placed on the larval medium. They hatch in about 36 h at 25-27°C. The larval medium consists of powdered brewers' spent grain (BSG), which is a by-product of the brewing industry, maize flour, yeast, malt, sugar, hydrochloric acid, methyl *p*-hydroxybenzoate (a preservative) and water. It is spread in a layer about 1 cm thick in shallow trays and seeded with the eggs at a rate of about 30,000/kg medium. The larvae complete their development in about 10 days. The contents of the trays are washed with water through a sieve (with holes 2 mm in diameter), which retains only the full-fed larvae. These are then placed on sand, which they enter to pupate. The pupae are later removed by sieving and placed in the muslin cages for adult emergence. The complete life-cycle from egg to adult lasts 23 days. Some 100,000 pupae are produced each week; four men are engaged in the work. (Review of Applied Entomology, A 63:1592)

MOORE, I. The role of the sterile male technique in integrated control. Bulletin, Organisation Européenne et Méditerranéenne pour la Protection des Plantes 3(3):77-83. 1973. (294

The author reviews instances in which the release of sterile insects has been integrated with other measures for the control of pest species. The species concerned are *Dacus dorsalis* Hend. on islands to the south of Japan, *Ceratitis capitata* (Wied.) on the Italian island of Procida, *Cydia* (*Laspeyresia*) *pomonella* (L.) in the Wenas Valley of Washington (United States) and *Anthonomus grandis* Boh. in the southern part of Mississippi (United States). (Review of Applied Entomology, A 62:4926)

* MORENO VAZQUEZ, R. et al. Ensayos contra *Ceratitis capitata* Wied. Boletín Informativo de Plagas, no. 100:13-15. 1972. (295

En la lucha contra la 'mosca de las frutas' últimamente se han venido utilizando en plan experimental mosqueros de plástico, en cuyo interior se colocan cargas que contienen una mezcla de atrayente sexual, Trimedlure y Vapona. Los resultados obtenidos fueron totalmente satisfactorios y en algunas ocaciones se alcanzaron éxitos espectaculares. En el año 1970 se efectuó una experiencia en la provincia de Málaga con este tipo de mosqueros.

* LA MOSCA del mediterráneo, *Ceratitis capitata* (Wiedemann). Panagfa (México) 4(26):9-13. 1976. (296

También en: Tierra (México) 31(5):196-198, 233. 1976.

El artículo hace referencia a la introducción de la mosca del mediterráneo en el Continente Americano y los esfuerzos realizados en Florida, E.U.A. para su erradicación. Da una lista de hospederos y los principales productos que serían atacados de llegar la *Ceratitis capitata* a México. Hace un

estimado por pérdidas anuales de cosecha en un 50%. Se indica la forma que se produce el daño a los frutos; cómo se propaga la mosca y las medidas que serían necesario tomar para evitar su introducción en el país. (CV)

LA MOUCHE des fruits ou ceratite. Ficheries Technical Division Vulgarisation Agr. 41:1-14. 1970. (297

The fruit fly (*Ceratitis capitata*) is a serious insect pest in Tunisia, infesting various fruit species especially citrus. Its life-cycle is outlined along with the different fruits it attacks. Various control measures including a trap designed to catch the flies for studying their distribution density, which is necessary in planning an effective control programme, are discussed. Chemical control is based on the use of dimethoate (90 ml/100 l water), trichlorphon (150 g/100 l water), or malathion (200 g/100 l water) at a rate of 1,000 l/ha. (Tropical Abstracts 27:v2820)

* MUERTE CON "M" de Mediterráneo. Amigo del Agricultor (México) 9(34):4-5. 1977. (298

El trabajo informa sobre la introducción de la mosca del mediterráneo en México en Arriaga, Chiapas y las medidas dictadas para evitar su propagación, instalándose 12.600 trampas de las cuales 6.000 están colocadas en la frontera con Guatemala. Para 1977, se ha programado colocar 40 mil trampas en todo el territorio llegando a tenerse en la frontera con Guatemala 12.000. Se hace una pequeña reseña sobre la localización de la plaga en el Continente Americano y la forma en que la mosca daña a la fruta. Se establece la importancia de mantener una red de trampeo y los diferentes tipos de trampas y cebos utilizados en Centroamérica (portici, steiner, cartulina y celotex). (CV)

MUNICIO, A. M. et al. *In vitro* elongation and desaturation of fatty acids during development of insects. Biochimica et Biophysica Acta 280(2):248-257. 1972. (299

_____, ODRIOZOLA, J. M. y RAMOS, J. A. *In vitro* regulation by NADPH of fatty acid biosynthesis with larval and pharate adult homogenates of the fly, *Ceratitis capitata*. Insect Biochemistry 2(7):353-360. 1972. (300

_____, ODRIOZOLA, J. M. y RAMOS, J. A. Effect of diet on lipogenesis of larvae of *Ceratitis capitata*. Insect Biochemistry 3(12):359-366. 1973. (301

Dietary experiments were carried out with larvae of *Ceratitis capitata* (Wied.) to study the adaptability of fatty acid synthetase. The fatty acid synthesis from labelled acetate was investigated in several nutritional states as free fatty acid triglycerides and phospholipids. A short

period of fasting abruptly abolished the *in vitro* fatty acid synthesis by larval homogenates. Feeding again for 4 h was sufficient to stimulate enzyme activity, and the highest values of lipogenic activity in the refed larvae were those obtained with the balanced diet. The variation of the lipogenic activity as a result of fasting and refeeding did not modify the fatty acid composition of the insect. (Review of Applied Entomology, A 62:2536)

MUNICIO, A. M. et al. *In vitro* and *in vivo*($^{14}$C) acetate incorporation during development of insects. Insect Biochemistry 3(9):19-29. 1973. (302

A comparative study of the *in vitro* and *in vivo* incorporation of acetate labelled with $^{14}$C into different classes of lipids by *Ceratitis capitata* (Wied.) was carried out. The pattern of labelled lipids obtained in the *in vitro* experiments depended on both the time of incubation and the stage of development of the insect. Larval homogenates and pharate adult homogenates incorporated acetate rapidly during the first 60 min., mainly into phospholipids. In the *in vivo* experiments, triglycerides accounted for the highest percentages of incorporation in both stages of development, whereas free fatty acids and phospholipids exhibited lower levels of incorporation. Radioactivity of individual fatty acids present in the lipid classes was determined by gas-liquid radiochromatography. The specific activity of fatty acids present as free fatty acids in triglycerides increases during the larval-pharate adult transition, whereas that of those present in phospholipids decreased. The relative abundance of monoenoic fatty acids synthesised *de novo* generally decreased from larva to pharate adult. Triglycerides from both larvae and pharate adults showed the highest levels of unsaturation. (Review of Applied Entomology, A 62:27)

_____, ODRIOZOLA, J. M. y PEREZ-ALBARSANZ, M. A. Biochemistry of development in insects. Incorporation of fatty acids into different lipid classes. European Journal of Biochemistry 60(1):123-128. 1975. (303

In order to study the different metabolic behaviour of the various development stages of *Ceratitis capitata* (Wied.), the incorporation of labelled decanoic, lauric, myristic, palmitic, stearic, oleic and linoleic acids into triacylglycerols by insect homogenates was investigated. The time-course of labelled fatty-acid incorporation was first studied with oleic acid, and this experiment showed that after 10 min. of incubation the levels of radioactivity incorporated into triacylglycerols and those remaining in the free fatty acids were almost unchanged. All labelled fatty acids were efficiently incorporated by larval homogenates; with pharate-adult homogenates, most of the radioactivity remained as free fatty acids, palmitic and stearic acids showing the least degree of incorporation. On graphs, triacylglycerol and free fatty-acid radioactivity plotted against the development stage of the homogenate defined a crossing-zone coinciding with larval-pupal apolysis. This metabolic difference between larval and pharate-adult

homogenates could not be explained by differences in teh acyl-CoA synthetase activity of the insect, since this enzyme activity was notably higher in pharate-adult than in larval homogenates regardless of the nature of the fatty acid. Triolein labelled with $^{14}C$ was hardly hydrolysed at all either by larval or by pharate-adult homogenates. Double-label experiments were carried out by incorporating either oleic acid labelled with $^{3}H$ or a mixture of palmitic acid labelled with $^{3}H$ and glycerol 3-phosphate labelled with $^{14}C$ by larval and pharate-adult homogenates at different incubation intervals. Diacylglycerols, triacylglycerols and phosphoglycerides were isolated and the molar ratio of $^{14}C$ to $^{3}H$ calculated. Results suggest the existence of differing acyltransferase activities in the different development stages of the insect. (Review of Applied Entomology, A 65:554)

MUNICIO, A. M., GARCIA, R. y PEREZ-ALBARSANZ, M. A. Biochemistry of development in insects. Stereospecific incorporation of fatty acids into triacylglycerols. European Journal of Biochemistry 60(1):117-121. 1975. (304

Previous experiments have shown that fatty acids are incorporated into triacylglycerols by homogenates of larvae of *Ceratitis capitata* (Wied.) far more efficiently than by homogenates of pharate adults, and this metabolic behaviour in both development stages has been interpreted as a result of differing acyltransferase activity. To obtain new data on the acyltransferase mechanism, a time-course of the stereospecific incorporation of labelled myristic, palmitic, oleic and linoleic acids into the *sn*-positions of triacylglycerols has been followed. Studies on the stereospecific incorporation of labelled fatty acids confirmed previous results. Palmitic acid was mainly incorporated into *sn*-1 and *sn*-3 positions and only slightly into *sn*-2. Myristic acid acylated *sn*-3 position at a higher rate than it acylated the other *sn*-positions. Oleic acid was more specifically distributed than palmitic acid, and linoleic acid was more efficiently incorporated than the monounsaturated acid. All these data reflect substrate differences in the acyltransferase activity of larval homogenates. Pharate-adult homogenates incorporated fatty acids very little and mainly into positions 1 and 3. The kinetics of incorporation of labelled fatty acids into the *sn*-positions point to a non-random distribution with regard to the major saturated and unsaturated fatty acids in triacylglycerols of the larvae of *C. capitata*. (Review of Applied Entomology, A 65:553)

_____. Fatty acid synthetase complex from the insect *Ceratitis capitata*. Biochimica et Biophysica Acta 487(1):175-188. 1977. (305

_____. Lipid metabolism during development in insects. Advances in Experimental Medicine and Biology 83:241-248. 1977. (306

MUÑIZ, M. Technique for oviposition in *Ceratitis capitata* (Wied., 1824). Graellsia 31:277-292. 1975. (307

MUÑIZ, M. Eclosión de huevos de *Ceratitis capitata* Wied. en función del pH de soluciones de electrolitos. Boletín del Servicio de Defensa contra Plagas e Inspección Fitopatológica 2(1):55-71. 1976. (308

* _____. Influencia de la actividad química de electrolitos en la eclosión de huevos de *Ceratitis capitata* Wied. (Diptera: Trypetidae). Anales del Instituto Nacional de Investigaciones Agrarias. Protección Vegetal, no. 6: 67-87. 1976. (309

Se han realizado experimentos para ver la influencia de factores físico-químicos sobre el avivamiento de los huevos de *Ceratitis capitata* Wied. La actividad media molal de los electrolitos utilizados es, de todas las unidades de dosis ensayadas, la que mejor explica la relación existente entre mortalidad, expresada en probits y dosificación. La ley que define tal relación, para soluciones 4 m es la siguiente:

$$p = 4,5808\ a_m 0,0463$$

con un coeficiente de correlación de 0,808, significativo al 99%.

_____. Técnica para la evaluación de puesta en *Ceratitis capitata* (Wied., 1824) (Dipt. Trypetidae). Graellsia 31:277-292. 1977. (310

Tests were carried out in Spain to develop a laboratory technique that would result in a large number of eggs being laid by a very small number of pairs of adults of *Ceratitis capitata* (Wied.). The best results were obtained when the main holding unit for the adults (3 pairs confined together) was a jar (8.7 cm in diameter and 4.6 cm high) covered with a plastic top. In addition to numerous small perforations in this top (to avoid excessive humidity building up), 2 larger holes were made, one for the insertion of a cotton wick to provide drinking water (fed from a separate container outside the main jar; a small container with 75% sugar and 25% hydrolysed yeast was suspended beneath the wick to provide food for the adults. A small dome covered with soft yellow cloth was fixed beneath the second hole to provide an oviposition site, and the hole was covered with a petri dish cover containing a filter paper moistened with water, orange or peach juice. With this technique, females laid averages of up to 82 eggs each/day, and up to 91% of the eggs hatched. Adult mortality was reduced to a minimum and the oviposition period was therefore extended. Isolated females survived for up to 42 days, ovipositing for more than 34 days. Isolated males lived for up to 60 days. In all the tests, adult males lived longer than the females. Both males and females were observed to pair more than once. (Review of Applied Entomology, A 66:3426)

MURTAS, I. D. DE, CIRIO, U. y ENKERLIN, D. Dispersal of *Ceratitis capitata* Wied. on Procida Island. I. Distribution of sterilized Mediterranean fruit-fly on Procida and its relation to irradiation doses and feeding. Bulletin EPPO, no. 6:63-68. 1972. (311

A preliminary experiment on the island of Procida, Italy, to relate the flight capability of *Ceratitis capitata* (Wied.) to irradiation doses and to feeding showed that 9 Krad $\gamma$-radiation is suitable dose for control programmes and that feeding the newly emerged flies seems to reduce their distribution over greater distances. (Review of Applied Entomology, A 61:3546)

_____, CIRIO, U. y ENKERLIN, D. Dispersal of *Ceratitis capitata* Wied. on Procida Island. II. Movement studies. Bulletin EPPO, no. 6:69-76. 1972. (312

The experiments described were undertaken to collect information on the behaviour of adults of *Ceratitis capitata* (Wied.), bred and irradiated with $\gamma$-radiation in the laboratory, when liberated in an ecologically heterogeneous area such as Procida Island. Irradiated pupae were sent periodically by the IAEA laboratory at Seibersdorf near Vienna. The adults, made recognizable through a dye applied to the pupae, were released when 2-3 days old at a southern tip of Procida (Sochiaro) characterised by low precipitation and intensive isolation. Flies were released or various dates in 1968 and 1969, and recapturing was done by means of Nadel traps on Procida and sticky traps as well on the Island of Ischia and on the Italian mainland. On several occasions irradiated flies were found to have covered considerable distances (4.3 and 5 km in Ischia and 2.9 km in the Pioppeto area of Procida), but they never reached the mainland. Nevertheless, these long-distance migrations were too infrequent to be of practical value in control campaigns. Apparently the flies rapidly left the arid Solchiaro district, but their spread became very limited as soon as they reached zones where suitable host-fruits were numerous. The general picture of the flights indicated certain preferential directions. It is concluded that, for practical control purposes, sterile flies should be released also in places where host-fruits are absent or rare, since they would rapidly move to more favourable places of their own choice. On the other hand, movement in regions with a dense network of host-fruits was found to be slow. In such regions, the release points should therefore not be more than 100 m apart. (Review of Applied Entomology, A 61:3547)

_____ y CIRIO, U. La sterilisation de la mouche Mediterranenne des fruits *Ceratitis capitata* Wied.; methode industrielle etudiee par le CNEN dans le cadre de la lutte autocide. In Symposium on the Sterility Principle for Insect Control, Innsbruck, 1974. Proceedings. Vienna, International Atomic Energy Agency, 1975. pp. 49-55. (313

MYBURGH, A. C., WHITEHEAD, V. B. y DAIBER, C. C. Pests of deciduous fruit, grapes and miscellaneous other horticultural crops in South Africa. Republic of South Africa. Department of Agricultural Technical Services. Entomology Memoir, no. 27. 1973. 38 p. (314

In South Africa, *Cydia* (*Carpocapsa*) *pomonella* (L.). *Ceratitis capitata* (Wied.), *C.* (*Pterandrus*) *rosa* Karsh, *Planococcus citri* (Risso), *Tetranychus cinnabarinus* (Boisd.) and the fruit-piercing moth *Serrodes partitus* (F.) are the most important pests of deciduous fruits and grapes. Heavy reliance is placed on chemical control measures, except in the case of *Serrodes*, which can be controlled by a certain extent by repellant light. Biological control measures are applied against *Planococcus* in some areas. Reviews of past and present research on all deciduous fruits in South Africa are presented, their present status in relation to production and international phytosanitation is discussed and the economic necessity for synchronised control of all pests is stressed. In general discussion, the possibilities of reducing the reliance on chemical control by integrated control and various non-chemical methods are outlined. (Review of Applied Entomology, A 62:541)

_____. Pests of peaches, apricots and plums in South Africa. Fruit World Annual 74(12):6-8. 1973. (315

_____. A new monitoring system for fruit fly. Deciduous Fruit Grower 26(11):441-447. 1976. (316

In the system described, rubber pills impregnated with fruit fly attractants are placed in orchard traps as used for codling moth.In large-scale trials baited traps were placed in apple, pear and peach orchards in February, and fruit fly infestation was monitored until May. The Mediterranean fruit fly (*Ceratitis capitata*) was the predominant species trapped. but Natal fly (*C. rosa*) and bramble fly (*C. rubivora*) were also trapped. Data are also presented on the percentage infestation in sprayed and unsprayed apple orchards and in several apple cvs during the month before harvest. In unsprayed orchards up to 8% infestation occurred. Dunn's Seedling apple cv. appeared resistant, but other cvs, including Golden Delicious and Granny Smith, were susceptible. (Horticultural Abstracts 47:6274)

* NAKAGAWA, S., CUNNINGHAM, R. T. y FARIAS, G. J. Differentiation of parasitized and unparasitized pupae of the melon fly and oriental and Mediterranean fruit flies. Journal of Economic Entomology 62(4):970-971. 1969. (317

Since 1913 more than 35 species of fruit fly parasites have been introduced into Hawaii to combat the oriental fruit fly, *Dacus dorsalis* Hendel; the melon fly, *D. cucurbitae* Coquillett; and the Mediterranean fruit fly, *Ceratitis capitata* (Wiedmann). About 27 species are believed to be established. At present only a few of these can be considered as both established and effective. The dominant

species are *Opius oophilus* Fullaway on oriental fruit fly, *O. fletcheri* Coquillett on melon fly, and *O. tryoni* Cameron on Mediterranean fruit fly. We receive numerous requests for shipment of parasites to areas of the world inhabited by fruit flies. Segregation of parasite species during the pupal stage of the flies rather than as adults simplifies manipulation and reduces mortality of both parasite and host.

NAKAGAWA, S., FARIAS, G. J. y STEINER, L. R. Response of female Mediterranean fruit flies to male lures in the relative absence of males. Journal of Economic Entomology 63(1):227-229. 1970. (318

The following is virtually the authors' abstract. When sexually mature males of *Ceratitis capitata* (Wied.) were absent or scarce during field tests in Hawaii in 1965-67, sexually mature, virgin females and fertile females one month or more old responded to the male attractants trimedlure, medlure and angelica-seed oil in daylight at 21°C and above. However, as soon as sterile males in a mixed population introduced into field populations reached sexual maturity, the virgin females stopped responding to the attractants. It is though that this behaviour could be a useful criterion in delimiting new outbreaks, in measuring progress in some types of eradication programmes and in shortening the time needed for eradication by the method of male annihilation. (Review of Applied Entomology, A 58:1977)

_____, CUNNINGHAM, R. T. y URAGO, T. The repellent effect of high trimedlure concentrations in plastic traps to Mediterranean fruit fly in Hawaii. Journal of Economic Entomology 64(3):762-763. 1971. (319

Field tests in Hawaii in 1969-70 indicated that the baiting technique of exposing 9.7 ml trimedlure in a plastic trap to capture adult males of *Ceratitis capitata* (Wied.) is not desirable, as the initially high output of lure has a repellent effect. (Review of Applied Entomology, A 59: 3254)

* _____. Reproduction of the Mediterranean fruit fly; frequency of mating in the laboratory. Annals of the Entomological Society of America 64(4): 949-950. 1971. (320

Tests of mating behavior in the laboratory showed that *Ceratitis capitata* (Wiedemann) males are polygamous; however, 40% of the females did not remate. Among remating females (96 of 173), 75% remated 1-2 times in 49 days. Female receptivity to remating apparently correlated with the volume of stored sperm in the spermathecae.

