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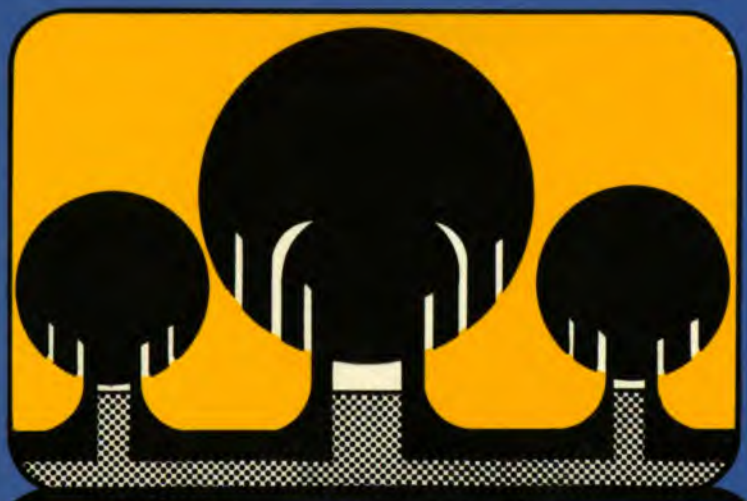

BIBLIOGRAFIA SOBRE MOLUSCOS COMO PLAGA EN PLANTAS DE INTERES ECONOMICO

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Compilada por:

Alba Iris Calderón de Cerdas
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Centro Interamericano de Documentación e Información Agrícola-CIDIA
Biblioteca Conmemorativa Orton
Turrialba, Costa Rica
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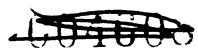

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Bibliografía sobre moluscos como plaga en plantas de interés económico : bibliografía parcialmente anotada / compilada por Alba Iris Calderón de Cerdas, Ana María Arias de Guerrero. -- Turrialba, C.R. : Centro Interamericano de Documentación e Información Agrícola. Biblioteca Conmemorativa Orton, 1985.
78 p. ; 28 cm. -- (Documentación e Información Agrícola / Instituto Interamericano de Cooperación para la Agricultura, ISSN 0301-438X ; no. 135)

1. Moluscos - Bibliografía 2. Agricultura - Enfermedades y plagas I. Arias de Guerrero, Ana María, comp. II. IICA-CIDIA III. Título IV. Serie

DEWEY 632.64016 AGRINTER H10 4040

TABLA DE CONTENIDO

INTRODUCCION

Las babosas o ligosas (*phylum Mollusca*) son de importancia económica como plagas de diversos cultivos en muchas partes del mundo. Aunque hay grupos de plagas de mayor importancia, hay pocos con una distribución geográfica tan amplia y que afecta un rango de cultivos tan diverso.

Los moluscos son plagas claves en cultivos de frijol en muchas zonas de los trópicos americanos, especialmente en fincas de pequeños agricultores que siembran en el rastrojo de malezas o de cultivos anteriores.

Por muchos años los agricultores han combatido estas plagas con cebos envenenados con metaldehido, lo que a menudo resulta ineficaz en regiones tropicales, especialmente las de alta precipitación. También hay problemas de disponibilidad de los cebos y muchas veces resultan demasiado costosos para los agricultores de recursos limitados.

Aunque recientemente se han hecho esfuerzos para mejorar los métodos de combate de babosas, estos sistemas de combatir con cebos no ha cambiado mucho y no existen recomendaciones prácticas de nuevos métodos de combate. Tomando en cuenta la necesidad de diseñar otras alternativas que puedan sustituir eficientemente los métodos usuales, hay que enfatizar la investigación sobre factores ecológicos, culturales y biológicos que afectan a estas plagas, en adición a la búsqueda de mejores métodos y productos de combate químico.

Joseph Saunders (Ph.D.)
Entomólogo
Centro Agronómico Tropical de
Investigación y Enseñanza-CATIE

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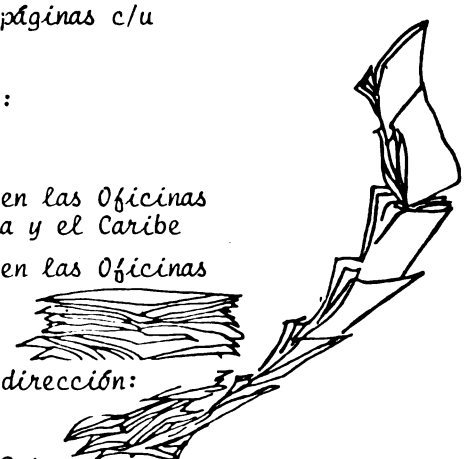

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BIBLIOGRAFIA SOBRE MOLUSCOS

COMO PLAGA EN PLANTAS DE INTERES ECONOMICO

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AGRAWAL, H.P. Control of the slug *Anadenus altivagus* (Theobald) by certain pesticides. Food Farming Agric. 8(11):16-18. 1977. (002

/Damage to potato crops/

_____. Control of the land snail, *Bensonia monticola* (Hutton) by certain pesticides. Journal of Animal Morphology and Physiology 25(1-2):101-105. 1978. (003

/Pest damage to crops of morning glory, beans, ladies finger and maize/

* AGUAYO, C.G. Notas sobre la distribución de la babosa *Vaginulus plebeius*, mollusca: Veronicellidae. Caribbean Journal of Science (Puerto Rico) 4(4):549-551. 1964. (004

The land slug *Vaginulus plebeius* is recorded from the Lesser Antilles to Puerto Rico, Dominican Republic, Jamaica, Cuba, as well as from Florida, U.S. No differences have been found between *V. plebeja* Fisher and *P. dubia* Semper at specific or subspecific levels.

AGUILAR, J.D. y PACQUETIAN, B. Damage done to sunflower by slugs (En Francés). Phytoma 15(144):27-28. 1963. (005

* ALFARO, R. Biología y daños provocados por las babosas. In _____. El cultivo del frijol. San José, Costa Rica, CAFESA, 1983. pp. 75-76. (006

* ALMEIDA, P.R. DE. Contribuiçao para o estudo do combate aos caramujos do cafeeiro. Biológico (Brasil) 32:65-69. 1966. (007

A spray containing 50% metaldehyde used at the rate of 10 l. of 1.5% liquid per 8 trees was as effective against snails as the standard mixture of 97% metaldehyde at 0.75% plus milk and oil. Still better control was achieved with a 1.5% solution of a product containing 10% of Isolan (isopropylmethylpyrazolyl dimethylcarbamate). (Horticultural Abstracts 37:1872. 1967).

ANDERSON, K. y NILSSON, I. /Field slugs, a problem of plant protection on heavy soils/. VaxtsKyddsnotiser 31:67-70. 1967. (008

Reports of unsatisfactory control of the slug *Agriolimax agrestis* by liming led to comparative tests with 4 formulations of metaldehyde and liming. The metaldehyde preparations appeared to give better control than liming, but all slugs (alive and dead) could not be counted. Meta NA powder (50% metaldehyde) applied in a spray appeared to be the easiest to apply. (Horticultural Abstracts 38:4743. 1968).

* ANDREWS, K.L. y LEMA L., F. Dinámica poblacional de la babosa, *Vaginulus plebeius* en lotes de maíz - frijol en relevo. Tegucigalpa, Honduras, Escuela Agrícola Panamericana, s.f. 16 p. (009

Highest numbers of bean slug, *Vaginulus plebeius*, were found in simulated small farmers' maize-bean plots which had high organic

matter soil, an abundance of broad leafed weeds and were located near streams. Population densities of the slug increased only slightly during the first 10 weeks of maize growth, but exploded during weeks 11 to 14. Preparation of the plots for sowing of beans during week 17 reduced slug populations. The use of pit-fall traps would have allowed prediction of the relative intensity of attack in the plots with up to 10 weeks anticipation. One generation of the slug requires approximately 2 1/2 months under field conditions.

* ANDREWS, K.L. y HUEZO DE MIRA, A. Relación entre densidad poblacional de la babosa *Vaginulus plebeius* y el daño en frijol común, *Phaseolus vulgaris*. Turrialba (Costa Rica) 33(2): 165-168. 1983. (010

Se estableció la relación entre el número de babosas, *Vaginulus plebeius* y el daño causado a plántulas de frijol midiendo la densidad poblacional de dos formas. Por cada babosa activa/m^2/ noche, fueron dañadas el 20% de las plantas y los rendimientos reducidos en un 16%. El número de babosas activas se determinó usando una trampa que consistió en una lata enterrada con cebo envenenado; por cada babosa capturada por noche se perdió 14% de las plantas y se redujo el rendimiento en un 11%. Los niveles de daño económico fueron aproximadamente 0.25 babosas activas/ m^2/noche o 0.4 babosas/trampa/noche. En presencia de plántulas de frijol, las babosas mostraron poca movilidad.