NAKAGAWA, S. et al. Traplure combinations for surveys of Mediterranean fruit flies in Hawaii. Journal of Economic Entomology 64(5):1211-1213. 1971. (321

A horizontally positioned cylindrical plastic trap (the Steiner trap) baited with trimedlure, a vertically positioned cylindrical plastic trap (the Nadel trap) baited with trimedlure, and an invaginated glass trap (the McPhail trap) baited with undiluted protein hydrolysate (PIB-7) and borax were evaluated for their effectiveness in capturing adults of *Ceratitis capitata* (Wied.) in comparative field tests in Hawaii in 1968-69. The Steiner trap was the most effective, but the McPhail trap occasionally performed as well or better, though it was erratic. Although the Nadel trap took fewer flies than the others, it was though worthy of further consideration as it is economical and easily serviced. (Review of Applied Entomology, A 60:1172)

* _____ et al. Mating behavior of the Mediterranean fruit fly following excision of the antennae. Journal of Economic Entomology 66(2):583-584. 1973. (322

The Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann), or medfly, has diurnal mating habits with the males emitting a distinctive odor that attracts females. Since olfaction is an important sensory stimulus to mating, and since olfactory receptors are usually associated with the antennae, we determined the effect of excision of the antennae on the mating behavior of the Mediterranean fruit fly in the laboratory.

_____. Laboratory evaluation of effectiveness of some insecticide emulsifiable concentrates for the immature stage of the Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann). Botyu-Kagaku 39(4):125-133. 1974. (323

A laboratory method for evaluating the effectiveness of emulsion concentrates of insecticides in controlling the immature stages of *Ceratitis capitata* (Wied.) in coffee berries is described. (Review of Applied Entomology, A 63:3929)

* _____ et al. Performance of a sticky trap with trimedlure impregnated in the adhesive material. Journal of Economic Entomology 68(6):817-818. 1975. (324

A trap that contained 2.0 g of trimedlure in the adhesive material trapped more male Mediterranean fruit flies, *Ceratitis capitata* (Wiedemann), than the standard Steiner trap. It was especially effective during the lst 3 weeks of exposure but remained effective for 6 weeks. The principle of incorporating an attractant into sticky material can be applied to other traps.

* NAKAGAWA, S., URAGO, T. y HARRIS, E. J. Plastic dog-flea collar strips used in traps to kill Mediterranean fruit fly in Hawaii. Journal of Economic Entomology 71(2):339-340. 1978. (325

A plastic dog-flea collar strip (2.0 cm) secured separately from the trimedlure-baited cotton dental wick in Steiner's plastic trap eliminated the problems of wick solidification and corroded (galvanized) wires. A strip impregnated with nales or dichlorvos (9-20%) placed in conjunction with trimedlure was as effective in capturing and killing *Ceratitis capitata* (Wiedemann) in Hawaii as a mixture of trimedlure + 25-30% naled.

_____ et al Visual orientation of *Ceratitis capitata* flies to fruit models. Entomologia Experimentalis et Applicata 24(2):193-198. 1978. (326

When wooden and rubber fruit models of different shapes, colours and sizes were hung in fruiting coffee trees, spheres (7.5 cm in diameter) were much more attractive to *Ceratitis capitata* (Wied.) than cubes, cylinders or rectangles of equivalent surface area. Plack and yellow were the most attractive of eight colours and white and grey were the least attractive. When an array of spheres sizes were tested, the attraction to flies increased as the size of yellow spheres increased from 1.5 to 18 cm diameter. Trimedlure enhanced the attraction for males when added to 20.3 x 25.4 cm yellow rectangles and to 7.5 cm black spheres. (Review of Applied Entomology, A 67:1334)

* NASCA, A. J. y AGUERO, A. Parasitismo comparativo de *Pachycrepoideus vindemmiae* (Rond.) sobre *Drosophila melanogaster* Meig. y *Ceratitis capitata* (Wied.) en condiciones de laboratorio. Revista Agronómica del Noroeste Argentino 13(1-4):69-75. 1976. (327

El presente trabajo se ha realizado en la Cátedra de Zoología Agrícola de la Facultad de Agronomía y Zootecnia de la Universidad Nacional de Tucumán. El mismo se ha planeado con el objeto de investigar acerca del grado de preferencia de *Pachycrepoideus vindemmiae* (Rond.), frente a dos de sus huéspedes, *Ceratitis capitata* (Wied.) y *Drosophila melanogaster* Meig., puestos en idéntica situación y en condiciones de laboratorio. Se han realizado tres experimentos similares con tres repeticiones cada uno en ambientes controlado de laboratorio a 24°C y 70% de humedad relativa. En total se emplearon 900 pupas de cada uno de los huéspedes en las tres experiencias con sus repeticiones. Se obtuvo el 24% de pupas parasitadas en *C. capitata* y el 83.44% en *D. melanogaster*. No hubo emergencia de adultos de ninguno de los dos huéspedes, habiéndose observado alta mortalidad de pupas y desconociéndose las reales causas a qué atribuir este hecho. Se concluye en que *P. vindemmiae* tiene una marcada preferencia por *D. melanogaster* frente a *C. capitata*, en las condiciones del experimento. Además, que es necesario hacer nuevas investigaciones para ampliar los conocimientos sobre este parásito y determinar su real importancia en moscas de las frutas.

* NASCA, A. J. Tiempo óptimo de exposición de las pupas de *Ceratitis capitata* (Wied.) y *Drosophila melanogaster* Meig. en el parasitismo de *Pachycrepoideus vindemmiae* (Rond.). Revista Agronómica del Noroeste Argentino 13(1-4):77-84. 1976. (328

El presente trabajo ha sido planeado con el objeto de determinar el tiempo de exposición de las pupas del huésped al parásito, para perfeccionar la técnica del manejo del material en insectario. Se realizaron cuatro experimentos con tiempos de exposición distintos: treinta minutos, una hora, una hora treinta minutos y cuarenta y ocho horas. En cada experimento se usaron 100 pupas de *C. capitata* y 100 pupas de *D. melanogaster* expuestas a 150 parejas de *P. vindemmiae*. El recuento de puparios parasitados se hizo disectando los mismos, bajo lupa binocular, después de cinco días de haber sido expuestos al parásito. El análisis de la información obtenida ratifica lo observado anteriormente sobre la preferencia de *P. vindemmiae* a pupas de *D. melanogaster*. No deja dudas sobre la importancia del tiempo de exposición de las pupas del huésped al parásito. Para pupas de *D. melanogaster*, en las condiciones en que se hizo la experiencia, el mejor tiempo fue de una hora treina minutos, y para pupas de *C. capitata* fue de cuarenta y ocho horas o algo más.

* _____ y RODRIGUEZ, C. T. Parasitismo múltiple en *Ceratitis capitata* (Wied.) en condiciones de laboratorio. Revista Agronómica del Noroeste Argentino 15(13):283-300. 1978. (329

En el insectario de la Facultad de Agronomía y Zootecnia se están criando y multiplicando tres especies importadas de parásitos de moscas de las frutas. Ellos son *Opius longicaudatus* (Ashm.) (Braconidae); *Synthomosphyrum indicum* Silv. (Eulophidae) y *Pacycrepoideus vindemmiae* (Rond.) (Pteromalidae). Se emplearon larvas y pupas de *C. capitata* criadas de huevos colectados en 24 horas y luego separados en ocho grupos uniformes. A cada uno de estos grupos se le dió un tratamiento distinto. A tres de ellos se hicieron parasitar con una especie de parásito. A otros tres se hicieron parasitar con dos especies de parásitos por vez. A uno, se hizo parasitar con las tres especies y por fin, el otro grupo se dejó como testigo. Los resultados se midieron en base a emergencia de adultos de moscas. El análisis de los resultados muestra: 1) El mejor resultado se obtuvo empleando las tres especies; 2) Desde el punto de vista de la eficiencia medida en base a la emergencia de moscas han resultado eficaces todos los tratamientos; 3) Existe interferencias entre *P. vindemmiae* y las otras dos especies de parásitos. El mismo se comporta como hiperparásito; 4) No se ha observado interferencias entre *S. indicum* y *O. longicaudatus*.

* OHINATA, K. et al. Sterilization of the Mediterranean fruit fly by irradiation: comparative mating effectiveness of treated pupae and adults. Journal of Economic Entomology 64(4):781-784. 1971. (330

Treatment of male *Ceratitis capitata* (Wiedemann) as 2-day-old adults with 10-krad gamma irradiation did not reduce their mating effectiveness; however, the same treatment applied to pupae 2 days before adult eclosion reduced mating effectiveness about 50%. Treatment of the pupal stage with substerilizing doses of 2.5 and 5 krad did not reduce mating effectiveness, but there was no indication of hereditary transmission of sterility when partially sterile flies or their progeny were outcrossed with untreated flies.

_____, STEINER, L. F. y CUNNINGHAM, R. T. Thixcin E as an extender of poisoned male lures used to control fruit flies in Hawaii. Journal of Economic Entomology 64(5):1250-1252. 1971. (331

In small-plot field tests in Hawaii in 1968, the stir-in thixotrope Thixcin E (a non-toxic, chemically inert organic powder) was more effective than Myverol (distilled monoglycerides of lard) or CAB-O-SIL (an amorphous, pyrogenic silica of very small particle size and large external surface area) as an extender of the artificial sex attractants for males of *Dacus dorsalis* Hend. (methyl eugenol), *D. cucurbitae* Coq. (cue-lure) and *Ceratitis capitata* (Wied.) (medlure and trimedlure) mixed with naled. Moreover, mixtures containing Thixcin E were easier to prepare than those containing Myverol. When evaluated by the number of adults attracted and killed, foliar deposits of lures containing Thixcin E were as effective as lures containing Myverol and more effective than lures containing CAB-O-SIL. (Review of Applied Entomology, A 60:1183)

* _____ et al. Mediterranean fruit fly: bioassay techniques for investigating sex pheromones. Journal of Economic Entomology 66(3):812-814. 1973. (332

A biological assay technique for evaluating the attractiveness of materials to adult females of *Ceratitis capitata* (Wied.) (as judged by the number taken in sticky traps inside cages) is described. Filter papers that had been exposed to adult males served as the reference standard. A method of preparing them is described. (Review of Applied Entomology, A 61:4834)

_____ et al. Mediterranean fruit fly: laboratory and field evaluations of synthetic sex pheromones. Journal of Environmental Science and Health Part A: Environmental Science and Engineering 12(3):67-78. 1977. (333

* OHINATA, K., ASHRAF, M. y HARRIS, E. J. Mediterranean fruit flies: sterility and sexual competitiveness in the laboratory after treatment with gamma irradiation in air, carbon dioxide, helium, nitrogen or partial vacuum. Journal of Economic Entomology 70(2):165-168. 1977. (334

The level of sterility of males of *Ceratitis capitata* (Wiedemann) was similar when a given dose of gamma irradiation was applied to pupae in atmospheres of nitrogen, carbon dioxide or helium or in a partial vacuum. A dose of 10 krad in air was sufficient to produce 99.5% sterility in males; a dose of 16 krad was required to obtain this same level of sterility when treatment was done in nitrogen, carbon dioxide, helium or partial vacuum. Males treated in each of the modified atmospheres were significantly more competitive than males treated in air; however, flies treated in nitrogen or helium were most competitive. When pupae treated in air, partial vacuum or nitrogen were packed in polyethylene bags and held for 20 h at 24°C to simulate shipping conditions, competitive values for males were 0.22, 0.56, and 0.71, respectively.

_____. Testing sex pheromones in *Ceratitis capitata* . Bull. SROP Int. Organ. Biol. Control Noxious Anim. Plants West Palearctic Reg. Sec. 5: 83-84. 1977. (335

* _____ et al. Mediterranean fruit fly: gamma-irradiation in nitrogen and packaging for sterile-insect release program in Los Angeles. Journal of Economic Entomology 71(4):610-612. 1978. (336

Ca. 600 million Mediterranean fruit flies, *Ceratitis capitata* (Wiedemann), were irradiated in a nitrogen atmosphere, packaged, and shipped to Los Angeles during a sterile-insect release program in 1975-76. Laboratory evaluations of the new procedure showed that ca. 99.95% of the processed males were sterile, that treated males were 40% as competitive as untreated males, and that treated males inseminated ca. 9 females/males.

* _____ et al. Methyl(E)-6-Nonenoate: a new Mediterranean fruit fly male attractant. Journal of Economic Entomology 72(4):648-650. 1979. (337

Several synthesized formulations of substances identified from volatiles of male *Ceratitis capitata* (Wiedemann) were highly attractive to these males in field evaluations. In treatments exposed in Steiner plastic traps or in delta-shaped Jackson cardboard traps, methyl(E)-6-nonenoate, the least complex of the formulations tested, was as attractive to males as trimedlure, the current standard lure for male Mediterranean fruit flies. Both substances remained attractive much longer when they were applied to cotton wicks placed in perforated polyethylene vial stoppers than when they were placed on cotton wicks not contained in vials. Neither the Z-isomer nor any of three positional isomers of methyl(E)-6-nonenoate tested was attractive to either sex of Mediterranean fruit flies in laboratory bioassays.

* OJIMA, M. et al. Estudo do controle de moscas-das-frutas en nesperas com a aplicaçao do inseticida fenthion e o ensacamento dos frutos. Revista Latinoamericana de Ciencias Agrícolas (ALCA) 12(1):46-50. 1976. (338

Field trials were conducted at Campinas, in the State of Sao Paulo, in order to study the viability of chemical control of fruit flies (*Ceratitis* sp. and *Anastrepha* sp.) in loquat (*Eriobotrya japonica* Lindley). In spite of fenthion insecticide having controlled the fruit fly larvae efficiently, the fruits showed egg laying punctures which damaged their appearance and consequently the commercial value. The best results were obtained when the fruits were protected with double walled newspaper bags.

* ONG'UTE, G. M. The Mediterranean fruit fly *Ceratitis capitata* (Wiedmann). Kenya Coffee 35(415):257-259. 1970. (339

*Ceratitis capitata* and its life history are described. Oviposition by the adult female on green coffee berries results in berry drop. The presence of larvae in ripe cherries could be responsible for off-flavour. Insecticidal bait sprays known to control the fruit fly in other crops are listed; their persistence and effectiveness in coffee have not been investigated. The control of larvae in berries and cherries is not expected to be important, but their control in pulp at the factories is considered necessary, especially if the pulp is returned to the plantation. Biological control is not expected to be successful. (Horticultural Abstracts 41:5084)

* ORLANDO, A. y SAMPAIO, A. S. Moscas das frutas. Notas sobre o reconhecimento e combate. Biológico (Brasil) 39(6):143-150. 1973. (340

Fruit flies cause extensive and severe damage to all types of fruits in the State of Sao Paulo, Brazil. The most injurious of the many species present are *Ceratitis capitata* (Wied.) and *Anastrepha fraterculus* (Wied.), and notes are given on their morphology and habits so as to facilitate their identification in the field. The measures recommended in Sao Paulo for the control of fruit-flies are reviewed. They include the application of bait-sprays containing diazinon, parathion, ethion, fenthion, malathion or trichlorphon (which have given excellent results in *Citrus* groves) and cover sprays containing enthion or dimethoate. Many growers place bags over fruits such as peaches and guavas, considering that the extra labour required is justified by the high price commanded by unblemished fruits. (Review of Applied Entomology, A 62:5107)

ORMIERES, R. et al. Ultrastructure de quelques stades de la microsporidie *Octosporea muscaedomesticae* Flu, parasite de *Ceratitis capitata* (Wiedemann) (Diptère, Trypetidae). Journal of Protozoology 23(2):320-328. 1976. (341

ORPHANIDIS, P. S. y PATSAKOS, P. G. Chimiostérilisation des *Dacus oleae* (Gmel.) et *Ceratitis capitata* Wied. au moyen de substances chimiques avec ou sans propriétés d'alkylation. Annales de l'Institut Phytopathologique Benaki 9(2):134-146. 1970. (342

Alkylating chemosterilants have been successfully used in the laboratory in Greece against *Dacus oleae* (Gmel.) and *Ceratitis capitata* (Wied.) but are considered dangerous to mammals. Hemel /hexamethylmelamine/ and hempa at 1% and fentin hydroxide (Du-Ter) at 0.5-2% were compared with apholate at 0.1 or 1% as possible alternatives for field use. The following is based on the authors' summary of this account of the work. Apholate had a strong sterilising effect on both species, especially when the males were treated, and hempa was effective against *D. oleae* but gave inconclusive results against *C. capitata*. Hemel had no appreciable effect on either species. Fentin hydroxide applied to the females markedly reduced the number of eggs laid and slightly reduced the proportion that hatched; treatment of the males only slightly decreased total egg production. (Review of Applied Entomology, A 60:258)

_____. Multiple action of methoprene, a chemical analog of the juvenile hormone on *Ceratitis capitata* Wied. Mededelingen vande Rijksfaculteit Landbouwwetenschappen 28(1):905-918. 1976. (343

_____. Influence du méthoprène, analogue chimique de l'hormone juvénile, sur les larves et les pupes de *Ceratitis capitata* Wied. Annales de l'Institut Phytopathologique Benaki 11(4):257-273. 1977. (344

Laboratory experiments in Greece in 1972-75 with *Cerc*
*capitata* (Wied.) showed that the administration of f
containing Altosid, an emulsifiable formulation of
juvenile-hormone analogue methoprene, to the larva
multiple effects on their subsequent development,
when the concentrations of methoprene were as lo
6-25 p.p.m. The main effects were the reductio
mal adult emergence (including increases in th
tions both of adults failing to emerge complet
the puparium and of adults emerging with defc
as well as of pupae that failed to reach the
at all), of female fecundity and of egg fer
experiments showed that reduction of adult
increase in the proportion of imperfect a
ed from dipping the pupae in aqueous sol
containing 5000-50,000 p.p.m. methopren
Applied Entomology, A 67:4276)

OUTBREAKS AND new records. FAO Plant Protect

It is reported by J. E. Lipes (p.
larvae found feeding on oranges a
1969 proved to belong to a speci
*aurantianum* Costa Lima. Eggs a

the larvae, which resemble those of the African *Cryptophlebia leucotreta* (Meyr.), bore into the fruits but pupate on the bark. Infestation was transitory, but the damage resembled that caused by *Ceratitis capitata* (Wied.), which is established in the area. (Review of Applied Entomology, A 58:2778)

PEDROSO, A. DOS S. Dados bionômicos de *Ceratitis capitata* Wied. 1824 (Diptera: Tephritidae) obtidos em laboratório em regime de dieta artificial. In Resumos de teses apresentadas a Escola Superior de Agricultura Luiz de Queiroz em 1972. Piracicaba, ESALQ, 1974. pp. 63-64, 280-282. (Boletím de Divulgaçao, no. 19). (346

PELEG, B. A. y RHODE, R. H. New larval medium and improved pupal recovery method for the Mediterranean fruit fly in Costa Rica. Journal of Economic Entomology 63(4):1319-1321. 1970. (347

In further studies in Costa Rica on improvements to methods of rearing *Ceratitis capitata* (Wied.) for the production of large numbers of adults, a modification of the larval medium is described, by which ground dried bagasse (extracted sugarcane) is substituted for dehydrated carrot, and sucrose and wheat germ are added. With this diet, full-fed larvae could not be recovered before pupation by washing through a sieve (as had been done previously) because the larger particle size and fibrous nature of the bagasse hindered separation of the larvae from it. The rearing trays were therefore covered with perforated metal lids and inverted on the ninth day after the eggs had been introduced; the larvae left the medium through the holes in the covers, dropped on to sloping plywood panels between the shelves of the recovery cabinet, and fell into a drawer filled with sawdust at the bottom of the cabinet. (Review of Applied Entomology, A 59:185)

PERERA, J. Histone H4 from the fruit fly *Ceratitis capitata*. Circula dichroism studies. Insect Biochemistry 9(1):39-42. 1979. (348

Conformational studies on histone H4 from pharate adults of *Ceratitis capitata* (Wied.) were carried out. The circula dichroism of histone solutions was measured at different conditions of pH and ionic strength. Similar experiments were also carried out with the homologous histone from chicken erythrocytes and both results are compared. Histones H4 from *C. capitata* and higher animals showed very close conformational stability. (Review of Applied Entomology, A 67:2550)

et al. Ensayo sobre la eficacia del producto fitosanitario ra *Ceratitis capitata* Wied. Boletín Informativo de Plagas, 1973. (349

ta experiencia es el de comprobar la eficaGardona 50% S.C. contra *Ceratitis capitade* naranjos del término municipal de

* PEREZ VERGARA, E. Efecto de la exotoxina-β de *Bacillus thuringiensis* var. *thuringiensis* en la mosca del mediterráneo (*Ceratitis capitata*). Tesis Ing. Agr. San José, Universidad de Costa Rica, Facultad de Agronomía, 1974. 55 p. (350

Se estudió la toxicidad de la exotoxina-β de *Bacillus thuringiensis* var. *thuringiensis* Berliner en larvas de mosca del mediterráneo (*Ceratitis capitata*). Se usaron tres tratamientos del *B. thuringiensis*; sin esterilizar y sin filtrar, esterilizado y sin filtrar. El tratamiento esterilizado fue el que requirió mayor cantidad de dilución para matar el 50% de larvas. Las variedades estudiadas con el sobrenadante filtrado y sin esterilizar de las variedades *Sotto*, *Kurstaki* HD-1 *Entomocicidos* e IICA-4 causaron una mortalidad errática en todas las diluciones probadas. Se demostró que ninguno de los tratamientos empleados produjeron la Exotoxina β, causante de la mortalidad en larvas de *Ceratitis capitata*, probablemente debido a las condiciones en que se cultivó la bacteria.