* _____. Trampa para determinar la densidad poblacional de la babosa, *Vaginulus plebeius*, plaga de frijol común. Turrialba (Costa Rica) 33(2):209-211. 1983. (011

Latas enterradas con un cebo a base de afrecho, miel de purga, cerveza y carbaryl son acertados indicadores de la densidad poblacional de individuos activos de la babosa, *Vaginulus plebeius*. Se hallaron 7 babosas/trampa por cada babosa activa/m^2 encontrada alrededor de la trampa en conteos directos la noche anterior. Esta trampa simple y de bajo costo podría ser útil para los agricultores que deseen determinar la presencia de manchas de la plaga, así como tomar decisiones respecto a control químico basándose en niveles económicos del daño.

ANGELIS, E. DE. Le lumache et le limacce. Lotta Antiparassitaria 31(9):166-167. 1979. (012

ANTONELLI, A.L. Slug control. Washington State University. Cooperative Extension Service. EM Cooperative Extension Service College of Agriculture. Washington State University no. 4318. 1978. 3 p. (013

APABLAZA H., J.U. Babosas y caracoles plagas agrícolas más destructivas en años lluviosos. El Campesino (Chile) 114(3):39-46. 1983. (014

* ARNOLD, W.J. Snail and lawn pest control with Zectran pesticide. Down to Earth 18(3):20-24. 1962. (015

Zectran pesticide as an emulsifiable spray applied to foliage, fence, wall and soil surfaces effectively controlled snails and was far

superior to the emulsifiable metaldehyde sprays. Zectran was easy to measure, mix and apply, whereas the metaldehyde sprays were very viscous liquids which settled out rapidly. Baits containing Zectran were at least equal to the proprietary baits during the warm seasons of the year and far superior to these same baits during cool, moist seasons. Pillbugs, sowbugs and millipedes were effectively controlled with sprays and baits containing Zectran. Sprays of Zectran were better than the proprietary products and granules of Zectran were equal to the proprietary products against turf cutworms.

ARRAS, G. Evaluation of chemicals for control of slugs on potato tubers. Informatore Fitopatológico 27(12):3-8. 1977. (016

AVAGNINA, G. Inspection problems of the marketing phases (En italiano). Informatore Zootecnico 28(15-16):32-34. 1981. (017

BALASUBRAMANIAN, M. y KALAYANASUNDARAM, P. A note on the incidence of giant African snail, *Achatina fulica* Bowdich. AUARA (Annamalai Univ. Agric. Res. Annu.) 4/5:217. 1972-1973. (018

* BARDNER, H.M. y WAINES, R.A. Wireworm and slug damage to the potato crop in Scotland, 1954 to 1960. Plant Pathology 13(1):15-19. 1964. (019

A summary of wireworms and slug damage to ware potato crops in Great Britain for the years 1954 to 1956 (Baker and Waines, 1957) and a paper on wireworm damage to the ware potato crop in England and Wales, 1954 to 1960 (Strickland, Bardner and Waines, 1962) have already been published. In this paper, damage to potato crops in Scotland by wireworms and other soil pests (mainly slugs) is considered for the years 1954 to 1960. Data have been obtained from the Potato Marketing Board. Potato fields were visited two or three weeks before crops were lifted and tuber samples were examined, weighed and graded in the standard crop-check manner. In general, crop checks were made on the same farms each year.

BARKER, G.M. y POTTINGER, R.P. Slugs-biology, damage and control in nurseries, vegetables, cereals and pasture. Farm Prod. Pract. Minist. Agric. Fisch Econ. Div. no. 439:2. 1980. (020

* BARRY, B.D. Slugs, cause damage in Ohio cornfields. Ohio Report 53(4):51-53. 1968. (021

In most instances, an economic population of slugs will not develop on conventionally tilled land in Ohio, except for areas of plowed down sod. Fall plowing of sod will reduce the probability of slug problems. If slugs do become a problem in fields which have been plowed or are free of surface debris, the surface may be given a light cultivation, covering the area at the base of the plants to create a dusty situation. This probably will discourage the slugs

and give satisfactory control, providing it does not rain for several days after the field is cultivated. Major slug problems may occur if high moisture conditions persist in cornfields with surface debris. No practical controls for slugs are available at present. If slugs become serious, persistent pests of field corn, adequate control measures can be developed through future research.