PLATIA, G. y PALOTTI, G. La piralide e altri insetti nocivi al peperone in Emilia-Romagna. Informatore Agrario 34(4):313-317. 1978. (351

Insect pests of large green capsicum are listed and discussed, including *Myzus persicae*, *Ceratitis capitata* and *Argyrotaenia pulchellana*. The biology and damage caused by *Ostrinia* are outlined; infested fruits are unsaleable. The need to avoid spraying just before harvest makes chemical control difficult in summer. The possible use of pheromones is mentioned. (Horticultural Abstracts 48:8232)

PODER EJECUTIVO, TEGUCIGALPA. Mosca del mediterráneo, peligr Café (Honduras) 5(25):13-15. 1975.

PODOLER, H. y MENDEL, Z. Analysis of solitariness in a p (*Muscidifurax raptor*, Hymenoptera: Pteromalidae - *Cer* Diptera: Tephritidae). Ecological Entomology 2(2):

The behaviour of the ovipositing female of *M tor* Gir. and Sanders when searching for pupa *Ceratitis capitata* (Wied.) was studied in t Israel. At low density the females tended tised hosts, but this tendency decreased searching females increased. The propor of superparasitism was calculated; it d ing numbers of encounters/host. The me ing superparasitism, which were invest consist of outer marking of parasitis by the females parasite and attack b site larva on unhatched eggs, older active and aggressive) and pupae o (Review of Applied Entomology, A f

PODOLER, H. y MENDEL, Z. Analysis of a host-parasite (*Ceratitis-Muscidifurax*) relationship under laboratory conditions. Ecological Entomology 4(1):45-59. 1979. (354

The relationship between the parasite *Muscidifurax raptor* Gir. & Sanders and one of its possible hosts, *Ceratitis capitata* (Wied.), was studied with locally-obtained material in the laboratory in Israel, emphasis being placed on quantitative descriptions of parasite responses and behaviour. Female parasites were found to 'paralyse' pupae of the host prior to oviposition on them. This treatment was not essential for larval development but appeared to be crucial when oviposition took place in fully developed pupae. When offered a choice, females preferred to parasitise older hosts. Parasite efficiency was affected by temperature, and reached its highest level at 28°C. Increasing parasite density reduced searching efficiency when it exceeded a certain level; a stronger effect of similar type was obtained by increasing the number of males/females. Apart from affecting efficiency of search, increasing parasite density caused an increasing proportion of males in the progeny. Parasites responded to increased host density by a weak functional response followed by reduction in efficiency of search; they aggregated on high host densities, such aggregation being antagonistic to the tendency to disperse due to mutual interference. (Review of Applied Entomology, A 67:3743)

PROKOPY, R. J. y ECONOMOPOULOS, A. P. Color responses of *Ceratitis capitata* flies. Zeitschrift für Angewandte Entomologie 80(4):434-437. 1976. (355

It is shown from further investigations in orchards of olive and apricot in Greece in 1973 that yellow rectangles were more attractive than rectangles of other colours to adults of *Ceratitis capitata* (Wied.). The use of yellow rectangles for monitoring fruit-flies is discussed, and it is suggested that those taken in the orchards had originated from nearby wild pear trees. (Review of Applied Entomology, A 65:1250)

_____. Testing responses to oviposition-deterring pheromones in Trypetinae. Bull. SROP Int. Organ. Biol. Control Noxious Anim Plants West Palearctic Reg. Sec. 5:68-70. 1977. (356

, ZIEGLER, J. R. y WONG, T. T. Y. Deterrence of repeated oviposition uit-marking pheromone in *Ceratitis capitata*. Journal of Chemical 4(1):55-63. 1978. (357

the ovipositor dragging on the fruit surface following ng in hawthorn fruit, females of *Ceratitis capitata* posit an unidentified pheromone that deters repeat- on attempts in that fruit. In tests, the phero- ter-soluble and, when collected and sprayed in onto uninfested fruits in laboratory cages, ed boring attempts by females of wild ori- days (termination of the test). A of *C. capitata* cultured on artificial generations deposited pheromone that

proved equally as deterrent to wild fly oviposition as pheromone from wild-caught flies. However, oviposition by females of the laboratory population was not effectively deterred by the presence of pheromone. The ecological significance of the pheromone is discussed. (Review of Applied Entomology, A 66:4709)

* PROKOPY, R. J. y HENDRICHS, J. Mating behavior of *Ceratitis capitata* on a field-caged host tree. Annals of the Entomological Society of America 72(5):642-648. 1979. (358

We systematically observed the mating behavior of wild *Ceratitis capitata* (Wiedemann) flies released on a field-caged host tree (coffee) growing naturally in a plantation in Guatemala. The principal site of attempted copulation was the bottom surface of leaves. During late morning and early afternoon, males stationed themselves at this site, often forming leks, and released sex pheromone, thereby attracting virgin or otherwise receptive females. An additional important site of copulation attempts, particularly among already-mated females, and particularly during mid-morning and mid- to late afternoon, was the fruit, where males were arrested by oviposition-deterring pheromone deposited by females after egg laying. The principal strategy of males at this site appeared to be attempted seduction or rape of already-mated or otherwise rather unreceptive females exhibiting oviposition behavior and little or no attraction to sex pheromone emitted by males on leaves. Possible selective advantages to males of each type of mate encounter pattern are discussed.

* PUZZI, D., ORLANDO, A. y ARRUDA, H. V. Influência do tipo de inseticida (pó molhável ou concentrado emulsionável) no r das iscas para o combate às "môscas das frutas". Arqui Biológico (Brasil) 36(2):85-88. 1969.

Two experiments were performed with fruit-flies. ment was to measure the attractivity of the bai tions tested included 1% "hydrolyzed corn wate Base 7" combined with two insecticides, 0.2% M 0.1% dieldrin, each applied in two formulati powder and an emulsifiable concentrated. Th ment with the same purpose used 10% molasse The results showed that dieldrin was bette in the presence of any of the baits. The formulation using corn water and Sauce B than the emulsifiable concentrated, but ses, there was no statistical differen lations.

QUESADA ALLUE, L. A., MARECHAL, L. R. y BELO prenol phosphate sugars by *Ceratitis ca* 67(3):243-247. 1976.

QUESADA ALLUE, L. A. y BELOCOPITOW, E. Lipid-bound oligosaccharides in insects. European Journal of Biochemistry 88(2):529-541. 1978. (361

QUINTANILLA, R. H. et al. Radiosensibilidad de huevos y pupas de la 'mosca del mediterráneo' (*Ceratitis capitata* (Wied.)). In Congreso Latinoamericano de Entomología, 1°., Cuzco, Perú, 1971. Anales. Cuzco, 1971. pp. 316-319. (362

Studies in Argentina in which eggs and pupae of *Ceratitis capitata* (Wied.) were exposed to X-rays showed that the LD50's and LD95's were about 480 and 4800 rad, respectively, for eggs exposed 0-24 h after oviposition and 900 and 1240 rad, respectively, for pupae exposed 0-72 h after the final moult. (Review of Applied Entomology, A 63:2478)

RABSON, R. Activities of the U.S. Atomic Energy Commission related to radiation techniques used in control of insects. In Panel on Application of the Sterile-Male Technique for the Eradication or Control of Harmful Species of Insects, Vienna, 1968. Proceedings. Vienna, FAO/IAEA, 1968. pp. 45-49. (363

The activities of the United States Atomic Energy Commission (USAEC) in connection with the use of the sterile-male technique for the control of insects are listed. Certain of the activities are outlined; these include co-operation with the Instituto Interamericano de Ciencias Agrícolas in work on the control of *Ceratitis capitata* (Wied.) and *Leucoptera coffeella* (Guér.) in Central America, and support for studies in Puerto Rico on the control of *Diatraea saccharalis* on sugar cane and in Peru on the control of *Anastrepha fraterculus* (Wied.). Investigations sponsored by the USAEC at various universities in the United States, including those in Louisiana, where the control of *Cylas formicarius elegantulus* (Summers) on sweet potato is being studied, are briefly described. (Review of Applied Entomology, A 58:1468)

* RADU, M., ROSSLER, Y. y KOLTIN, Y. The chromosomes of the Mediterranean fruit fly *Ceratitis capitata* (Wied.): karyotype and chromosomal organization. Cytologia 40(3/4):823-828. 1975. (364

The karyotype and chromosome behavior of *C. capitata* were studied both in mitosis and meiosis. The chromosome number is 12(n = 6), and includes two pairs of metacentric chromosomes, two pairs of submetacentric and two pairs of subtelocentric chromosomes. The sex chromosomes are ll differentiated in size, and the X chromosome is typi- by a secondary constriction. The somatic chromosomes y somatic association, which can be relaxed by col- Spermatogenesis is typically chiasmatic, suggest- ecombination occurs in the male. The study was part by the Israel National Council for Re- elopment.

RAGUSA, S. Influence of temperature on the oviposition rate and longevity of *Opius concolor siculus* (Hymenoptera: Braconidae). Entomophaga 19(1):61-66. 1974. (365

During further studies in the laboratory in Sicily on oviposition in *Opius concolor siculus* Monastero, the parasite was reared in larvae of *Ceratitis capitata* (Wied.) at 75-80% R.H. and constant temperatures of 22, 24, 26 or 28°C. There was constant illumination, and the adults were provided with sugar and honey. The adults were isolated in pairs. At the four temperatures, females laid averages of 67.7, 105.4, 156.2 and 53.8 eggs each, respectively. The most favourable temperature for oviposition thus appeared to be 26°C, which is that used in the laboratory in Sicily for the mass-rearing of the parasite. At this temperature, the preoviposition period lasted 1-11 (average 2.1) days, 54% of the females began to oviposit on the first day after emergence, the oviposition period lasted 3-24 (average 11.5) days, females laid an average of 14.1 eggs/day each, and the adult females lived for 3-33 (average 14.9) days, somewhat longer than the males. The author concludes that the rather different results reported by H. G. Stavraki-Paulopoulou may indicate a difference at subspecific level between material from Africa and that from Sicily. (Review of Applied Entomology, A 63:4522)

* RAMOS F., A. y CASTILLO, F. Evaluación de las poblaciones de *Ceratitis capitata* (Wied.) "moscamed" en el Valle de Palpa, Depto. de Ica. Avances en Investigación (Perú) 3(2-3):33-34. 1974. (366

El estudio de las fluctuaciones estacionales de las poblaciones de especies insectiles que hayan alcanzado nivel de plaga, es uno de los conocimientos más importantes para la adecuada aplicación de los diferentes métodos de con
de insectos dañinos.

* _____ y CASTILLO, F. Evaluación de las poblaciones de
(Wied.) y *Anastrepha* sspp. en el Valle Ica. Avances e
3(2-3):35-36. 1974.

Evaluar las poblaciones de las "moscas de la
cientes a la especie *Ceratitis capitata* (Wied
*Anastrepha*, de mayor importancia en el valle
tener la información necesaria para la elab
gramas de control de esta plaga.

RAUCH, F., LOMBRICI, G. y LHOSTE, J. Etude des
l'hormone juvénile sur *Ceratitis capitata* W
Revue de Zoologie Agricole et de Pathologie
1974.

Pupae of *Ceratitis capitata* (Wied.)
pupation with 0.1-15 µg juvenile h
11-epoxy-7-ethyl-3,11-dimethyl-2,
the morphological results in the

classified and illustrated. Adults in class 1 were able to leave the puparium but had genital malformations and crumpled wings, those of class 2 were able to emerge only partially from the puparium, and those of class 3 remained within the puparium and resembled pupae rather than adults. Some effects were noticed in the females after doses of 0.5 µg onwards. The main action of the hormone appeared to be in inhibiting leg movement and the mechanism that enables the adults to leave the puparium. *C. capitata* seemed to be affected similarly to other species of Diptera treated but to be less susceptible than *Tenebrio molitor* L. (Review of Applied Entomology, A 64:1709)

* RHODE, R. H. y CALDERON, W. Aerial release techniques for the Mediterranean fruit-fly. Journal of Economic Entomology 64(2):537-539. 1971. (369

In tests of techniques for the aerial release of sterile males of *Ceratitis capitata* (Wied.), paper bags containing insects only and fitted with X-shaped cardboard inserts, which were torn apart on leaving the chute, and bags containing wood-wool and insects, which were slit automatically, were compared with clusters of pasteboard tubes covered at each end with organdie cloth, from which the flies were drawn out of the aircraft by suction on insertion of one end of the tube cluster into the release chute and removal of the cloth from the other end. The effectiveness was assessed by means of Steiner traps on the ground. Trap-catches in the first few days after release varied with the degree of scattering produced by the three methods; flies in slit bags and to a less extent in bags torn apart were borne to the ground with the bags and therefore landed on target in greater numbers than did flies from tubes, which were dispersed immediately on ejection from the aircraft. No significant difference in mortality was observed between insects released by the three methods. Since *C. capitata* has been shown to survive free release from aircraft relatively well and wide dispersal of released flies is sometimes desirable, the tube method appears to merit further study. (Review of Applied Entomology, A 59:2797)

_____ et al. Application of the sterile-insect-release technique in Mediterranean fruit fly suppression. Journal of Economic Entomology 64(3): 708-713. 1971. (370

Populations of wild *Ceratitis capitata* were suppressed by gamma-irradiated flies in a 48-km$^2$ coffee and citrus area n Nicaragua. From September 1968 to May 1969, 40 million rile flies were released by air each week. Wild flies 2-km-wide border area around the release area were de- by aerial application of bait sprays. Average de- of viable Mediterranean fruit fly eggs, larval in coffee fruits, and recoveries of pupae from ges were at least 90.1% less in the release e checks. During the experimental period ons increased only 4-fold in the release 5- and 28-fold increases in the respect- Tropical Abstracts 26:u3068)

RHODE, R. H. et al. Control of Mediterranean fruit flies in shade-grown coffee with ultra-low-volume aerial insecticide applications. Journal of Economic Entomology 65(6):1749-1750. 1972. (371

In field tests in Nicaragua in 1970 on the control of sterile adults of *Ceratitis capitata* (Wied.) released in a plantation of shade-grown coffee by ultra-low-volume sprays of fenthion and malathion applied from an aeroplane, both compounds alone or mixed with protein hydrolysate at rates of about 2-3 oz/acre were effective. (Review of Applied Entomology, A 61: 2424)

_____. The history and current status of the Mediterranean fruit fly in North America, Rio Grande Valley. Horticultural Society Journal 30:11-17. 1976. (372

* _____. The medfly: containment in Central America. Citrograph 61(5): 153-154, 178. 1976. (373

Authorities believe that California's current outbreak of Mediterranean fruit fly came from an accidental import by a yacht which had visited Central America. This article reports on the situation in the infested areas of Central America and describes an international program to stop the spread.

RIGNEY, C. Fumigation of oranges: an export breakthrough. Agricultural Gazette of New South Wales 87(5):18-19. 1976. (374

Oranges infested with larvae of Queensland fruit fly /*Ceratitis capitata*/ were fumigated with ethylene dibromide (EDB) at various concentrations and temperatures for 2 h. Excellent control was achieved with concentration/temperature combinations of 24 g/$m^3$ at 20°C, 31 g/$m^3$ at 15°or 40.4 g/$m^3$ at 10°. (Horticultural Abstracts 47:7850)

RIPOLL, C. A. Evaluación del quimioesterilizante Hempa sobre mosca del Mediterráneo (*Ceratitis capitata*). Tesis Ing. Agr. Argentina, Universidad de Buenos Aires, Facultad de Agronomía, 1976. 20 p. (375

RIVARD, I. Aspect international des recherches sur les mouches des fruits. Phytoprotection 53(2/3):96-102. 1972. (376

The author reviews the achievements of the Working Group on Fruit Flies set up under the sponsorship of the International Biological Programme. The work is being carried out in many countries and on many species of fruit-flies, including *Ceratitis capitata* (Wied.) in Italy and Tunisia, *Dacus dorsalis* Hend. in Hawaii, *D. oleae* (Gmel.) in France, Italy and Greece, *D. tryoni* (Frogg.) in Australia, *Rhagoletis cerasi* L. in Switzerland and Czechoslovakia and *R. pomonella* (Walsh) in Canada. (Review of Applied Entomology, A 62:1655)

RIVERA GARCIA, S. Investigación sobre atrayentes venenosos (Cebos) para el control de la mosca de la fruta *Anastrepha* spp. y *Ceratitis capitata* (Wied.). In Reunión Anual del Programa Cooperativo Centroamericano para el Mejoramiento de Cultivos Alimenticios, 24a., San Andrés, El Salvador, 1978. Memoria. San Salvador, El Salvador, CENTA, 1978. v.3, pp. H6/1-H6/10. (377

* ROBISON, L. The medfly: containment in California. Citrograph 61(1):7-8, 22-23. 1975. (378

The outbreak reported on here is a small one and is well on its way to eradication, but all authorities agree that the Mediterranean fruit fly remains the number one threat to the California fruit industry. The insect is established in Hawaii and in Central America, and only by remaining aware and on guard can we prevent the costly experience of Florida and other producing areas.

ROBLES-CHILLIDA, E. M. Contribution to the micromorphological study of the egg and larva of *Ceratitis capitata* (Wied., 1824). Graellsia 29:211-224. 1973. (379

ROCHA, A. D. DA. et al. Eficiência de inseticidas no contrôle da mosca das frutas em citrus. Científica (Brasil) 6(2):191-194. 1978. (380

Bait-sprays of 0.5% hydrolysed protein and 0.04 or 0.08% formothion or 0.175% malathion were applied five times (at intervals of 15 days) to orange trees at Jaboticabal, Sao Paulo, Brazil, for the control of *Ceratitis capitata* (Wied.). Good control of the fly was afforded by all the sprays, but that containing 0.08% formothion resulted in the lowest percentage of damaged fruits. (Review of Applied Entomology, A 67:3325)

ROLLI, K. The acoustic sex signals of *Ceratitis capitata* Wied. and *Dacus oleae* Gmel. Zeitschrift fur Angewandte Entomologie 81(2):219-223. 1976. (381

The acoustic sexual signals of adults of *Ceratitis capitata* (Wied.) and *Dacus oleae* (Gmel.) are described from investigations in the laboratory with the aid of oscillograms. Males of *D. oleae* produced a single signal during courtship and those of *C. capitata* produced two successive signals. It is suggested that the signals probably serve either to test the female's willingness to copulate, or to stimulate the female to do so. Copulation without preceding signal was not observed. (Review of Applied Entomology, A 65: 1837)

* ROS, J. P. et al. Lucha biológica contra *Ceratitis capitata* por el método de 'machos estériles'. Anales del Instituto Nacional de Investigaciones Agrarias. Protección Vegetal, no. 3:225-250. 1973. (382

Desde 1965, el I.N.I.A. viene desarrollando un programa de lucha biológica contra *Ceratitis capitata* (Wied.) por el

método de 'insectos estériles'. Ensayos preliminares de campo en la isla de Tenerife en 1966-68 y en la provincia de Murcia (1969), han demostrado que el método es plenamente eficaz aplicado a zonas de reducida extensión y relativo aislamiento. En este trabajo se estudian las características agronómicas y fitopatológicas de una nueva zona experimental de melocotoneros, mayor que las de años anteriores (100 ha), situada en Pinos Puente (provincia de Granada) que por su relativo aislamiento es apta para ensayos del método de 'machos estériles' contra *Ceratitis capitata*. En dicha zona se han hecho estudios sobre nuevos métodos de sueltas de insectos estériles así como ensayos de alimentación, supervivencia y dispersión de los insectos estériles liberados. El nuevo método de suelta de insectos estériles consiste en una manga cilíndrica de tela de malla (50 cms de diámetro y 1 m de altura) suspendida del árbol. En la parte inferior se le adapta una cubeta de plástico donde se depositan las pupas irradiadas (50.000) y en la superior una placa circular de material plástico a modo de tapadera. De esta manera los adultos eclosionados van subiendo por la malla y al mismo tiempo secando sus alas y salen al exterior. La experiencia adquirida muestra que este sistema sustituye con ventaja a las bolsas de papel, método que se había venido utilizando anteriormente. Para los ensayos de alimentación previa a la suelta de los insectos estériles, se marcaron éstos con polvos fluorescentes de colores (Day-glo) según el tipo de alimentación recibida: Rojo: azúcar + hidrolizado de proteína (3:1); Azul: azúcar; Amarillo: sin alimentación. Para estudiar la supervivencia y dispersión de los diferentes tipos, se dispusieron mosqueros de plástico (tipo Nadel) con atrayente sexual (Trimedlure) y Vapona (DDVP) en lugares estratégicos. El estudio de los insectos capturados por los mosqueros, dio el siguiente resultado: 1. En el conjunto de la población aumenta cada vez más el porcentaje de moscas alimentadas con azúcar solamente, con relación a las alimentadas con azúcar + proteína y las no alimentadas. Ello parece indicar una mayor supervivencia de dichos adultos en relación con los otros. 2. Los porcentajes de insectos azules, rojos y amarillos en las capturas de cada una de las zonas de densidad, indican que la distribución de moscas de todos los colores es muy homogénea, no apreciándose diferencias significativas en cuanto a su dispersión.

ROS, J. P. Control genético contra *C. capitata* Wied. por el método de insectos estériles; trabajos realizados en España (1969-73). In Symposium on the Sterility Principle for Insect Control, Innsbruck, 1974. Proceedings. Vienna, International Atomic Energy Agency, 1975. pp. 57-92. (FAO-ACCESS, no. 29061). (383

* _____. Control genético de *Ceratitis capitata*, aplicación práctica de la técnica de insectos estériles; trabajos realizados en 1972-1973. Anales del Instituto Nacional de Investigaciones Agrarias. Protección Vegetal, no. 5:237-252. 1975. (384

En el presente trabajo se da cuenta de los procesos realizados en 1972 y 1973 en el programa de control biológico de *C. capitata*. La primera parte corresponde al estudio de la ecología

de *Ceratitis* en la provincia de Granada. En los estudios efectuados durante dos años consecutivos se ha visto un desplazamiento de la plaga desde la costa (sur), en la que vive en estado de adulto todo el año, hacia el interior (norte) a medida que las temperaturas iban en aumento y los frutos madurando. Se continúa trabajando en este aspecto para averiguar si es migración del insecto o es invernación *in situ*, con eclosión cuando se alcanzan temperaturas óptimas. La segunda parte detalla las dos experiencias para el control de C. *capitata* por el método de insectos estériles llevadas a cabo en Granada (1972 y 1973). Los resultados obtenidos han sido altamente satisfactorios así como los progresos realizados en el transporte de insectos refrigerados y métodos de suelta en el campo.

* ROS, J. P. Trabajos de erradicación de *Ceratitis capitata* Wied. en la Isla de Hierro (Islas Canarias). Anales del Instituto Nacional de Investigaciones Agrarias. Protección Vegetal, no. 7:177-195. 1977. (385

En 1975 el Instituto Nacional de Investigaciones Agrarias suscribió un nuevo contrato (Research Contract No. 1583/RB) con IAEA, cuyo fin es la erradicación de *Ceratitis capitata* Wied. en la isla de Hierro (Islas Canarias). La isla tiene una extensión de 277 $km^2$ y presenta una zona de 1.500 has de extensión llamada El Golfo, donde se concentra toda la producción frutícola (melocotoneros, vid, platanera, naranjos e higueras). En 1974 se hizo una prospección de la población indígena en El Golfo, llegándose a capturar 20 moscas/mosquero/día. En el resto de la isla no se ha encontrado presencia alguna de Ceratitis, ni en los mosqueros destinados a detectarla ni por frutos atacados. En la campaña de 1975 se liberaron 107 millones de pupas irradiadas a 9.000 rads con una eclosión media del 60%, en 1976 se liberaron 87 millones de pupas y debido a perfeccionamiento de los recipientes de envío, se ha elevado la eclosión a un 67%. Hasta el momento se ha logrado un control plenamente eficaz de la plaga al mantener el ataque en límites muy bajos.

ROSEN, D. Current status of integrated control of *Citrus* pests in Israel. Bulletin, Organisation Européenne et Méditerranéenne pour la Protection des Plantes 4(3):363-368. 1974. (386

The author reviews successes in the biological control of pests of *Citrus* in Israel, with special reference to the control of *Chrysomphalus aonidum* (L.) by *Aphytis holoxanthus* DeBach. To preserve populations of the parasite, control measures against other important pests of *Citrus* had to be modified; cover sprays against *Ceratitis capitata* (Wied.) were replaced by bait-sprays and broad-spectrum acaricides by more selective compounds, and increased emphasis was laid on the introduction of parasites and predators. However, problems persisted. *Aonidiella aurantii* (Mask.), no longer displaced by C. *aonidum*. increased in importance and chemical control measures were needed before the parasites *Aphytis melinus* DeBach and *Comperiella bifasciata* How., which were introduced from

California, became established. Other *Citrus* pests of increasing importance against which growers have applied non-selective compounds are *Parlatoria pergandii* Comst., *Ceroplastes floridensis* Comst., *Saissetia oleae* (Ol.) and *Prays citri* (Mill.). As a result, heavy outbreaks of *Planococcus citri* (Risso) and *Coccus hesperidum* L. have occurred in some areas. The general increase in populations of *Citrus* pests may be part of a vicious circle brought into being by the increased use of non-selective compounds. Local outbreaks of *Chrysomphalus aonidum* and *Pseudococcus citriculus* Green (which has long been held in check by *Clausenia purpurea* Ishii, introduced from Japan in 1940) have caused heavy damage in some groves. Efforts now being made to restore the biological balance in *Citrus* groves include the mass-rearing of parasites such as *A. holoxanthus*, *Clausenia purpurea*, *Aphytis* spp. and *Comperiella bifasciata* for release in areas where outbreaks of their hosts have occurred, the introduction of numerous parasitic species from Africa and California for the control of Coccids, and the development of the sterile-male technique as an alternative to bait-sprays for the control of *Ceratitis capitata*. (Review of Applied Entomology, A 63:5173)

ROSILLO, M. A. y P\'RTILLO, M. M. Factores que detienen el incremento de la densidad de pol ·ción de las especies *Anastrepha fraterculus* (Wiedemann) y *Ceratitis cap· ·ta* (Wiedemann) (Dipt. Acalypt.). Región citrícola de Bella Vista, Corrientes, Argentina. In Congreso Latinoamericano de Entomología, Cusco, Perú, 1971. Anales. Cuzco, 1971. pp. 323-333. (387

También en: IDIA (Argentina), no. 287:17-27.

Since fruit-flies are not a major problem in the *Citrus*-growing area of the Department of Bella Vista, in the Argentine Province of Corrientes, studies have been carried out there since 1958 to determine the factors that hold populations in check. *Ceratitis capitata* (Wied.) and *Anastrepha fraterculus* (Wied.) are the principal fruit-flies present. No hymenopterous parasites of the flies were found, and, though there were seasonal fluctuations in populations, numbers were never sufficiently large to cause serious damage to the crop. The principal factors adversely affecting development appeared to be the extremely high temperature in summer (when day temperatures exceed 28°C for prolonged periods from November to March), which inhibits pairing and oviposition, the action of fungi, bacteria and arthropods that attack the pupae in the soil, and the scarcity of secondary food-plants when *Citrus* is unavailable. (Review of Applied Entomology, A 60:4954)

* ROSSLER, Y. The ability to unseminate: a comparison between laboratoty reared and field populations of the Mediterranean fruitfly (*Ceratitis capitata*). Entomologia Experimentalis et Applicata 18(2):255-257. 1975. (388

* ROSSLER, Y. Reproductive differences between laboratory-reared and field-collected populations of the Mediterranean fruitfly, *Ceratitis capitata*. Annals of the Entomological Society of America 68(6):987-991. 1975. (389

The reproductive differences between laboratory-reared and field-collected populations of the Mediterranean fruitfly, *Ceratitis capitata* (Wiedemann), were studied in the laboratory. The laboratory population was reared for over 12 years under conditions differing from outdoor conditions and in complete isolation from field populations. The two experimental populations differed in their preoviposition periods and egg hatch but not in the female's longevity or total and daily oviposition. The $F_1$ hybrid females were heterotic, lived longer, had a longer oviposition period and a higher oviposition rate than either parental populations. No genetic breakdown of the $F_2$ hybrids was evident. Rudimentary sexual isolation between the field and laboratory populations was evident and expressed in low egg hatch in heterogamic crosses and in the $F_1$ homogamic crosses.

* _____y KOLTIN, Y. The genetics of the Mediterranean fruitfly, *Ceratitis capitata*: three morphological mutations. Annals of the Entomological Society of America 69(4):604-608. 1976. (390

Three morphological mutations were detected in the Mediterranean fruitfly. The mutations involve eye color, color of the pupae, and number of cephalic chaetae. All three mutations are recessive and autosomal. The eye color mutation and pupae pigment mutation are single-gene mutations. The mutation involving the cephalic chaetae may also be a single-gene mutation, but requires further confirmation since it leads to decreased viability. The results of the various crosses suggest that all three mutations lead to lowered viability. Two of the mutations, eye color and number of cephalic chaetae, are linked. It is proposed that these morphological mutations can serve as markers for ecological studies and genetic control of the fruitfly.

* _____y KOLTIN, Y. Fitness of the "apricot eye" mutant of the Mediterranean fruit fly, *Ceratitis capitata*. Annals of the Entomological Society of America 70(4):544-548. 1977. (391

The recessive mutant "apricot eye" was found inferior to the wild-type in mixed population cages. The apparent inferiority was due to a lower mating propensity of the "apricot eye" males and a lowered survival of the "apricot eye" larvae under competition with wild-type larvae on artificial diet. Attraction to host fruit (such as various citrus varieties) was not affected by the eye color. The use of the genetically-marked strain of the Mediterranean fruit fly in ecological field studies should take into consideration the sexual inferiority of the "apricot eye" males.

ROSSLER, Y. Measuring mating frequency and ability to inseminate in *Ceratitis capitata*. Bull. SROP Int. Organ. Biol. Control Noxious Anim. Plants West Palearctic Reg. Sec. 5:117-118. 1977. (392

_____. Testing for assortative mating in *Ceratitis capitata*. Bull. SROP Int. Organ. Biol. Control Noxious Anim. Plants West Palearctic Reg. Sec. 5:106-107. 1977. (393

_____. Testing the response of *Ceratitis capitata* to host odor. Bull. SROP Int. Organ. Biol. Control Noxious Anim Plants West Palearctic Reg. Sec. 5:62-63. 1977. (394

* _____. The genetics of the Mediterranean fruit fly: a "white pupae" mutant. Annals of the Entomological Society of America 72(5):583-585. 1979. (395

A recessive autosomal mutation affecting pupal color was discovered in laboratory strain of the Mediterranean fruit fly. The mutation "white pupae" is located on a different chromosome from the "dark pupae" and "apricot eye" loci.

RUSS, K. y SCHWIENBACHER, W. Monitoring acoustical signals related to mating in *Dacus oleae, Ceratitis capitata,* and other tephritids. Bull. SROP Int. Organ. Biol. Control Noxious Anim. Plants West Palearctic Reg. Sec. 5:89. 1977. (396

SALINAS, P. J. Algunos animales, especialmente insectos asociados con los cultivos de vid en Venezuela. In Simposio sobre la Producción e Industrialización de la Uva en Venezuela, 2°., Caracas, 1975. Trabajos. Caracas, 1975. pp. 100-124. (397

Notes are given on the habits, injuriousness, and in some cases, control, of insects, mites and other animals known to be associated with grapevines in Venezuela. The insects currently of most economic importance appear to be various species of thrips, *Aphis illinoisensis* Shimer, *Margarodes vitis* (Philippi) (*vitium* Giard), *Spodoptera frugiperda* (J.E. Smith), which though common in Venezuela has not previously been recorded from grapevines, *Harrisina mystica* (Wlk.), the larvae of which skeletonise the leaves, a bostrychid that is possibly *Neoterius vitis* Mendes, the wasps *Polistes versicolor* (Ol.) and *Polybia* sp., the eurytomid *Prodecatoma cooki* (How.) and bees of the genus Trigona. Species of potential importance as pests are *Ceratitis capitata* (Wied.) and *Viteus vitifloiae* (Fitch) (*Phylloxera vitifoliae*). Several beneficial species are also recorded, including coccinellid predators of aphids. (Review of Applied Entomology, A 65:3263)

SAMISH, M. The attraction of protein hydrolyzate for Hymenopterous parasites. Entomophaga 18(2):169-174. 1973. (398

*Diversinervus elegans* Silv., *Metaphycus zebratus* (Merc.) and *Scutellista cyanea* Motsch. are the most important parasites of *Saissetia oleae* (Ol.) in olive groves in Israel and keep

the Coccid in check there. Field and laboratory studies were carried out to determine whether the protein hydrolysate in the malathion or dimethoate bait-sprays that are widely applied in olive groves for the control of *Dacus oleae* (Gmel.) and in *Citrus* groves against the Mediterranean fruit fly /*Ceratitis capitata* (Wied.)/ also attracts these parasites, resulting in a decrease in their numbers. The protein bait used in the studies was Zaitan (R) 85, of local manufacture. Laboratory studies with an olfactometer confirmed field observations that parasitic Hymenoptera are not attracted to protein hydrolysate. The results provide an additional reason for the use of bait-sprays in preference to cover sprays. (Review of Applied Entomology, A 62:4989)

SAMPERIO, J. G. Ensayo sobre trampas para detectar la mosca del Mediterráneo (*Ceratitis capitata* Wied.). Folia Entomológica Mexicana, no. 23/24:58-59. 1972. (399

SCHROEDER, W. J. et al. A fluorescent compound for marking Tephritidae. Journal of Economic Entomology 65(4):1217-1218. 1972. (400

Laboratory and field tests in Hawaii in 1970-71 showed that a water-insoluble formulation of a fluorescent whitening agent, Tinopal SFG, was a suitable dye for marking adults of *Dacus cucurbitae* Coq., *D. dorsalis* Hend. and *Ceratitis capitata* (Wied.). (Review of Applied Entomology, A 61:377)

_____, MIYABARA, R. Y. y CHAMBERS, D. L. Protein products for rearing three species of larval Tephritidae. Journal of Economic Entomology 65(4):969-972. 1972. (401

In laboratory tests in Hawaii, various protein products were substituted for the main source of protein (torula yeast (type 200)) in the diet developed by N. Tanaka and others for fruit flies in an attempt to develop a fluid larval medium. Diets with their main protein source as torula yeast (type 200), cottonseed protein, soy-bean protein, torula yeast (type B), a combination of the yeast *Saccharomyces fragilis* and whey protein and a combination of cottonseed and torula yeast (with more fluid) were all nutrionally and physically adequate (as determined by regression analysis) for rearing *Dacus cucurbitae* Coq. and *D. dorsalis* Hend. However, only diets with protein from yeast products were adequate for *Ceratitis capitata* (Wied.). A diet with marine protein concentrate was inadequate for all three Tephritids. From the number of pupae/litre of diet, the number of pupae/100 newly hatched larvae, and the number of emerged adults for diets that had a significant negative linear regression between weight/pupa and number of pupae/litre of diet, it appeared that S. *fragilis* gave consistently high yields of the three species and should be evaluated in open-tray mass-rearing. (Review of Applied Entomology, A 61:1915)

SCHROEDER, W. J., MIYABARA, R. Y. y HARRIS, E. J. A disposable cage for the Mediterranean fruit fly. Journal of Economic Entomology 66(6):1342. 1973. (402

A large disposable cage for mass-rearing *Ceratitis capitata* (Wied.) in the laboratory in Hawaii is described. It consisted simply of a replacable plastic bag secured round a suitable frame. (Review of Applied Entomology, A 62:3061)

* _____, CHAMBERS, D. L. y MIYABARA, R. Y. Mediterranean fruit fly: propensity to flight of sterilized flies. Journal of Economic Entomology 66(6):1261-1262. 1973. (403

Sterilized (by irradiation) and untreated laboratory-reared *Ceratitis capitata* (Wiedemann) were studied in a specially designed flight-propensity chamber. Irradiation with 10 krad two days before adult eclosion produced a sedentary male and a very sedentary female, compared with the unirradiated counterparts and with native flies. The irradiated male and female were ca. 40 and 60% respectively, less active than the native fly. The irradiated laboratory-reared fly also had a reduced potential for survival in a field cage and was eliminated in 6-9 days; the unirradiated fly was eliminated in 7-11 days.