BARRY, B.D. Evaluation of chemicals for control of slugs on field corn in Ohio. Journal of Economic Entomology 62(6):1277-1279. 1969. (022

BEDFORD, E.C.G. Recent biological control projects and the further application of biological control. South Africa. Department of Agricultural Technology. Ser. Tech. Commun. 12: 188-195. 1964. (023

/To insect pests, snails and weeds/

BELARDELLI, C.F. Halarion for control of snails and slugs (En italiano). Lotta Antiparassitaria 14(11):12. 1962. (024

BELGICA. MINISTERE DE L'AGRICULTURE. ADMINISTRATION DE LA RECHERCHE AGRONOMIQUE. Le probleme des limaces dans la protection des vegetaux. Bruxelles, 1979. 6 p. (025

BHARDWAJ, A.K. y THAKUR, J.R. Occurrence of a slug, *Anadenus* schlagintweiti Hey o vegetables. Indian Journal of Entomology 36(3):239. 1974. (026

BOER, W. DEN. /Control of slugs in greenhouses/. Groenten en Fruit 21(11):513. 1965. (027

_____. /Cutworms (*Agrostis* spp.) and slugs in lettuces under glass/. Groenten en Fruit 28(10, 2):475. 1972. (028

Both pests can be controlled by methiocarb (as Mesurol), applied either just before planting or between the growing lettuces. (Horticultural Abstracts 43(4):1971. 1973).

BONINI, V. A million snails in two hectares of land (En italiano). Informatore Zootecnico 26(21):49-51. 1979. (029

* BONNEMAISON, L. Enemigos animales de las plantas cultivadas y forestales. Trad. española de Francisca Guerrero. Barcelona, España, Ediciones de Occidente, 1964. v.1, pp. 57-71. (030

/Includes slugs/

BRAR, H.S. y SIMWAT, G.S. Control of the common slug, *Laevicaulis alte* Ferussac (Gastropoda), with certain chemicals. Journal of Research Punjab Agricultural University 10:99-101. 1973. (031

* BRICEÑO, A. Control químico de babosas (Pulmonata-Limacidae) en alcachofa (*Cynara scolimus* L.). Revista de la Facultad de Agronomía. Universidad del Zulia (Venezuela) 2(1):7-15. 1972. (032

Se presentan los resultados del control químico de babosas (Pulmonata-Limacidae) en cultivos de alcachofa (*Cynara scolimus* L.) en la región Chachopo-La Venta, Estado Mérida, Venezuela. Se describen los daños causados por este molusco y una forma de muestreo y contaje para su evaluación. Se probaron nueve insecticidas en forma de cebos: cuatro carbamatos, un fosforado, dos metaldehídos, un clorado y un arseniato. De los productos ensayados, los más efectivos fueron los cebos envenenados a base de la mezcla Endrin 19,5% al 10.5% + Slugit 20% (Metaldehído) al 0.5% + maíz pilado o afrecho de trigo, Cebicid 85% al 0.5% + Slugit 20% al 0.5%, Mesurol (Bayer 37344) 10.4% y Matacil (Bayer 44646) 80% al 3%.

THE BROWN snail: another step closer to biological control. Citrograph 66(9):221. 1981. (033

BRUEL, W.E. VAN DEN y MOENS, R. Les proprietes de helicides et la protection des cultures. In Congress of Crop Protection, 4th., Hamburg, 1957. Proceedings. s.l., 1957. pp. 1255-1275. (034

* BRYDEN, J.W. y BEVAN, W.J. Control of wireworm and slug damage in potatoes. Plant Pathology 14(1,Sup.):23-24. 1965. /Sólo sumario/. (035

Trials in the East Midlands, 1964. Granular formulations of thionazin (1.7 lb. a.i. per acre); disulfoton (1.4 lb. a.i. per acre); phorate (1.6 lb. a.i. per acre); and Bayer 5299 1.2 lb. a.i. per acre); each applied at planting time, were compared with sprays of thionazin at 1 lb. a.i. per acre, and aldrin at 3 lb. a.i. per acre applied and worked in before final cultivations for wireworm control in potatoes on a site in Northamptonshire. Only the aldrin treatment gave an appreciable (65%) reduction in damage to harvested tubers compared with the untreated controls (in which only 6% of the tubers were wireworm-damaged). In a further trial at Preston, Rutland, in which three treatments were replicated six times, the untreated plots had 18% of the tubers with wireworm damage, and 13% with slug damage, at harvest. An aldrin pre-planting spray of 3 lb. a.i. per acre reduced the wireworm damage to 5%, and 8% of the tubers were slug damaged at harvest. The third treatment was of parathion granules at 1.0 lb. a.i. per acre at planting: 8% of the tubers were wireworm-damaged, and 8% were slug-damaged, at harvest.

BURCH, J.B. Some snails and slugs of quarantine significance to the United States. USDA. Research Service. ARS-82-1. 1960. 73 p. (036

CAIRNCROSS, G.T., ed. The delphinium year book 1960. London, Delphinium Society, 1960. 136 p. (037

Among articles of general interest is one by A.A. Samuelson on the scarlet flowered species *D. nudicaule* and *D. cardinale* and another by H.S. Hodson on the control of slugs and snails, mainly by baits containing metaldehyde. Scented delphiniums and true yellow delphiniums are discussed by N. Dain, and there are several notes on varieties, both old and new. (Horticultural Abstracts 30:4160. 1960).

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* CARDONA, C. et al. Babosas, lesmas, slugs. In _____ et al. Problemas de campo en los cultivos de frijol en América Latina. Centro Internacional de Agricultura Tropical. Serie CIAT No. 075SB-1. 1982. pp. 122-123. (039

* CARMAN, G.E. Electrical trapping device for land snails. Journal of Economic Entomology 58(4):786-787. 1965. (040

CATALINA, L. Slugs and snails (En español). Cult. Mod. 49(6):219-220. 1966. (041

Plant pests and their chemical control.

CATLING, H.D. Notes on new minor pests of citrus in Southern Africa. South African Citrus Journal 444:11-14. 1970. (042

CENTRE TECHNIQUE INTERPROFESSIONNEL DES OLEAGINEUX METROPOLITAINS (FRANCE). Soigner l'implantation. Premiere condition de la reussite en culture de colza d'hiver /date de semis, fertilisation, lutte contre insectes et limaces; France/. France Agricole 37(1885-1886): 39-43. 1981. (043

* COMBATAMOS LA babosa. Honduras. Secretaría de Recursos Naturales. Boletín Popular no. 63. 1980. 9 p. (044

COFFEE RESEARCH STATION (RUIRU, KENYA). Annual report 1962/63, Coffee Research Station, Ruiru, and Coffee Research Service, Kenya. Kenya, 1963. pp. 55-57. (045

Persistence of insecticides; screening insecticides for the control of leaf miners, antestia bug, lace bug and giant looper; and investigations on green looper, tailed caterpillar, green scale mealybug ant, flower midges and slugs. (Horticultural Abstracts 34: 1704. 1964).

* CONTROL OF slugs. Publication of the Canadian Department of Agriculture no. 1213. 1972. 4 p. (046

/On farms, home gardens and in greenhouses/

CONTROL SLUGS in bananas. Citrus and Subtropical Fruit Research Institute (South Africa). Information Bulletin no. 81:2-4. 1979. (047

A bait of metaldehyde/carbaryl or methiocarb was effective for at least 7 weeks. (Horticultural Abstracts 51(8):6580. 1981).