_____ y CHAMBERS, D. L. Measuring the startle activity in Mediterranean fruit fly, *Ceratitis capitata*, populations. Bull. SROP Int. Organ. Biol. Control Noxious Anim. Plants West Palearctic Reg. Sec. 5:35-36. 1977. (404

SCHWARTZ, A. y KOK, I. B. Cold sterilization and fumigation for the control of false condling moth, *Cryptophlebia leucotreta* Meyr., and fruit flies, *Ceratitis* spp. in export citrus fruit. Journal of the Entomological Society of Southern Africa 39(2):261-266. 1976. (405

_____. Evaluation of fruit fly traps for use in citrus orchards. Citrus and Subtropical Fruit Journal, no. 539:16-17. 1978. (406

The results are given of a trial in a citrus orchard comparing the effectiveness of the Pherocon-2 (a new type of fruit fly trap) and the standard Israeli fruit fly trap. Both trapped males of *Ceratitis capitata* and *C. rosa*, but the numbers caught in the Israeli trap were much greater. Moreover, the Israeli trap withstood adverse weather conditions the better. (Horticultural Abstracts 49:3805)

_____ y TOIT, W. J. DU. Improvements to the mass rearing technique for the Mediterranean fruit-fly *Ceratitis capitata* (Wied.). Citrus and Subtropical Fruit Journal, no. 540:7-9, 12. 1978. (407

Modifications to the technique for mass-rearing *Ceratitis capitata* (Wied.) that were developed in South Africa are described. The adult flies are kept and fed in a sleeve cage made of gauze netting. Oviposition takes place

through the gauze and the eggs drop into water from which they are retrieved by sieving. The larvae are reared on an artificial medium that consists of distilled water, yeast powder, white sugar, sodium benzoate, hydrochloric acid and wheat bran and has a pH of 4-4.2. The tray containing the medium and eggs is kept in a wooden box with a tightly fitting cheesecloth cover to exclude *Drosophila*. The fully grown larvae emerge from the medium to pupate in sawdust provided on the bottom of the box; the pupae are then separated by sieving. A total of 16,000 pupae (occupying 400 ml) is produced from a 4 ml eggs/kg medium. (Review of Applied Entomology, A 68:1318)

SCIROCCHI, A. y CIRIO, U. Richerche ecologiche per un programma di lotta contro la *Ceratitis capitata* Wied. nella Piana di Fondi. Bollettino del Laboratorio de Entomologia Agraria 'Filippo Silvestri' 33:113-127. 1976. (408

Ecological investigations were carried out in 1972-74 over the coastal valley of Fondi in the Italian Province of Latina as a first stage towards determining whether the sterile-male technique could be usefully applied in that area against *Ceratitis capitata* (Wied.), which until then had been controlled exclusively by chemical applications. The studies concerned the types of fruit infested and seasonal rates of infestation, the population fluctuations of *C. capitata*, the relative abundance of the pest in different biotopes and its economic importance in the whole valley; details of the findings are shown in diagrams and tables. The highest rate of infestation (100%) occurred on apricot in July and on peach in August, but 60-65% occurred on figs in August and oranges in October. In general, *Ceratitis* populations (as deduced from captures of adults in traps baited with trimedlure) were highest and most uniformly distributed throughout the area in September-October, but population density varied greatly at all times from place to place. These data (and especially the isolation of the valley of Fondi from other fruit-growing regions and the heterogeneous nature of population densities), indicate that the sterile-male technique should be very effective for this area if employed in separate localities only at the times when populations are lowest in each locality. (Review of Applied Entomology, A 65:6737)

SCOPPA, P. y CAVALLORO, R. Attività delle ossidasi a funzione mista in *Ceratitis capitata* Wiedemann. Redia 60:375-385. 1977. (409

Preliminary studies were made in the laboratory at Ispra, Italy, with enzyme preparations from the abdomens of adults of *Ceratitis capitata* (Wied.), on some representative activities of the enzyme system (aminopyrine *N*-demethylation, *p*-nitroanisole *O*-demethylation and aniline hydroxylation) that metabolise compounds extraneous to the organism tested. Enzyme assays indicated that mixed-function oxidases were located in the microsomes and were slower in action than those detected in other insects. This has practical implications for the reactions of *C. capitata* to insecticides and other chemicals absorbed by it. (Review of Applied Entomology, A 66:5765)

SECRETARIA DE RECURSOS NATURALES, TEGUCIGALPA. Acción tomada por el Ministerio de Recursos Naturales contra la mosca del mediterráneo en Honduras. Tegucigalpa, 1975. 22 p. (410

_____. La mosca del mediterráneo; su detección y control. Tegucigalpa, 1975. 8 p. (411

SEHNAL, F. et al. Activities of oxa-analogues of farnesane-type juvenoids on cyclorrhaphous flies. Acta Entomologica Bohemoslovaca 72(6):353-359. 1975. (412

When administered in solution to post-feeding larvae by means of calibrated capillaries equipped with metal pistons, isopropyl and occasionally also the ethyl esters but not the *N,N*-diethylamides of the 5-oxa and 10-oxa analogues of farnesane-type juvenoids readily inhibited metamorphosis in *Ceratitis capitata* (Wied.), *Drosophila melanogaster* Mg., *Musca domestica* L., *Calliphora vomitoria* (L.) and *Sarcophaga crassipalpis* Macq., but the corresponding 6-oxa, 8-oxa, and 9-oxa analogues had little or no effect. Of the available juvenoids, isopropyl 10,11-epoxy-3,7,11-trimethyl-5-oxa-2-dodecenoate showed the greatest activity in *Ceratitis* and *Drosophila* and isopropyl 3,7,11,11-tetramethyl-10-oxa,2,4-dodecadienoate on *Calliphora* and *Sarcophaga*. Isopropyl 3,7-dimethyl-11-ethyl-10-oxa-2-tridecenoate was highly active against *Musca*, but its activity was surpassed by that of methoprene (Altosid) and methyl 2,3-methylene-3,7,11-trimethyl-11-ethoxy-6-dodecenoate. (Review of Applied Entomology, A 64:6938)

* _____ y ZDAREK, J. Action of juvenoids on the metamorphosis of cyclorrhaphous diptera. Journal of Insect Physiology 22(5):673-682. 1976. (413

Administrations of high doses of juvenoids to the last instar larvae of cyclorrhaphous flies cause occasionally lethal defects in puparium formation but mostly affect only the pupal-adult transformatiom. In pupae, juvenoids impede proliferation and differentiation of the imaginal disks and of abdominal histoblasts: at low doses they cause incomplete rotation of male genitalia and deformations of the ovipositor, at higher doses their effects gradually spread from the tip of abdomen towards the middle of the body. The highest amounts influence the entire abdomen, size and pigmentation of the eyes, and development of hairs and sclerotization of the integument on the head and thorax. Various species slightly differ in the pattern of morphological effects produced, in the ability of affected insects to leave the puparium, and in the sensitivity to juvenoids of different types. A uniform scale for classification of morphological effects in the species examined is described in this paper. The most potent juvenoids are effective at doses around one nanogramme per specimen. Out of 29 selected compounds tested, isopropyl 11-methoxy-3,7,11-trimethyl-2,4-dodecadienoate is the most active juvenoid for *Drosophila*,

*Musca*, and *Sarcophaga*; methyl 10,11-epoxy, 3,7,11-trimethyl-2,6-tridecadienoate is the most active juvenoid for *Ceratitis*; and isopropyl 11-chloro-3,7,11-trimethyl-2-dodecenoate possesses the highest activity for *Calliphora*.

SEHNAL, F., ROMANUK, M. y STREINZ, L. Potent juvenoids with cyclohexane moiety in the molecule. Acta Entomologica Bohemoslovaca 73(1):1-12. 1976. (414

The influence of the structural changes in the terminal part of the molecule of farnesane-type compounds on hormonal activity was investigated. All were tested on larvae or nymphs of *Nauphoeta cinerea* (Ol.), *Galleria mellonella* (L.), *Autographa gamma* (L.) (*Plusia gamma*), *Spodoptera littoralis* (Boisd.), *Leptinotarsa decemlineata* (Say) and *Ceratitis capitata* (Wied.), and the most active alicyclic compounds and the reference compounds were further testes on *Schistocerca americana* subsp. *gregaria* (Forsk.) (*S. gregaria*), *Dysdercus cingulatus* (F.), *Malacosoma neustria* (L.), *Agrotis ipsilon* (Hfn.), *Pieris brassicae* (L.), *Tenebrio molitor* L., *Chironomus riparius* Mg. (*thummi* (Kieff.)), *Musca domestica* L., *Calliphora vomitoria* (L.), *Sarcophaga crassipalpis* Macq. and *Apis mellifera* L. Alkyl esters of acids containing the isoprenic chain attached to the cyclohexane ring had a considerable juvenilising effect on the metamorphosis of the cockroach, the locust and the various species of Lepidoptera, a moderate effect on *A. mellifera* and the two species of Coleoptera and little effect on several species of Diptera and on *Dysdercus*. The degree of activity depended mainly on the length and isoprenic segmentation of the aliphatic chain and on the presence and position of the methyl substituents on the cyclohexane ring. Activity as high as 0.05 µg/g insect was found in ethyl 3,7-dimethyl-9-cyclohexyl-2,4-nonadienoate and its methyl homologues, especially in the 2-methylcyclohexyl derivative. These substances seem to be the most potent juvenoids at present available for the Blattid and Lepidoptera tested. Their lack of significant activity against *A. mellifera* and several flies suggest that they could be used against lepidopterous larvae, which are highly sensitive, without endangering dipterous and hymenopterous parasites. (Review of Applied Entomology, A 64:6939)

SELIM, O. F. Studies on the Mediterranean fruit fly, *Ceratitis capitata* Wied., in U. A. R. (Diptera : Tephritidae). Bulletin de la Société Entomologique d'Egypte 51:315-341. 1967. (415

*Citrus* groves throughout Egypt were surveyed in 1960-64 for infestation by *Ceratitis capitata* (Wied.), the most important of the fruit-flies attacking *Citrus* and other fruits in the country. The infested areas found are shown on a map, with indications of importance. The Governorates of Kaliuba, Sharkia, Dakahlia and the northern part of Behara, in Lower Egypt, and Fayum, in Upper Egypt, are the areas most heavily infested. No infestation was observed in Aswan Governorate or in the New Valley, and the intensity of the attack varied in other areas. In the Nile Delta and probably in most parts of the country, suitable host fruits are available throughout the year. Detailed information is given on

the results obtained when the natural population density during different periods of the year was determined in mixed orchards at Sabahia (Alexandria Governorate), Barrage (Kaliuba Governorate) and Wadi El-Natrun (Mersa Matruh Governorate) by means of glass traps baited with 3% diammonium phosphate. The average numbers of flies taken per trap per week in the three areas were 335, 93 and 28, respectively. In general, *Ceratitis capitata* was present on *Citrus* throughout the year at Barrage and Wadi El-Natrun and from April to January at Sabahia. From April-May to November-December, it was present in all three localities on other fruits, its abundance varying with the ripening period. (Review of Applied Entomology, A 60:4645)

SEO, S. T. et al. Residues of ethylene dibromide, methyl bromide, and ethylene chlorobromide resulting from fumigation of fruits and vegetables infested with fruit flies. Journal of Economic Entomology 63(4):1093-1097. 1970. (416

During laboratory investigations in Hawaii in 1955-68, asparagus, smooth cayenne pineapples (*Ananas comosus*), bell peppers (*Capsicum annuum*), papayas, navel oranges, litchis, tomatoes and avocados were fumigated with ethylene dibromide, methyl bromide or ethylene chlorobromide (though not all with all three) at the minimum dose currently recommended to prevent the accidental introduction of *Ceratitis capitata* (Wied.), *Dacus dorsalis* Hend. or *D. cucurbitae* Coq. into uninfested areas and at twice this rate in order to determine the residues of these three compounds and of inorganic bromide (usually after one and three days). After fumigation with methyl bromide, no residues of methyl bromide could be detected and residues of inorganic bromide were below the tolerated level; the amount of methyl bromide sorbed increased as the amount of protein in the produce (highest in asparagus) increased. After treatment with ethylene dibromide, residues of inorganic bromide increased as those of ethylene dibromide decreased; however, the residues of inorganic bromide, except in the case of peppers, were always low. Dipping papayas in hot ethylene dibromide solution left low residues of both inorganic bromide and ethylene dibromide. Fumigating peppers with ethylene chlorobromide gave high residues of inorganic bromide but low residues of ethylene chlorobromide. When papayas and pineapples in various types of packaging materials were fumigated with ethylene dibromide, the residues of ethylene dibromide in the packaging materials were both high and persistent. (Review of Applied Entomology, A 59:132)

_____ et al. Fumigation with methyl bromide plus refrigeration to control infestations of fruit flies in agricultural commodities. Journal of Economic Entomology 64(5):1270-1274. 1971. (417

The following is virtually the authors' abstract. In investigations in Hawaii, the minimum doses of methyl bromide (administered at the optimum temperature after a period of low-temperature storage), the minimum period of low-temperature storage, and the most effective combination of the two treatments were investigated for quarantine treatment of

papaya and avocado fruits infested with *Ceratitis capitata* (Wied.), *Dacus dorsalis* Hend. or *D. cucurbitae* Coq. Equations were used to approximate the separate effects of each of the treatments and of the combined treatments, and the results are discussed. Effective treatments resulted in about 32 survivors from a million eggs and larvae. Also, the residues in papayas and avocados were determined after fumigation and are shown in a table and tests are reported on minimum treatments to establish tolerance levels for residues in these fruits. A suitable integrated treatment proved to be fumigation with 32 g methyl bromide/$m^3$ for 2.5 h at 21.1°C and post-fumigation storage for six days at 7.2°C. (Review of Applied Entomology, A 60:1189)

SEO, S. T. et al. Hot water-ethylene dibromide fumigation-refrigeration treatment for mangoes infested by oriental and Mediterranean fruit fly. Journal of Economic Entomology 65(5):1372-1374. 1972. (418

In laboratory tests in Hawaii in 1971, mangoes were freed from infestation by *Dacus dorsalis* Hend. and *Ceratitis capitata* (Wied.) by sequentially heating the fruits in water at 46.3°C for 20 min., fumigating them with ethylene dibromide at 8 or 12 g/$m^3$ in wooden field boxes (41x56x16 cm) at 21.1°C for 2 h, and refrigerating them at 7.6°C for four days. The rate of infestation of the test fruits was 93-1060 larvae/kg, about 3-353 times that of fruit obtained from field collections. When the fumigation rate was 8 g/$m^3$, only one adult resulted from an estimated population of 207,019 eggs and larvae of the two Tephritids, while, when the rate was 12 g/$m^3$, no adults resulted from an estimated population of 215,012 eggs and larvae. The residues of ethylene dibromide in the peel and pulp of mangoes (variety Haden) fumigated at 8, 12 and 16 g/$m^3$ and kept at 23.3-30.6°C (the ambient temperature) for 1 or 3 days after refrigeration at 7.6°C ranged from 2.6 to 3.4 p.p.m. after 1 day and from 0.14 to 0.4 p.p.m. after 3 days; the residues of inorganic bromide ranged from 1 to 2.3 p.p.m. Mangoes of the varieties Pairi and Haden were not injured by any single treatment or by a combination of the three treatments. (Review of Applied Entomology, A 61:1656)

_____ et al. Mediterranean and oriental fruit flies: survival in commercial fruit cocktail. Journal of Economic Entomology 65(6):1652-1654. 1972. (419

When commercial fruit cocktail (consisting of diced papaya (*Carica papaya*), diced pineapple, sugar syrup and lime juice) was placed in sealed polyethylene bags and artificially infested with about a million eggs and larvae of *Dacus dorsalis* Hend. and *Ceratitis capitata* (Wied.) in laboratory tests in Hawaii, only four examples of *D. dorsalis* survived at air temperatures of 22-28°C for 1-24 h. Also, none of a million similar insects infesting fruit cocktail survived storage at about 1.7°C for 1 or 4 days. When fruit cocktail made with unpeeled papayas was infested

with about 114,000 examples of *D. dorsalis*, none survived storage at 1.7°C for four days or at 22-28°C for three days. When peeled fruits were used in the cocktail, storage at 1.7°C or 22-28°C for one day resulted in complete mortality of about 113,000 examples of *D. dorsalis*. It is concluded that careful selection of fruits, removal of large amounts of peel and pedicel ends, the use of diced pineapple, minimising air pockets in polyethylene bags, and storage of the fruit cocktail in sealed bags at 1.7°C for 1-3 days before shipment would make survival of the Tephritids unlikely. (Review of Applied Entomology, A 61:2459)

* SEO, S. T. et al. Hawaiian fruit flies in papaya, bell pepper, and eggplant; quarantine treatment with gamma irradiation. Journal of Economic Entomology 66(4):937-939. 1973. (420

Minimum doses of γ-radiation of 20.9, 21.4, 24.6, 25.2, and 29.1 krad in papaya, bell pepper, or eggplant for thicknesses of 1.47, 1.73-1.87, 2.18, 2.81 and 3.14 g/cm$^2$, respectively, prevented emergence of the adult oriental fruit fly, *Dacus dorsalis* Hendel; melon fly, *D. cucurbitae* Coquillett; and Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann). The irradiated population developed to 3rd-stage larvae, but the number of larvae was reduced significantly by refrigeration at ca. 7.2°C. Two-day-old or 12-day-old adult oriental fruit flies that were irradiated with minimum doses were sterile for longer than one month.

* _____ et al. Oriental and Mediterranean fruit flies; fumigation of papaya, avocado, tomato, bell pepper, eggplant, and banana with phosphine. Journal of Economic Entomology 72(3):354-359. 1979. (421

Infestations (1- to 3-day-old eggs and larvae) of the oriental fruit fly, *Dacus dorsalis* Hendel, or the Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann), were eliminated from packaged papayas, *Carica papaya* L., by low-temperature (12.8°C) fumigation with phosphine generated from 1/2 of a FUMI-CEL. There were no survivors from 103,880 oriental fruit flies after an exposure of 4940 ppm-h. Where fumigations were done at 12.8° or 18.5°- 26.1°C and 80% RH (ambient) mortality varied both with the natural logarithm of the concentration and treatment time because of the variable rates of phosphine generated. Time influenced efficacy more than concentration. The residues of phosphine in the fumigated papayas were 0.8 ppb after low-temperature fumigation and an exposure of 7600 ppm-h. These residues dissipated to trace levels after two days of storage at 12.8°C. Residues were 1.0-1.4 ppb after fumigation at ambient and an exposure of 770-9100 ppm-h. These residues decreased to 0.18-0.3 ppb after one day of storage. Residues of 1.3 ppb on the carton and the polyethylene foam sheet dissipated to levels ranging from trace to 0.4 ppb. Papayas and 10 Hawaiian varieties of avocado, *Persea americana* Mill., were not injured by low-temperature fumigation, but fumigated avocados ripened faster than unfumigated avocados. 'California Wonder' bell peppers, *Capsicum annuum* L. var. *annuum*, 'apple' and 'Williams

Hybrid' bananas, *Musa paradisiaca* spp. *sapientum* (L.) O. Ktze., 'N-52' and 'Anahu' tomatoes, *Lycopersicon esculentum* Mill., and five varieties of avocado were uninjured after fumigation for 12-63 h and exposures of 5500-20,000 ppm-h at ambient. 'Black Beauty' eggplant, *Solanum melongena* L., tolerated 550 ppm-h.

SERGHIOU, C. The sterile-male technique for control of the Mediterranean fruit fly, *Ceratitis capitata* Wied. in the Mediterranean basin. In Symposium on the Sterility Principle for Insect Control, Innsbruck, 1974. Proceedings. Vienna, International Atomic Energy Agency, 1975. pp. 11-28. (422

* _____. Selected factors affecting the quality of Mediterranean fruit fly used in sterile release programs. Journal of Economic Entomology 70(3): 351-356. 1977. (423

Adult irradiation of *Ceratitis capitata* (Wiedemann) males resulted in a lower degree of sterility and a higher degree of competitiveness compared to pupal irradiation. It was consistently observed with both adult and pupal irradiation that the increased level of sterility obtained with increasing dose was counteracted to the same extent by decreasing level of male competitiveness. In a test in which the marking efficiency and persistence of fluorescent powders was tested, best results were obtained with Tinopal-SFG. Marking did not have any adverse effect either on male competitiveness or on fly survival. Competitiveness of irradiated male flies decreased as their exposure to chilling increased. Chilling, however, did not have any adverse effect on fly survival.

_____. Testing the influence of marking on mating in *Ceratitis capitata*. Bull. SROP Int. Organ. Biol. Control Noxious Anim. Plants West Palearctic Reg. Sec. 5:110-111. 1977. (424

SERVAS, G. On the toxicity of insecticides against first-instar larvae of the Mediterranean fruit fly and of the vinegar fly reared on an artificial food medium. Zeitschrift für Angewandte Zoologie 58(3):297-362. 1971. (425

In nutritional studies in Berlin with a culture medium based on carrot powder and yeast, the susceptibility of first-instar larvae of *Ceratitis capitata* (Wied.) and *Drosophila melanogaster* Mg. to chlorinated hydrocarbon, organophosphorus and carbamate insecticides was investigated. In the first group, aldrin, dieldrin, heptachlor, heptachlor epoxide, toxaphene, Hostatox /polychloro-endomethylenetetrahydroindene/ and DDT had little direct effect on the larvae, but after repeated treatments the accumulated chemicals in the insects caused the ensuing adults to die just before, during or soon after emergence. The lethal doses of the first four compounds to the larvae were over 0.15 p.p.m. in the medium, and those of the last three were even higher. The lethal doses of endosulfan and γ BHC

(lindane) were over 40 p.p.m.; these compounds considerably affected larval growth but had no secondary effects on adults developing from the larvae. Methoxy-DDT (methoxychlor) was ineffective at less than 100 p.p.m. The organophosphates tested all gave excellent kill of the larvae, with LD50's of less than 1 p.p.m. for *C. capitata* and less than 1.5 p.p.m. for *D. melanogaster*. *Drosophila* adults, however, were less susceptible than the larvae to naled (Dibrom), dimethoate and bromophos. The carbamates differed greatly in their effects on first-instar larvae and adults of *D. melanogaster*. The most effective was methiocarb (Metmercapturon), followed by promecarb and Isolan, while carbaryl was effective only after repeated high doses. The high susceptibility of young *Ceratitis* and *Drosophila* larvae to organophosphates indicates that they might be useful as test insects for determining residues of these compounds in harvested crops. (Review of Applied Entomology, A 62:2933)

SERVICIO AGRICOLA Y GANADERO, SANTIAGO, CHILE. Las moscas de la fruta. 3a. ed. Santiago, Chile. Servicio Agrícola y Ganadero. Agroinformativo, no. 137. 1977. 4 p. (426

SHAABAN, A. M. et al. Pseudo-juvenilizing action of Dursban and Temik against pupae of the Mediterranean fruit fly, *Ceratitis capitata* (Wied.). Zeitschrift für Angewandte Entomologie 81(3):330-335. 1976. (427

A bioassay for the morphogenetic activity of chlorpyrifos (Dursban) and aldicarb (Temik) when applied topically to pupae of *Ceratitis capitata* (Wied.) is described. Both insecticides had a high pseudo-juvenilising action, adults categorized in scores from 0 to 4 surviving for only two days. The sensitivity of the pupae decreased at the pupal-adult apolysis. Both compounds were active as soil treatments, aldicarb being 19 times as active as chlorpyrifos. (Review of Applied Entomology, A 65:1805)

SHARP, J. L., CHAMBERS, D. L. y HARAMOTO, F. H. Flight mill and stroboscopic studies of oriental fruit flies and melon flies, including observations of Mediterranean fruit flies. Proceedings of the Hawaiian Entomological Society 22(1):137-144. 1973. (428

An automatically recording flight mills system consisting of 18 individual flight mills was developed in Hawaii and used to study the flight ability of males and females, 1, 2, 4, 8, 16 and 32 days old, of *Dacus cucurbitae* Coq. and *D. dorsalis* Hend. Determinations of wing-beat frequencies of these two species and of *Ceratitis capitata* (Wied.) were also made. Females of *D. cucurbitae* flew significantly better than males except at ages of one and four days. Males of *D. dorsalis* flew significantly better than females only when both were 16 days old. The flight ability of both species increased with age, and in both sexes of *D. cucurbitae* developed at approximately the same rate; the flight ability of females of *D. dorsalis* developed earlier than that of males. Among *D. cucurbitae*, the

earliest maximum weights and wingbeat frequencies were attained by eight-day old males and nine-day old females. In general, the wingbeat frequencies of all three species increased with advancing age. Males and females of C. *capitata* showed the highest mean wingbeat frequencies at all ages and *D. cucurbitae* the lowest. (Review of Applied Entomology, A 64:4699)

* SHARP, J. L. y CHAMBERS, D. L. A white-eyed mutant of the Mediterranean fruit fly. Journal of Economic Entomology 66(2):560-561. 1973. (429

This paper constitutes preliminary notification to the many scientists engaged in studies with C. *capitata* that a white-eyed strain is possible and potentially available. Such a variant may be useful for many studies, even if it proves to be functionally abnormal.

_____ y CHAMBERS, D. L. Gamma irradiation effect on the flight mill performance of *Dacus dorsalis* and *Ceratitis capitata*. Proceedings of the Hawaiian Entomological Society 22(2):335-344. 1974. (430

When pupae of *Dacus dorsalis* Hend. were exposed two days before adult emergence to doses of 20 krad γ-radiation, the 1- and 4-day-old males and the 2-,4-, 8- or 16-day-old females showed no abnormal flight behaviour when tested on a flight mill system. However, 2-day-old males spent more time in flight and flew longer distances than normal 2-day-old males; also 8- and 16-day old males flew more slowly than normal flies. Peak flight velocities lower than normal were shown by irradiated females 1 day old. When pupae of *Ceratitis capitata* (Wied.) were marked with blue dye and exposed to a dose of 10 krad γ-radiation two days before adult emergence or the adults were exposed two days after emergence, the adults flew shorter distances and more slowly than normal unmarked flies of the sage age. Marked males irradiated two days after emergence and tested five days after it spent more time in flight, flew greater distances and stopped less often than similar males tested at 10 days. Marked males irradiated as pupae and tested five days after emergence showed a reduced flight ability as compared with marked males irradiated as adults. By 10 days after emergence, the differences were either reversed or had disappeared. Irradiation of adults may be preferable to irradiation of pupae if sterile flies are required to play their greates role in a sterile-release programme during the first week after release. (Review of Applied Entomology, A 66:78)

* SHAW, P. E. et al. Preparation and insect attractant activity of some alkoxystyrene derivatives. Journal of Agricultural and Food Chemistry 24(6): 1186-1189. 1976. (431

The synthesis of hydroxy- and alkoxystyrene derivatives was studied and 15 derivatives were prepared from inexpensive, naturally occuring reagents. These compounds were evaluated as fruit fly attractants in an outdoor

olfactometer, and several were moderately attractive to male Mediterranean fruit flies. Others were moderately to strongly attractive to male oriental fruit flies. Several derivatives were moderately attractive to female Mediterranean fruit flies or melon flies, and 4-hydroxy-3-methoxystyrene benzoate was moderately attractive to both male and female melon flies. Effective female attractants are not available currently for these three insect pests.

SHOUKRY, A. Mating behaviour and competitiveness of sterile adult Mediterranean fruit fly, *Ceratitis capitata* Wied. in Egypt. Zeitschrift für Angewandte Entomologie 74(4):366-370. 1973. (432

_____. Determination of sterile dose of gamma irradiation for adult Mediterranean fruit fly *Ceratitis capitata* Wied. in Egypt. Zeitschrift für Angewandte Entomologie 75(1):109-112. 1974. (433

_____. Effects of juvenile hormone analogue ZR-512 on Mediterranean fruit fly *Ceratitis capitata* Wied. Zeitschrift für Angewandte Entomologie 76(2):134-137. 1974. (434

_____ y HAFEZ, M. Studies on the biology of the Mediterranean fruit fly *Ceratitis capitata*. Entomologia Experimentalis et Applicata 26(1):33-39. 1979. (435

The duration of the egg stage of *Ceratitis capitata* (Wied.) was significantly influenced by temperature. The threshold of egg development occurred at 11°C. Preservation of eggs at 8-9°C for two days reduced the hatch from 98 to 48%, and after six days no hatching occurred. Desiccation of eggs at 30% RH for 6 h reduced hatch from 98 to 12%, and after 12 h of desiccation no hatching occurred. The duration of the larval stage was affected by temperature. The zero point of larval development occurred at 5°C. The highest percentage of pupation was at 27°C, and at 35°C most of the larvae failed to jump from the medium. Humidity had no effect on pupal duration within the same temperature. Pupal duration was, however, influenced by temperatures between 22 and 30°C; with 35°C being fatal. At 60% RH, the threshold of pupal development occurred at 13°C. The highest percentage of emergence was observed at 25°C and 60% RH. Males lived for an average of 36 and 25 days at 25 and 30°C, respectively, while the female life-span was 31 and 25.5 days for the same temperatures. Females produced more eggs at 25°C (826 eggs/female) than at 30°C (459 eggs/female). Females reared withput males lived longer (67 days) and laid fewer eggs (248 eggs/female). (Review of Applied Entomology, A 68:1247)

* SIMON F., J. E. et al. Contribución al desarrollo de técnicas de cría masal de las moscas de la fruta, *Ceratitis capitata* Wied. y *Anastrepha fraterculus* (Wied.). Investigación Agropecuaria (Perú) 2(1):8-18. 1971. (436

Los autores presentan su contribución durante los dos últimos años (1969-70) al desarrollo de técnicas de cría masal

de las moscas de las frutas *Ceratitis capitata* (Wied.) moscamed y *Anastrepha fraterculus* (Wied.) moscasud, extractada de sus experiencias en los Laboratorios de OIRSA, en San José, Costa Rica y Estación Experimental Agrícola de La Molina en Lima, Perú. Incrementos en la producción de huevos de moscamed de hasta 2 1/2 veces, gracias al aumento de aeración e iluminación, con alargamiento de la vida útil de las moscas en el laboratorio de hasta 50% e incremento de la capacidad de vuelo de los adultos en campo, así como el desarrollo de una dieta larval a base de productos y subproductos de caña de azúcar, que permitió reducir el precio del millón de moscamed por debajo de US$12.00, incluyendo el valor de los huevos y mano de obra, aún en condiciones inadecuadas de laboratorio, son referidas en el trabajo. Nuevos dispositivos de oviposición de moscasud, que permitieron reducir grandemente la mano de obra necesaria para la obtención de huevos y un aumento en la vivacidad de los adultos, gracias a incrementos en la luminosidad y aeración, son presentados. Así mismo se hace referencia a ensayos de nuevas dietas larvales y a la tendencia a evitar el "lavado" de los medios, con el fin de reducir el empleo de mano de obra. Mayor trabajo tiene que ser hecho para aumentar la recuperación huevo-pupa, que es de 5 a 6%, lo que hace antieconómica la producción de A. *fraterculus* en el laboratorio.

* SIMON F., J. E. et al. Investigaciones sobre control de *Ceratitis capitata* W. por la técnica de insectos estériles en Moquegua, Perú. Revista Peruana de Entomología Agrícola 15(1):1-21. 1972. (437

En 1965 se inciaron los trabajos preparatorios para emplear la Técnica de Insectos Estériles en el control de las moscas de la fruta, *Ceratitis capitata* W., moscamed y *Anastrepha fraterculus* (Wied.), mosca Sudamericana, en la Estación Experimental del Ministerio de Agricultura en La Molina, los que fueron complementados con estudios de campo en Ica, Tacna, Moquegua y Lima, durante los siguientes años. En 1969 una dieta larval económica se había conseguido, así como la dosis de irradiación con rayos gamma de 10 Kr. había sido encontrada como eficiente en inducir esterilidad, permitiendo una razonable dispersión y competencia de los insectos irradiados con los normales, cuando los primeros estuvieron en una proporción de 50 a 100 por un normal. Por otro lado, se determinó que la eficiencia de captura de la trampa Steiner, cebada bimensualmente con 3 ml. de Trimedlure, era de 0,1% y que el transporte aéreo, en líneas comerciales, de pupas irradiadas, de Lima a Tacna, para su posterior teñido con 4 g de pigmentos fluorescentes "Daylight", embolsándolas con totora como superficie de sustentación y endurecimiento de alas y una fuente alimenticia de miel de abeja, azúcar de caña y agua en la proporción de 1:4:10, no afectaba mayormente la vitalidad de los individuos; por lo que se decidió tomar el valle de Moquegua, para ejecutar un ensayo piloto. Mediante 446 trampas Steiner se evaluó entre julio de 1969 y junio de 1970 la población natural de moscamed, sometiendo el valle a más 200 mil aplicaciones de insecticidas a fin de salvar la cosecha. Junio a octubre se mostraron como los meses de

menor población natural, iniciándose en julio de 1970 las liberaciones de insectos estériles en 2410 has del valle central de Moquegua, dejándose la parte baja, llamada valle de Ilo, como testigo sin insecticidas ni insectos estériles. Ilo con 306 has. de superficie cultivadas está a 25 kms aguas abajo de la zona de liberación de moscas irradiadas, separado por un estrecho y profundo curso de agua conocido como Cañón de Osmore. Los resultados obtenidos hasta marzo de 1971, muestran poblaciones mínimas y máximas de 0,900 a 25.000 moscas normales por trampa y por día, para la zona testigo; de 0,027 a 0,497 para la zona tratada con insecticidas y de 0,003 a 0,022 para la zona liberación de insectos estériles, a pesar de la falta de medidas de control cuarentenario en la carretera panamericana y de la migración de moscas desde el testigo a la zona de liberación que alcanzó hasta 0,047 moscas por trampa por día, en marzo. Desde el punto de vista económico la mayor cosecha sana dió un margen a favor de la técnica de insectos estériles en comparación con el control químico.

SIMON F., J. E. et al. Present status of the Peruvian project on Mediterranean fruit fly control by the sterile-male technique. In Panel on the Practical Use of the Sterile-Male Technique for Insect Control, Vienna, 1972. Proceedings. Vienna, International Atomic Energy Agency, 1974. pp. 95-101. (IAEA-STI/PUB/364) (438

SOMMEIJER, M. J. The distribution of some important insect pests in the eastern Caribbean. In Symposium on the Protection of Horticultural Crops in the Caribbean, St. Augustine, Trinidad, 1974. Proceedings. St. Augustine, Trinidad, University of the West Indies, Department of Crop Science, 1978. pp. 275-285. (439

The distribution of several agricultural insect pests in the eastern Caribbean is discussed. The main species dealt with are *Aeneolamia varia saccharina* (Dist.) on sugar-cane, *Anastrepha striata* Schin., *A. serpentina* (Wied.), and *A. obliqua* (Macq.) (*mombinpraeoptans* Sein) on fruit crops, *Faustinus cubae* (Boh.) on sweet pepper, *Cylas formicarius elegantulus* (Summers) on sweet potato, *Cholus martiniquensis* Mschl. on coconut, *Hellula phidilealis* Wlk on cabbage and cauliflower, *Megastes grandalis* Gn. on sweet potato, *Brassolis sophorae sophorae* (L.) on coconut, and *Acromyrmex octospinosus* (Reich) and *Atta cephalotes* (L.) on many crops. Although most major pests are present in all sizeable territories, these species are not evenly distributed throughout the territories but are of major importance in the areas where they do occur. Possible factors responsible for the present geographical distribution of 'local' pests are discussed as well as some of the factors that may contribute to a change in their distribution in future. In addition, several species that are potential pests but not yet known to occur in the Caribbean are dealt with because of the risk of their being introduced; these include *Ceratitis capitata* (Wied.) and *Anastrepha ludens* (Lw.). (Review of Applied Entomology, A 66:4150)

SOUTHERN, D. I. Cytogenetic observations in *Ceratitis capitata*. Experientia 32(1):20-22. 1976. (440

SOUZA, H. M. L. DE, PIEDRABUENA, A. E. y PAVAN, O. H. O. Biología de *Ceratitis capitata* (Wiedemann) (Diptera-Tephritidae). Um novo meio artificial de criação para produção em massa. Papéis Avulsos de Zoologia 31(14): 213-220. 1978. (441

A method used to rear large numbers of *Ceratitis capitata* (Wied.) in the laboratory in Brazil is described. Larvae were collected in the field from peach fruits and the adults to which they gave rise were held at 17-24°C (average 20°C) and 40-50% RH. Eggs were collected daily and placed on the surface of the larval rearing medium. The basic diet contained honey, maize meal, Fleischman yeast, agar, Nipagin /methyl 4-hydroxybenzoate/ and water, to which was added daily orange juice or a mixture of Gevral (a product containing vitamins, proteins and mineral salts), extra yeast and extra water and honey. When full-fed, the larvae left the diet to pupate in moist sawdust. Eggs, larvae and pupae were kept at 21°C and 80% RH. The adults were provided with a mixture of Gevral, raw sugar, refined sugar, Levemil, Fleischman yeast and honey. About 97-98% of the eggs hatched. When the basic larval diet was supplemented with the mixture, 92.72% of the larvae completed their development and 89.45-97.45% of the pupae developed to the adult stage. The egg, larval and pupal stages lasted for about 2-4, 9-18 and 10-16 days, respectively. Adults became sexually mature in 3-4 days and females laid an average of about 150 eggs each. Adults of both sexes lived for up to 75-80 days, but the average life-span was 33.85 days. (Review of Applied Entomology, A 67:2635)

SOYLU, O. Z. y UREL, N. Investigations on the parasites and predators of insects injurious to citrus orchards in the region of South Anatolia. Bitki Koruma Bülteni 17(2/4):77-112. 1977. (442

In 1973-74, surveys made on the parasites and predators of the arthropod pests on citrus in 12 orchards in different localities of the Mediterranean region of Turkey (southern Anatolia) and 33 species of insect pests, 4 mite pests, some 70 species of beneficial insects and 2 species of predacious mites (together with their hosts or prey) are listed. Since it was difficult to distinguish the activity of individual species of natural enemies on individual pest species, natural control was assessed of the major citrus pests such as *Planococcus citri* (Risso) (which is parasitised by *Achrysopophagus* sp., *Anagyrus pseudococci* (Gir.) and *Leptomastidea abnormis* (Gir.) and preyed upon by *Scymnus* spp., *Hyperaspis polita* Weise, *Sympherobius sanctus* Tjeder, *Chilocorus bipustulatus* (L.) and *Orius minutus* (L.)) and *Aonidiella aurantii* (Mask.) (which is parasitised by *Aphytis chrysomphali* (Merc.), *A. melinus* DeBach, *Aspidiotiphagus lounsburyi* (Berl. & Paoli) and *A. citrinus* (Craw) and preyed upon by *Pharoscymnus ovoideus* Sic. and *P. pharoides* (Mars.)). Different situations were found in

different regions. The two pests mentioned were very common in the Adana district, with low populations of natural enemies, and the situation was further complicated by the location of the citrus orchards near cotton fields, where frequent insecticide applications prevented the development of populations of predators such as *C. bipustulatus* in the citrus orchards. In the Hatay and Icel districts, different pests (mostly scale insects and mites) were common, but except for *Coccus* spp. they were usually kept under control by their predators and parasites if the only sprays used were of light mineral oil without other chemicals. It is recommended that (contrary to the current practice in Turkey of frequent organophosphate applications), oil sprays should be applied against scale insects, selective acaricides against mites and, if necessary, bait-sprays against the occasional outbreaks of *Ceratitis capitata* (Wied.), besides cultural measures, in order to take advantage as much as possible of natural control by beneficial insects. (Review of Applied Entomology, A 66: 5494)

SPHARIM, Y. Economic feasibility of establishing a pilot plant for control of the Mediterranean fruit fly by distribution of sterile males. In Symposium on the Sterility Principle for Control Insect Control, Innsbruck, 1974. Proceedings. Vienna, International Atomic Energy Agency, 1975. pp. 151-158. (FAO-ACCESS, no. 29066) (443

* SPROUL, A. N. Disinfestation of Western Australia Granny Smith apples by cold treatment against the egg and larval stages of the Mediterranean fruit fly (*Ceratitis capitata* (Wied.)). Australian Journal of Experimental Agriculture and Animal Husbandry 16(79):280-285. 1976. (444

In a series of tests during 1974 export grade Granny Smith apples artificially infested with eggs, young and old larvae of Mediterranean fruit fly (*Ceratitis capitata* (Wied.)) were cold stored at 0.5°C ± 0.5°C for 14 days and at 1.5°C ± 0.5°C for 16 days in simulated commercial conditions. No survivors were recorded from tests in which an estimated total of 340,200 eggs and larvae were treated. No injury to the fruit was caused by the treatments. Apples are held in cool stores after harvest at these temperatures as normal commercial practice. The experimental programme demonstrated that such commercial treatments can be applied to meet export requirements to obtain entry to quarantine areas.