* COTO ALFARO, T.D. Combate de la babosa (*Diplosolenodes occidentale* (Guilding) (Soleolifera: Veronicellidae) con extractos de plantas. Tesis Ing. Agr. San José, Universidad de Costa Rica, Centro Regional del Atlántico, 1983. 53 p. (048

Este estudio se realizó en el Centro Agronómico Tropical de Investigación y Enseñanza (CATIE) en Turrialba, Costa Rica, entre marzo y noviembre de 1982. El objetivo fue determinar el efecto tóxico o repelente de algunas plantas, que contienen sustancias venenosas sobre la babosa *Diplosolenodes occidentale*. Este estudio se dividió en tres fases experimentales en el laboratorio: 1) consumo de cuadrados de hojas, tallos, frutos y semillas de plantas que contuvieran alguna sustancia nociva; 2) consumo de cuadrados de hojas de *Phaseolus vulgaris* L., tratadas con extractos de plantas seleccionadas en la fase uno; 3) consumo de plántulas de *P. vulgaris*, tratadas con extractos de plantas seleccionadas en la fase dos. De 60 especies de plantas tres dieron buenos resultados, ellas son: *Canavalia ensiformis* (semilla), *Nerium oleander* (tallo y hoja) y *Thevetia peruviana* (hoja), pues mantuvieron un bajo nivel de consumo de plántulas de frijol. Estas tres especies podrían ser utilizadas en el futuro como agentes promisorios para la protección de cultivos como el frijol común.

CRAWFORD-SIDEBOTHAM, T.J. Differential susceptibility of species of slugs to metaldehyde/bran and to methiocarb baits. Oecologia 5:303-324. 1970. (049

_____. The influence of weather upon the activity of slugs. Oecologia 9:141-154. 1972. (050

CROWELL, H.H. Slug control. Oregon Insect Control Handbook 1965:117-118. 1965. (051

Chemical control on vegetables and forage crops.

* _____. Slug and snail control with experimental poison baits. Journal of Economic Entomology 60(4):1048-1050. 1967. (052

Metaldehyde, a long-established specific molluscicide for land slug and snail control, is not satisfactory under moist weather conditions. The search for a more effective molluscicide has resulted in a laboratory screening technique, simulating natural conditions, by which

experimental baits are presented to various species of land molluscs. The brown garden snail, *Helix aspersa* Muller and the European black slug *Arion ater* (L.), are laboratory reared for the tests, while other species are field collected in season. Five experimental carbamate materials have shown outstanding activity against land molluscs to date: Bay 37344 (4-(methylthio)-3,5-xylyl methylcarbamate), UC 20047A (Tranide^{R}) (*exo*-(5-chloro-6-oxo-*endo*-2-norbornanecarbonitrile *O*-(methylcarbamoyl) oxime), EP-332 (*m*-[[(dimethylamino) methylene]amino] phenyl methylcarbamate hydrochloride), EP-316 (*m*-cym-5-yl methylcarbamate), and IN-1179 (methyl *N*-[(methylcarbamoyl) oxy] thioacetimidate). All established chlorinated hydrocarbon and organophosphate pesticides tested have shown little or no toxicity to slugs and snails.

CROWELL, H.H. Slug control. Oregon Insect Control Handbook 11:89-90. 1968. (053

Chemical plant protection.

_____. Slug and snail control. Oregon Insect Control Handbook 1970:95. 1970. (054

_____. Chemical control of terrestrial slugs and snails. Oregon Agricultural Experiment Station. Bulletin no. 628. 1977. s.p. (055

* CHARLTON, J.F.L. Slugs as a possible cause of establishment failure in pasture legumes oversown in boxes. New Zealand Journal of Experimental Agriculture 6(4):313-317. 1978. (056

Preliminary studies on the survival of legume seedlings exposed to slug attack were conducted in two box experiments. The first experiment investigated the effect of slugs and their control by molluscicide seedcoating on seedling survival in turf, and the second the survival of legume seedlings at several stages of growth when subjected to grazing by slugs. When slugs were present, less than 10% of oversown legumes survived at six weeks. Coating of seed with the molluscicide methiocarb greatly increased seedling survival. Seedlings in the early stages of development (germinating seed to cotyledon stage) were severely depleted. Once seedlings reached the 1-5 true-leaf stage there was little seedling mortality.

_____. Effects of slugs during establishment of oversown legumes in box experiments. In Australasia Conference of Grassland Invertebrate Ecology, 2nd., s.l., 1978. Proceedings. s.l., 1980. pp. 253-255. (057

* CHATTERJEE, P.B. y DUTTA, S. Snails - a new pest of Azolla. International Rice Research Newsletter 5(4):24. 1980. /Sólo sumario/ (058

A snail was found to damage plants of the water fern *Azolla pinnata*, which harbors the blue-green alga *Anabaena azollae*, during an attempt at its large-scale multiplication for application in rice fields.