_____. Green lemons safe from fruit fly. Journal of Agriculture, Western Australia 17(1):32. 1976. (445

Eureka lemons at various stages of maturity, from green export grade to yellow-ripe and over-ripe were placed singly in cages containing about 5,000 adult Mediterranean fruit flies /*Ceratitis capitata* (Wied.)/. In over-ripe lemons, the number of punctures on the fruit in a period of 16 h averaged 505, as compared with 34-97 for the other fruit; and the number of pupae that developed 68, as compared

with none. Even when eggs hatched in export grade lemons, the larvae died in the first instar. The results are discussed in relation to the selection in the orchard of fruit for export, and restrictions on movements between States in Australia and exports to other countries such as Japan and the United States. (Review of Applied Entomology, A 65:1437)

* SUPLICY FILHO, N., SAMPAIO, A. S. y MYAZAKI, I. Flutuaçao populacional das "moscas das frutas" (*Anastrepha* spp. e *Ceratitis capitata* (Wied., 1824)) em citros na fazenda Guanabara, Barretos, SP. Biológico (Brasil) 44(11): 279-284. 1979. (446

Em cultura intensiva de citros, no município de Barretos (SP), realizou-se um levantamento populacional das "moscas das frutas" (*Ceratitis capitata* (Wied.) e *Anastrepha* spp.). Na captura desses tefritídeos, utilizou-se caça-moscas tipo "valenciano", modificado e a solução atrativa foi melaço a 7%; as trocas da solução e as contagens foram realizadas semanalmente. Obtidas as curvas representativas da flutuação populacional, procurou-se correlacioná-las com os dados meteorológicos registrados; mas, nos 18 meses de ensaio, esses dados não sofreram grandes variações, salvo a precipitação, impossibilitando essa comparação. Nos três semestres, o comportamento das curvas foi assim: predominância de *Ceratitis capitata* (Wied.) no. 1° semestre; no. 2; presença absoluta da *Anastrepha* spp., estando ausente a "mosca do Mediterraneo; e no último, ambas as espécies foram capturadas em números reduzidos. Este resultado inesperado, permite supor que, a interferência dos inimigos naturais e outros fatores predisponentes são expressivos.

SWART, P. L., BARNES, B. N. y MYBURGH, A. C. Pests of table grapes in the Western Cape. Deciduous Fruit Grower 26(5):169-172, 174-179, 181-183, 187-195. 1976. (447

Descriptions are given of the damage caused, with details of the life history and recommended control measures against mealybug (*Planococcus ficus*), snoutbeetles (*Phylctinus callosus* and *Eremnus* spp.), vine blister mite (*Eriophyes vitis*), fruit flies (*Ceratitis capitata* and *Pterandrus rosa*), bollworm (*Heliothis armigera*) and fruit piercing moths (*Serrodes partita* and *Calpe* spp.). Notes are also included on damage by and control of snails (*Theba pisana* and *Helix aspersa*), red spider mite (*Tetranychus cinnabarinus*) and birds (especially *Passer melanurus*). (Horticultural Abstracts 47:1331)

* TANAKA, N. et al. Low-cost larval rearing medium for mass production of oriental and Mediterranean fruit flies. Journal of Economic Entomology 62(4): 967-968. 1969. (448

Following an investigation in Hawaii in 1964 to find an inexpensive substitute for dehydrated carrot powder in the larval diet used for rearing *Dacus dorsalis* Hend. and *Ceratitis*

*capitata* (Wied.), a new formulation was developed containing sugar, torula yeast, wheat shorts, wheat middlings and a moisture control agent to maintain relatively dry conditions. Egg production, viability and the quality of the pupae when the two species were reared on the diet were found to be comparable to those of adults reared on a carrot medium. (Review of Applied Entomology, A 58:146)

TANAKA, N. et al. Control of the excessive metabolic heat produced in diet by a high density of larvae of the Mediterranean fruit fly. Journal of Economic Entomology 65(3):866-867. 1972. (449

Laboratory tests were carried out in Hawaii in 1967 on the control of the excessive metabolic heat produced in a laboratory diet by a dense population of larvae of *Ceratitis capitata* (Wied.) during rearing. Transferring the rearing trays from 27 to 21°C when the temperature of the diet rose was found effective, and the new technique permitted the production of more than 50 million pupae in two years. (Review of Applied Entomology, A 60:5043)

* _____. Facility for large-scale rearing of tephritid fruit flies. U. S. Department of Agriculture. Technical Bulletin, no. 1576. 1978. pp. 63-64. (450

The rearing facility of the Hawaiian Fruit Flies Laboratory, located on the "upper" campus of the University of Hawaii, is used for production of the melon fly, *Dacus cucurbitae* Coquillett, the Mediterranean fruit fly, *Ceratitis capitata* (Wiedemann), and the oriental fruit fly, *D. dorsalis* Hendel. These insects are used for research on commodity treatments, attractants, physiology, irradiation, chemical control, and related problems. The facility also is suitable for mass producing up to 30 million flies per week for pilot test studies or actual sterile-fly release programs.

* TERAN, H. R. Comportamiento alimentario y su correlación a la reproducción en hembras de *Ceratitis capitata* (Wied.) (Diptera, Trypetidae). Revista Agronómica del Noroeste Argentino 14(1-4):17-35. 1977. (451

Se registró la cantidad de sustancia orgánica nitrogenada y de carbohidratos, requeridas por la hembra adulta de *Ceratitis capitata* (Wied.). Estos datos fueron referidos a su potencial de reproducción, al desarrollo de los óvulos y a la puesta de huevos, durante distintos períodos de tiempo de su vida. Se demuestra que la cantidad de sustancia orgánica nitrogenada seleccionada es necesaria para completar el desarrollo de los óvulos y que es proporcional a la cantidad de huevos puestos. Además, se demostró que la cantidad de esta sustancia, ingerida en el segundo día de vida adulta, indica su potencial de productividad. En cuanto a la selección de carbohidratos, queda establecido que no sólo son utilizados para oviponer, sino también para otras funciones.

* TERAN, H. R. Selección de alimentos por los machos e influencia de éstos y del espacio vital sobre el comportamiento reproductivo de las hembras de *Ceratitis capitata* (Wied.) (Diptera, Trypetidae). Revista Agronómica del Noroeste Argentino 15(2):59-66. 1978. (452

Se realizó un estudio del comportamiento alimentario de los machos de *Ceratitis capitata* (Wied.), midiéndose la cantidad de alimento seleccionado por ellos durante la primera semana de vida adulta. Los resultados indican que las sustancias orgánicas nitrogenadas no son indispensables para su vida. En cuanto al consumo de sustancia azucarada no se detectó variabilidad en esta población. Además se estudió la influencia que los machos ejercen sobre el comportamiento reproductivo de las hembras y la incidencia del espacio vital en la postura. Los resultados indican que la presencia de machos apresura la puesta en las hembras y que la cantidad de hembras por volumen vital, afecta la postura.

* TOLEDANO ALONSO, A. y STEPHENS, D. Actividades del Cordón Fitosanitario del Sureste durante el año de 1969. Fitófilo (México) 23(65):14-17. 1970. (453

La "mosca del Mediterráneo" *Ceratitis capitata* (Wied.) se encuentra distribuida en diferentes países de Centro y Sudamérica, constituyendo un peligro de invasión a nuestro país por las fronteras de Chiapas, Tabasco, Campeche y Territorio de Quintana Roo, así como por los puertos marítimos y aeropuertos internacionales. El Cordón Fitosanitario del Sureste, con sede en Tapachula, Chis., realiza los trabajos preventivos de trampeo, inspección, decomiso y quema de frutos hospederos y liberación de parásitos para evitar la introducción y establecimiento de la "mosca del Mediterráneo" en territorio nacional. Durante el año de 1969 se manejaron 2.722 trampas, de las cuales 566 están provistas de doble mecha para también detectar la "mosca del melón" *Dacus cucurbitae* (Coq.). Se inspeccionaron en Talismán 4.264 vehículos; en Ciudad Hidalgo 3.667, y Ciudad Cuauhtémoc, Chis., 756, procedentes de países centro y sudamericanos. Se liberaron 119.713 parásitos *Syntomosphyrum indicum* (Silv.) y 4.123 *Opius* sp. enviados de México y 41.773 criados en el Laboratorio de Tapachulas, Chis. Se identificaron un total de 1.551 insectos y arácnidos capturados en las trampas. En nueve años de trabajo de este Cordón no se ha capturado ningún ejemplar de "mosca del Mediterráneo".

TRONOV, V. N. y VASHAKMADZE, G. G. Fumigation of oranges at low temperatures. Zashcita Rastenii, no. 8:47. 1973. (454

Fumigation of imported oranges with methyl bromide against Mediterranean fruit fly /*Ceratitis capitata*/ at 8°C in the lower boxes resulted in temperatures of 18° in the upper boxes and fruit weight loss. At a fruit temperature of 4-5° fumigation with methyl bromide at 60 g/m$^3$ for 4 h gave 100% control and only 0.8% fruit weight loss. (Horticultural Abstracts 44:7098)

TROUILLON, L. L. Un succes du controle phytosanitaire; la disparition en France de la mouche des fruits. Phytoma 28(277):27-29. 1976. (455

The biology of *Ceratitis capitata* (Wied.) on fruit trees in France is described. The fruit fly was for many years the most important pest of orchards in the south and south-east of France, and repeated applications of insecticides were necessary for its control. As a result of strict control of imported fruit since 1959, *C. capitata* is now rarely found in France. (Review of Applied Entomology, A 65:3281)

_____. A nouveau la mouche des fruits. Phytoma 29(286):17-18. 1977. (456

The fruit-fly /*Ceratitis capitata* (Wied.)/, which had been considered to be now virtually absent from France, reoccurred in orchards in the south of the country in summer 1976. Except in one or two areas, *C. capitata* is unable to overwinter in France, and it is suggested that the fruit-fly was probably imported with fruit (especially apricots, pears, plums and citrus), completing its development in infested fruit that was discarded and not incinerated. (Review of Applied Entomology, A 65:5540)

TUCUMAN. ESTACION EXPERIMENTAL AGRICOLA. Memoria 1973. Tucumán. Estación Experimental Agrícola. Publicación miscelánea, no. 51. 1974. 202 p. (457

Citrus: Chemical control of *Aceria sheldoni*, *Aonidiella aurantii* and *Unaspis citri*; poison bait for *Ceratitis capitata* and its effects on beneficial insects; NPK trials; rootstock trials for oranges and lemons; and improvement of *Poncirus trifoliata* rootstocks for nucellar mandarin. Avocado: Fungicide trials on trees affected with decline. (Horticultural Abstracts 46:1762)

TUNCYUREK, M. Recent advances in the bio-ecology of *Ceratitis capitata* Wied. in Turkey. Bulletin EPPO 6:77-81. 1972. (458

Since 1960, many studies on *Ceratitis capitata* (Wied.) have been carried out in Turkey. A considerable number of host-fruits were recorded, but the main one is *Citrus*. Damage to *Citrus* was recorded as 6.1 - 7.8% in the western parts of the country in 1961 and 3.5 - 6.2% in the south in 1961-65. Field observations in both western and southern Turkey on the most suitable periods for control are recorded. The population densities of the fly in the various areas are shown on graphs. (Review of Applied Entomology, A 61:2840)

* TURICA, A. Los atractivos principales de las moscas de los frutos y la influencia de las temperaturas. In Jornadas sobre Moscas de los Frutos, Tucumán, Argentina, 1969. Documentos. Argentina. Estación Experimental Agrícola de Tucumán. Publicación miscelánea, no. 32. 1970. p. 7. (Sólo resumen). (459

Durante los últimos años se trató de determinar el comportamiento que tienen las principales sustancias atractivas de

las moscas de los frutos (Trypetidae) durante las diferentes estaciones del año, por medio de ensayos comparativos. Los atractivos fueron colocados en mosqueros "Portici" que se mantuvieron permanentemente en funcionamiento durante los últimos tres años, en dos montes frutales vecinos al Gran Buenos Aires. De acuerdo con los registros semanales de la cantidad de adultos atrapados se pudieron extraer las siguientes conclusiones: a) Cuando las temperaturas medias del ambiente estuvieron por debajo de 18°C solamente el Trimedlure y el extracto de levadura de cerveza (al 1%) y sus derivados detectaron la presencia de adultos de la mosca del Mediterráneo. Otros atractivos, como ser: vinagre de vino (al 0.25%) y agua de maceración de maíz (E 801) (al 1%) no respondieron; b) El clásico atractivo de vinagre de vino recién empezó a actuar cuando el valor térmico medio superó los 18°C y las primeras caídas de moscas de produjeron de 20 a 26 días después de que las habían registrado los productos anteriormente citados; c) Durante el período de mayor densidad de la plaga, que se produce generalmente en el verano, el vinagre de vino capturó la mayor cantidad de moscas, actuando momo medio de control y no como detector. El agua de maceración de maíz fue la que menor cantidad de adultos atrapó; d) De lo expuesto resulta que los únicos detectores entre las sustancias ensayadas fueron Trimedlure y extracto de levadura de cerveza y sus derivados ("HVP" y el primer extracto de levadura), mientras que tanto el vinagre, como el agua de maceración pueden hacer confundir cuando son utilizados como indicadores de la existencia de la población de moscas en los períodos de baja temperatura.

* TURICA, A. y VALSANGIACOMO, F. J. Evaluación de la técnica de machos estériles en el control integrado de la mosca del mediterráneo. In Jornadas sobre Moscas de los Frutos, Tucumán, Argentina, 1969. Documentos. Argentina. Estación Experimental Agrícola de Tucumán. Publicación miscelánea, no. 32. 1970. pp. 9-10. (Sólo resumen). (460

Los ensayos conducidos para determinar si la "mosca del mediterráneo" reúne las condiciones necesarias para la aplicación de la técnica de "machos estériles" han demostrado, que cuando son irradiadas las pupas de ocho días de edad, mantenidas a la temperatura constante de 26°C, reciben el factor letal dominante trasmisible a las células germinativas de hembras naturales de cualquier edad. La dosis más adecuada fue de 10.000 rad, que produjo la infertilidad total de hembras tratadas, y dejó en condiciones al sexo masculino para la transmisión de la esterilidad. Por medio de aplicación de 30.000 rad se produjo la muerte de ambos sexos de esta plaga. En el primer ensayo de campo donde se combinaron los tratamientos químicos por medio de la colocación de la red de mosqueros con el atractivo de Trimedlure, en cantidad de seis frascos por hectárea, y posterior liberación de moscas irradiadas y los enemigos naturales, se llegó a la erradicación de las "moscas de los frutos" del área del ensayo, constituído por un monte de citrus de 30 hectáreas de superficie, situado en la zona de Concordia, Provincia de Entre Ríos. Repetido este ensayo en la zona de Yuquerí (Concordia), en una superficie de 2.700 hectáreas

de cultivos cítricos, con la modificación de la aplicación de control químico que aquí se efectuó por medio de los tratamientos químicos con cebos tóxicos, como se acostumbra en dicha zona, a los que siguieron las liberaciones masivas de moscas estériles, en cantidad de cinco millones, y las sueltas periódicas de los parásitos naturales de la plaga, se llegó a reducir las poblaciones de la plaga hasta llegar al cero de población en el mes de marzo, mientras que las parcelas testigos acusaron en el mismo mes que la plaga prosiguió su actividad, si bien con una densidad reducida. En los registros posteriores, la plaga reapareció después de haberse terminado las liberaciones de moscas estériles a pesar de haberse reiniciado los tratamientos con cebos tóxicos, manteniéndose activa con poblaciones reducidas hasta el mes de julio. Este ensayo proseguirá, habiéndose programado para tres años. La diferencia registrada entre la densidad con que actuó la plaga en el área del ensayo y las parcelas testigos, fue comprobada durante este primer año del ensayo mediante la evaluación de los daños en la fruta, habiéndose obtenido en el primero un promedio de 0,4% de pomelos agusanados, mientras que en testigos llegó hasta un 15% de daños. El método empleado en la cría artificial, como también en la irradiación, transporte y distribución de pupas irradiadas en los montes frutales, permitió una buena difusión de moscas estériles. Se ensayó la distribución por medio de bolsas de papel que contenían unas 10.000 pupas por unidad, que fueron ubicadas a 200 metros de distancia entre cada una, tratando de concentrar una cantidad mayor alrededor de los centros de infestación que tiene la plaga en los hospederos intermedios que maduran durante los meses de verano, como ser: durazneros, higueras, guayabos, etc. Por el otro lado, la combinación de control integrado entre los cebos tóxicos aplicados durante el período en que la fruta cítrica ofrece el blanco para los ataques de los Trypetidae y la liberación continuada de los parásitos naturales, de origen nativo y exótico, en los ensayos efectuados durante los últimos tres años en la zona de Calilegua (Jujuy) y en Eldorado (Misiones), dió buen resultado. En ambas zonas ensayadas el nivel de los daños bajó considerablemente en comparación con las zonas testigos. Las especies útiles empleadas demostraron alto grado de adaptación habiéndose podido recuperar las siguientes: *Opius longicaudatus*, *Syntomosphyrum indicum*, *Opius tucumanus* y *Eucoila (Cothonaspis) haywardi*.

* TURICA, A., VALSANGIACOMO, F. J. y MALLO, R. G. Utilización de la técnica de machos esterilizados en el control integrado de las "moscas de los frutos" en los cítricos. IDIA (Argentina), no. 281:6-24. 1971. (461

En el presente trabajo se trata de aportar algunos conocimientos sobre las posibilidades de un control más efectivo de las moscas de los frutos, mediante la combinación racional de diferentes métodos de lucha, en montes frutales de distintas regiones citrícolas de nuestro país. El objetivo principal de estos ensayos fue hallar el modo de reducir aún más los focos que generalmente, quedan después de haberse aplicado tratamientos comunes con cebos tóxicos. Sin duda, éstos son responsables de la constante reaparición de la plaga que exige un sinnúmero de tratamientos químicos todos los años.

* TURICA, A. Evaluación del quimioesterilizante "Apholate" en el control de la "mosca del mediterráneo". IDIA (Argentina), no. 302:11-20. 1973. (462

En este trabajo se presenta una serie de ensayos realizados con el propósito de contribuir a la solución de algunos problemas sobre quimioesterilización de *Ceratitis capitata*, relacionados con determinar la dosis mínima efectiva de Apholate. Los ensayos se efectuaron en laboratorio y fueron corroborados mediante pruebas de campo. De los resultados obtenidos se puede concluir que la dosis de 0,5% de Apholate es efectiva siempre que se aplique en forma de alimentación del sexo masculino. Los tratamientos por contacto no alcanzaron la efectividad necesaria. Se ensayó el suministro del Apholate en el monte frutal en forma de hisopos embebidos con el cebo esterilizante en la dosis mínima eficiente de 0,5%. Para atraer a los machos se agregó por separado en los soportes una mecha de atractivo sintético Trimedlure. La experiencia demostró que a pesar de lograrse una importante reducción en la densidad de población a partir de la generación siguiente, como consecuencia del efecto esterilizante, no es suficiente para reducir su actividad dañina, por lo que hay que combinar este método con otros de lucha dentro de los principios de control integrado para obtener óptimos resultados. (CV)

* _____ y PEREZ DE CALVO, M. C. Esterilidad transmitida en apareamientos alternados entre moscas esterilizadas y normales de *Ceratitis capitata*. IDIA (Argentina), no. 325-327:1-3. 1977. (463

Estos ensayos se realizaron en el Departamento de Patología Vegetal en Castelar, Argentina, para conocer qué ocurre con los apareamientos alternados entre "moscas de los frutos" irradiados y normales. Se efectuaron cuatro repeticiones utilizándose jaulas munidas de igual cantidad de moscas. Se analizaron en total alrededor de once mil huevos por cada repetición. La relación de sexos por jaula fue de 20 hembras por 100 machos. Las hembras fueron expuestas en este trabajo como si se tratara de un caso de "biandria". Se comprobó que machos irradiados que en su primer apareamiento con hembras silvestres dieron desoves estériles en su totalidad. Cuando se aparearon con hembras ya fertilizadas su grado de fertilidad se reduce, emiten huevos con una fertilidad media de 59,5%. Se demostró también que las hembras liberadas conjuntamente con machos esterilizados, que se hace por falta de método de separación masiva por sexos, no ocasiona perjuicio alguno por ser totalmente infértiles y su posible desventaja de atraer una parte de machos liberados se compensa por el hecho de atraer a machos silvestres. (CV)

UMEYA, K. y YAMAMOTO, H. Studies on the possible attack of the Mediterranean fruit fly (*Ceratitis capitata* Wiedmann) on the green bananas. Research Bulletin of the Plant Protection Service, no. 9:6-18. 1971. (464

Females of *Ceratitis capitata* (Wied.) were found in Japan to oviposit equally and freely both on green-harvested

and unharvested banana fruits. The numbers of eggs laid/puncture in green bananas was half that in ripe fruit. No larvae survived in green fruit left unpicked for ten days after oviposition. In harvested fruit a few larvae were found after five days, but no further development took place unless the fruit ripened within six days of oviposition. (Review of Applied Entomology, A 62:1105)

UNITED STATES DEPARTMENT OF AGRICULTURE. Mediterranean fruit fly (*Ceratitis capitata*) - California. Cooperative Plant Pest Report 1(30):467; 1(42):763. 1976. (465

At the end of a control campaign against *Ceratitis capitata* (Wied.) in Los Angeles County, California, by means of releases of sterile adults beginning in November 1975, releases have been discontinued and catches of sterile flies are decreasing markedly each week. No fertile flies have been found, and no larvae reared from collected fruits. (Review of Applied Entomology, A 65:2277)

_____. Mediterranean fruit fly (*Ceratitis capitata*) - Mexico. Cooperative Plant Pest Report 2(6):54. 1977. (466

*Ceratitis capitata* (Wied.) is recorded for the first time in Mexico; two females were trapped in February 1977 in Chiapas State just north of the border with Guatemala. Citrus trees in private gardens and coffee appear to be the only important food-plants in the area. Susceptible commodities are now not allowed out of the regulated area of 12 mile$^2$. (Review of Applied Entomology, A 65:5452)

* VARGAS VARGAS, C. y MELLADO BRAUNS, L. Efecto del tratamiento combinado de refrigeración e irradiación gamma en adultos de *Ceratitis capitata* Wied. Anales del Instituto Nacional de Investigaciones Agrarias. Protección Vegetal, no. 2:171-183. 1972. (467

Se efectuó una serie de tres ensayos con el fin de determinar el efecto de la irradiación de *Ceratitis capitata* al estado de adulto, con radiación gamma a la dosis de 10,5 Krads sobre la fertilidad, supervivencia y oviposición. Los adultos empleados en estos ensayos fueron adormecidos mediante enfriamiento a bajas temperaturas con la finalidad de facilitar la manipulación de los mismos antes y después de ser irradiados. Adultos machos de un día de edad mantenidos en cámara frigorífica a 12°C durante un período de dos horas, luego irradiados y posteriormente mantenidos a 2°C durante 72 horas mostraron un nivel de esterilidad del 99,65%, pero también una supervivencia reducida. Sin embargo, cuando adultos machos de un día de edad fueron mantenidos en cámara frigorífica a -23°C durante cinco minutos, luego irradiados y posteriormente mantenidos durante 24 horas a 5°C., mostraron un nivel de esterilidad del 98,60% al 100%; no hallándose síntomas de recuperación de fertilidad por lo menos hasta la edad de 18 días. Además,

la supervivencia resultó menos reducida. Por otro lado, la supervivencia de individuos no irradiados resultó ser más elevada que la supervivencia de individuos irradiados. Cuando machos irradiados fueron sometidos a enfriamiento en cámara frigorífica a 5°C durante períodos de 24, 48 y 72 horas, la supervivencia disminuyó conforme se incrementó el tiempo de enfriamiento.

VARGUES, H. Action de divers antibiotiques sur la fécondité de la mouche des fruits (*Ceratitis capitata* Wied.). Comptes Rendus des Séances de la Société de Biologie 163(8/9):1933-1938. 1969. (468

In further laboratory experiments with *Ceratitis capitata* (Wied.), the same antibiotics as before were incorporated into an adult liquid diet containing honey, yeast, potassium sorbate, citric acid, choline chloride and benzoic acid. Groups of newly emerged males and females were confined with the medium, and eggs were collected at intervals. Aureomycin, even when applied at 1 g/kg diet, considerably reduced the numbers of eggs laid, while tyrothricin and spiramycin were effective at high and colimycin at very high doses only; penicillin had no effect. Females treated with aureomycin for six days and then transferred to a normal diet did not return to a normal rate of oviposition, and the numbers of eggs laid were similar for those having undergone either complete or interrupted treatment; females having had a period of normal diet before the introduction of aureomycin showed reduced fecundity for seven days after the change, followed by complete cessation of oviposition. Dwarf females resulting from larval treatment with antibiotics laid few eggs, of small size, and suffered heavy mortality; treatment in the adult diet had little further effect. (Review of Applied Entomology, A 60:3283)

_____. Action de divers antibiotiques sur le développement larvaire de la mouche des fruits (*Ceratitis capitata* Wied.). Comptes Rendus des Séances de la Société de Biologie 163(8/9):1915-1918. 1969. (469

In laboratory studies in France, the effects of incorporating penicillin, streptomycin sulphate, colimycin sulphate, tryrothricin, spiramycin and chlortetracycline hydrochloride (aureomycin) at 1, 3 or 5 g/kg into the rearing medium of newly hatched larvae of *Ceratitis capitata* (Wied.) were investigated. Aureomycin was by far the most active even at the lowest dose, inhibiting larval growth, delaying pupation but not adult emergence, and reducing both the number and the size of the insects surviving to the adult stage. Streptomycin and tyrothricin appeared to have no effect on larval development but reduced the number of adults produced. Colimycin was effective only at high concentrations, and penicillin and spiramycin appeared completely without effect. Transfer of the larvae to untreated medium after seven days of treatment with any of the antibiotics resulted in resumption of normal development, with pupation after six days and the production of adults that laid eggs developing normally. It could not be discovered whether aureomycin acted directly on the larvae or through their symbiotic bacteria. (Review of Applied Entomology, A 60:3282)

* VERGANI, A. A. Dosificación de insecticidas para cebos tóxicos en la lucha contra las moscas de los frutos. In Jornadas sobre Moscas de los Frutos, Tucumán, Argentina, 1969. Documentos. Argentina. Estación Experimental Agrícola de Tucumán. Publicación miscelánea, no. 32. 1970. p. 11. (Sólo resumen)(470

Los ensayos se realizaron en jaulas conteniendo cada una cien *Ceratitis capitata* Wied. En las mismas se colocó fruta cítrica pulverizada con seis dosificaciones del tóxico mezcladas con el atractivo. Los testigos fueron tratados con el cebo que consistió en diluciones de extracto de malta o bien proteína hidrolizada, ambos al diez por mil. Para cada ensayo se hicieron tres repeticiones. Los productos probados fueron: ácido fosforotiónico, 5 cloro, 1,2,3, benzotiazol-6-il-dimetil éster (50% p.a.); ácido acético, tio,S-cianometil éster metil-carbomoiloxima (50% p.a.); ácido acético,tio, S-(2-cianoetil) éster, metil-carbomoiloxima (50% p.a.); dimetilfosfato de 3-hidroxil-N-metil-cis-crotonamida (56% p.a.); isómero trans de 2-cloro-1-(2,4,5-triclorofenil) vinil dimetil fosfato (24% p.a.); 0,0 dimetil-S-(N-metil-N-formil-carbamoil-metil) ditiofosfato (25% p.a.); tricloroxietil-0,0-dimetil-fosfonato (50% p.a.). Se han obtenido numerosos datos, que aumentarán con la incorporación de otros productos insecticidas y se someterán finalmente a la interpretación estadística. De primera intención se destacan los fosforados y también dos ésteres metilcarboiloxima del ácido acético. Los productos seleccionados en estos ensayos y otros nuevos serán probados en tratamientos de campo.

VERNEAU, R. y SCOGNAMIGLIO, A. Parassiti animali e vegetali dell'albicocco. Frutticoltura 38(9):23-28. 1976. (471

The following pathogens and pests, and their control are discussed: the fungi *Sclerotinia laxa* and *Valsa cincta*; the bacterium *Pseudomonas morsprunorum*; Sharka (plum pox) and apricot ring pox viruses: the insects *Anarsia lineatella* and *Ceratitis capitata*; and several nematodes of the genera *Meloidogyne* and *Pratylenchus*. (Horticultural Abstracts 47:5274)

VILLIERS, E. A. DE. Guava pests. Farming in South Africa, no. H.1:1-3. 1978. (472

Methods are described for controlling pests (including arthropods) of guava in South Africa. These include the use of fenthion, malathion (mercaptothion) and trichlorphon against the fruit-flies *Ceratitis rosa* Karsch and *C. capitata* (Wied.), malathion against the mealybugs *Ferrisia virgata* (Ckll.) and *Pseudococcus longispinus* (Targ.) and the scales *Chloropulvinaria psidii* (Mask.) (*Pulvinaria psidii*) and *Hemiberlesia lataniae* (Sign.), and orchard sanitation for the control of *Cryptophlebia leucotreta* (Meyr.). (Review of Applied Entomology, A 66:4468)

VITA, G. et al. L'uso di sostanze naturali presenti nell'oliva come prospettiva di lotta contro il *Dacus oleae* (Gmel.). Bollettino del Laboratorio di Entomologia Agraria 'Filippo Silvestri' 34:55-61. 1977. (473

Further experiments were carried out in Italy with the juice of olives that had been pressed to extract the oil, applied on fresh olives as a means of repelling *Dacus oleae* (Gmel.). In this more detailed laboratory investigation, four different extracts of the juice were tested by application to artificial fruits. The phenolic compounds extracted from the water-soluble fraction of the fruits were found to be the substances active in repelling ovipositing females of *D. oleae*, but the repellent effect decreased as the deposits dried. A repellent action was also observed against *Ceratitis capitata* (Wied.) and *Rhagoletis cerasi* (L.), but *Opius concolor* Szépl., a parasite of *D. oleae*, was not affected. (Review of Applied Entomology, A 67:1116)

WAKID, A.F.M. Effect of nitrogen during gamma irradiation of puparia and adults of the Mediterranean fruit fly on emergence, sterility, longevity, and competitiveness. Environmental Entomology 2(1):37-40. 1973. (474

When males of *Ceratitis capitata* (Wied.) were treated either in the late pupal stage (2 days before eclosion) or the adult stage (1-24 h old) with 7, 9 and 11 krad γ-radiation from a $^{60}$Co source in air and in nitrogen, exposure to nitrogen before and during irradiation decreased sterility. No significant differences in sterility were found for nitrogen exposure periods of 5, 15, 25 or 35 min. before irradiation. Adult life-span decreased with increasing radiation dose regardless of whether the adults of the pupae were irradiated in air or in nitrogen. However, at any of the doses, individuals irradiated in nitrogen as pupae were longer lived than comparable pupae irradiated in air. By contrast, those irradiated in nitrogen as adults lived as long as those irradiated in air. The competitiveness of males irradiated as adults in nitrogen was higher than that of males irradiated in air, but the difference was not statistically significant. Males irradiated as pupae in nitrogen were significantly more competitive than those irradiated in air. Differences in the competitiveness of males irradiated in air as pupae and males irradiated as adults were not significant. In contrast, when irradiation was applied in a nitrogen atmosphere, the competitiveness of males irradiated as adults was significantly less than that of males irradiated as pupae. (Review of Applied Entomology, A 61:2170)

WAKID, A. M. y SHOUKRY, A. Dispersal and flight range of the Mediterranean fruit fly, *Ceratitis capitata* Wied. in Egypt. Zeitschrift für Angewandte Entomologie 81(2):214-218. 1976. (475

In two tests in 1974, groups of 2500-5000 adults of *Ceratitis capitata* (Wied.) that had been irradiated at 9 krad as pupae and marked with coloured dyes were released in *Citrus* orchards in a semiarid area in Egypt. The flight range

within an orchard was found from recaptures in traps to be 700 m, but flies released in one orchard did not reach another orchard 700 m from the release point. (Review of Applied Entomology, A 65:2723)

WIENDL, F. M., SGRILLO, R. B. y WALDER, J. M. M. Influencia da idade pupal na radiosensibilidade as radiaçoes gama de *Ceratitis capitata* (Wied.). Energia Nuclear e Agricultura (Brasil) 1(1):15-19. 1979. (476

WILLERS, P. Suitability of *Harpephyllum caffrum* (kaffir plum) as host for Mediterranean fruit fly and false codling moth. Citrus and Subtropical Fruit Journal, no 543:5-6. 1979. (477

The indigenous tree kaffir plum (*Harpephyllum caffrum*) was found to be a good food-plant for *Ceratitis capitata* (Wied.) and to be suitable also for *Cryptophlebia leucotreta* (Meyr.). It is suggested that the indiscriminate planting of *H. caffrum* for ornamental purposes in the citrus-producing areas of the Eastern Cape, South Africa, must be considered carefully; trees for ornamental purposes can be vegetatively propagated from cuttings collected from trees bearing exclusively male flowers. The baiting of existing fruit-bearing kaffir plum trees for *Ceratitis capitata* in home gardes, together with sanitation, can make a significant contribution to the control of citrus pests using this tree as a food-plant. (Review of Applied Entomology, A 68:1466)

* WONG, T. T. Y. y NAKAHARA, L. M. Sexual development and mating response of laboratory-reared and native Mediterranean fruit flies. Annals of the Entomological Society of America 71(4):592-596. 1978. (478

In the laboratory, 100% of the laboratory-reared female *Ceratitis capitata* (Wiedemann) were mated by the fourth day postemergence, whereas only 65% of females of the native strain were mated 10 days postemergence. Also, in field cage tests, twice as many unirradiated laboratory-reared flies as native flies mated; however, when the laboratory flies were irradiated and dyed, mating response of the two strains did not differ. Mating of the unirradiated laboratory-reared flies peaked 1 h after sunrise; but mating of the irradiated laboratory-reared flies peaked later in the day, so their response was similar to that of the native flies.

WRIGHT, R. H. Correlation of far infrared spectra and Mediterranean fruit fly (Diptera: Tephritidae) attraction. Canadian Entomologist 103(2):284-285. 1971. (479

The far infra-red absorption frequencies of 67 compounds reported to be attractants for *Ceratitis capitata* (Wied.) were determined, and the number with absorption maxima falling in a band 7 $cm^{-1}$ wide at successive points across the spectral range from 100 to 500 $cm^{-1}$ is shown diagrammatically. The results indicated that attractiveness

depends on absorption maxima falling, not in certain bands, but in various alternative bands from among eight 'favourable' ones near 184, 199, 247, 299, 328, 399, 429 and 453 $cm^{-1}$ and not in three 'adverse' ones near 139, 172 and 416 $cm^{-1}$. The spectrum of trimedlure, a strong attractant for *C. capitata*, has absorption maxima in five of the eight 'favourable' bands and none in the 'adverse' ones, whereas an isomer that differs only in the orientation of a chlorine atom and has similar chemical and stereochemical properties, but is not attractive to *C. capitata*, has maxima centered on one of the 'adverse' bands and at most two of the 'favourable' ones. (Review of Applied Entomology, A 60:89)

* WRIGHT, R. H., CHAMBERS, D. L. y KEISER, I. Insect attractants, anti-attractants, and repellents. Canadian Entomologist 103(4):627-630. 1971. (480

Anti-attractants, defined as substances with little or no intrinsic repellency but with the property of diminishing the attractiveness of a lure, are prediced on spectroscopic grounds and their existence demonstrated in experiments with *Ceratitis capitata* (Wiedemann), and *Dacus cucurbitae* (Coquillett).

* YOKOYAMA, M., MARCHINI, L. C. y NAKANO, O. Ensaio com novos inseticidas no combate a "mosca da fruta" - *Ceratitis capitata* (Wied., 1824) (Diptera: Tephritidae). Ecossistema (Brasil) 1(1):33-36. 1976. (481

Este trabalho mostra a ação de 2 inseticidas, ethyl e methyl chlorpyrifos no controle da mosca das frutas, *Ceratitis capitata* no estágios de adulto e larval. Como padrão foi usado o inseticida fenthion. O experimento foi planejado para investigar a ação de contato dos inseticidas nos adultos que podiam caminhar sobre as frutas tratadas e a ação de penetração sobre as larvas dentro das frutas. Os inseticidas foram usados nas seguintes dosagens: para as larvas: methyl chlorpyrifos 40,8E 2,7 e 5,4 ml/l; fenthion 50E 5,4 ml/l e para os adultos: methyl chlorpyrifos 22E 1,7 e 3,4 ml/l; ethyl chlorpyrifos 40,8E 1,5 ml; fenthion 1,5 ml/l. Os resultados mostram que os melhores inseticidas foram: methyl chlorpyrifos 22E 3,4 ml/l; ethyl chlorpyrifos 40,8E 1,5 ml/l e fenthion 50E 1,5 ml/l com suas eficiências em porcentagem para adultos 97,4 - 95,9 - 83,0%, respectivamente.

* ZUMREOGLU, A. et al. Gamma irradiation of the Mediterranean fruit fly; effect of treatment of immature pupae in nitrogen on emergence, longevity, sterility, sexual competitiveness, mating ability, and pheromone production of males. Journal of Economic Entomology 72(2):173-176. 1979. (482

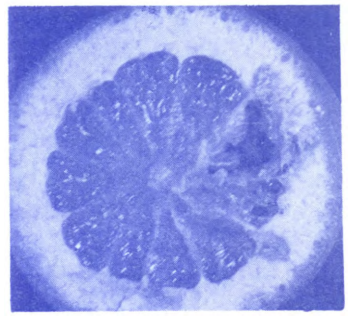
When 6-day-old (immature) pupae of *Ceratitis capitata* (Wiedemann) were irradiated in nitrogen with doses of 10, 12, or 14 krad, the males had a higher level of sterility than males irradiated in nitrogen as 9-day-old (mature) pupae with 14 krad. However, sexual competitiveness, ability to inseminate females, and production of sex pheromones to attract females of flies irradiated as immature pupae were significantly reduced compared with flies irradiated as mature pupae.

# INDICE DE AUTORES

# INDICE DE AUTORES

# INDICE DE MATERIA

# INDICE DE MATERIA



Daño en el fruto - naranja -

Arbol de naranja, con los frutos en el suelo; daño de la mosca

# INDICE GEOGRAFICO

# INDICE GEOGRAFICO

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IICA

IMPRENTA IICA