The snail, identified as *Lymnaea (Pseudosuccinea) luteola* Lamarck, is quite common in West Bengal wetland rice fields. Conchlike in appearance, its average weight is 0.3 g. The snail floats in water and adheres to the lower surface of the free-floating azolla. About 800 snails/m^2 were observed in a heavily infested rice field. The snails feed voraciously on the host, leaving no remnants. Their peak period of activity is from July to October. The snail is not noticed in the field during the dry winter months from November to January.

CHRYSANTHEMUM PESTS under glass and their control. Inglaterra. Ministry of Agriculture. Short Term Leaflet no. 122. 1971. 10 p. (059

Advice on general pesticide application and damage to susceptible cultivars, with details on the control of aphids, *Tetranychus urticae, Phytomyza syngenesiae, Aphelenchoides ritzemabosi, Scutigerella immaculata, Psila nigricornis*, caterpillars, *Forficula auricularia*, capsids, thrips and slugs. (Horticultural Abstracts 42(1):1658. 1972).

DAMAGES AND control of slugs. Cultivar 98:12-13. 1977. (060

/In cereal crops/

DAVIDSON, O.W. Orchid ailments not caused by insects or diseases. American Orchid Society Bulletin 36:464-475; 564-574. 1967. (061

Detailed descriptions of cultural disorders and injuries caused by air pollution, snails, mice and chipmunks, a key to their identification and advice on their prevention and cure. (Horticultural Abstracts 38:1567. 1968).

* DAVIDSON, R.H. Experiments with Zectran to control snail attacking orchids. Down to Earth 18(2):2, 23, 24. 1962. (062

The author's experiments show that Zectran insecticide is a promising chemical for control of the "bush" snail on orchids. Immersing pots, including roots and pulverized fir bark rooting material, in a water suspension containing Zectran gave better control than a heavy drench treatment applied to the potted plants.

* DAVIS, B.N.K. y FRENCH, M.C. The accumulation and loss of organochlorine insecticide residues by beetles, worms and slugs in sprayed fields. Soil Biology and Biochemistry 1(1): 45-55. 1969. (063

Analysis of samples of ground-beetles, worms and slugs at four sites showed large differences in uptake, retention and metabolism by these groups. Live beetles caught in pitfall traps after field applications of DDT did not contain more than about 4 ppm pp'-DDT,

but beetles artificially exposed during spraying acquired up to 70 ppm on their body surfaces. Metabolism to pp'-DDE was rapid and in one species resulted in residues of 58-75 ppm which declined to about 5 ppm after four months. Worms and slugs acquired much higher levels of DDT and these were more persistent. Breakdown in worms was chiefly to DDE and in slugs to TDE. Worms from an aldrin-treated site contained both dieldrin and aldrin, the proportions of each changing with time. The aldrin was probably from the soil within their guts. It was concluded that higher residues were picked up by invertebrates which fed at the soil surface after a foliage application of pesticide than by subterranean species after a soil application followed by rotovation. Acute poisoning of birds could result from the consumption of insects exposed to DDT spraying.

DAVIS, C.J. Recent introductions for biological control in Hawaii. IV. Hawaii. Ent. Soc. Proc. 17(1):62-66. 1959. (064

_____. Recent introductions for biological control in Hawaii. V. Hawaii Ent. Soc. Proc. 17(2):244-248. 1960. (065

_____. y KRAUSS, N.L.H. Recent introductions for biological control in Hawaii. VII. Hawaii Ent. Soc. Proc. 18(1):125-129. 1961. (066

Snail, weed, and insect pest control.

_____. y KRAUSS, N.L.H. Recent introductions for biological control in Hawaii. VIII. Hawaii Ent. Soc. Proc. 18(2):245-249. 1962. (067

Includes snails introduced to control other snails, and insects to control weeds and other insects.

_____. y BUTLER, G.D. Introduced enemies of the giant African snail, *Achatina fulica* Bowditch, in Hawaii (Pulmonata: Achatinidae). Hawaii Ent. Soc. Proc. 18(3):377-389. 1963. (068

Includes introduction of Carabidae as control predators.

_____. y KRAUSS, N.L.H. Recent introductions for biological control in Hawaii. IX. Hawaii Ent. Soc. Proc. 18(3):391-397. 1963. (069

Snail, weed, and insect pest control.

_____. Recent introductions for biological control in Hawaii. XVI. Hawaii Ent. Soc. Proc. 21(1):59-62. 1971. (070

/Snails, insects, weeds/

DAVIS, C.J. Recent introductions for biological control in Hawaii. XVII. Hawaii Ent. Soc. Proc. 21(2):187-190. 1972. (071

/Snails, weeds/

DAXL, R. /The influence of temperature and relative humidity on the effectiveness of the molluscicides metaldehyde, Isolan and Ioxynil against *Limax flavus* and its eggs/. Zeitschrift fuer angewandte Entomologie 67:57-87. 1970. (072

The susceptibility of slugs to molluscicides was increased by low R.H., high temperatures and small body size. Hence young slugs are more susceptible than large adult ones. The toxicity ranking of the molluscicides tested was Ioxynil > metaldehyde > Isolan. R.H. influenced the effectiveness of metaldehyde most and of Ioxynil least, whereas Isolan was most and Ioxynil least influenced by temperature. All 3 substances acted as ovicides. The susceptibility of the embryos increased as they developed. (Horticultural Abstracts 41:5389. 1971).

DEN BOER, W. /Slug control on the mixed holding/. Groenten en Fruit 22:607. 1966. (073

Trials on controlling slugs by applying chemicals via the irrigation system were carried out on glasshouse and frame crops that included lettuce, endive, tomatoes, carrots and brussels sprouts. The best control in lettuce and endive was obtained when metaldehyde in suspension was applied at early stages of growth at 10-day intervals; slug pellets distributed amongst the crops gave only partial control and did not attract the small grey slugs that caused most damage. Application of 0.5 l. of metaldehyde per sq. m. of bed through a hose gave good results in tomatoes and lettuces. On a commercial holding good slug control in carrots forced under straw was obtained by applying 500 g. superphosphate or 500 g. nitrate of potash per sq. m., either alone or with metaldehyde in suspension. A double application of slug pellets had little effect. General advice is given on slug control, together with a diagram showing how suitable chemicals can be introduced through the irrigation system. (Horticultural Abstracts 37:2781. 1967).

DI MARTINO, E. Lotta contro i fitofagi degli agrumi. Informatore Fitopatologico 16:367-380. 1966. (074

Tables show the appropriate chemicals and times of application for the control of aphids (particularly *Toxoptera aurantiae*), *Aspidiotus hederae*, *Chrysomphalus dictyospermi*, *Coccus hesperidum*, *Ceroplastes sinensis*, *Saissetia oleae*, *Parlatoria zizyphus*, *Mytilococcus gloverii*, *Lepidosaphes beckii*, *Pseudococcus citri*, *Heliothrips haemorrhoidalis*, ants, *Empoasca decedens*, *Ceratitis capitata*, *Otiorrhynchus cribricollis*, *Prays citri*, *Hemitarsonemus latus*, *Aceria scheldoni*, snails and *Tetranychus telarius*. Additional pests controlled by each chemical are mentioned. (Horticultural Abstracts 37:3724. 1967).

DIRZO, R. Studies on plant-animal interactions: terrestrial molluscs and their food plants. Ph.D. Thesis. s.l., University of Wales, 1980. s.p. (075

DISNEY, R.H.L. A further case of a scuttle fly /*Megaselia ciliata*/ (Diptera, Phoridae) whose larvae attack slug eggs. Entomologists' Monthly Magazine 112(1344/47):174. 1976. (076

* DOSSAJI, S.F. et al. On the evaluation of the molluscicidal properties of *Polygonum senegalense* forma *senegalense*. Lloydia 40(3):290-293. 1977. (077

* DUNDEE, D.S., STUTTS, B.S. y HERMANN, P.W. Preliminary survey of a possible molluscan pest in the southern United States. Ecology 46(1-2):192-193. 1965. (078

A Veronicellidae slug, heretofore unknown in the Gulf Coastal region, appeared in late 1960 in both Mobile and New Orleans. Since then, it has spread rapidly throughout much of the area. Studies on the distribution, ecology, and behavior are being made.

_____. Introduced slugs still spreading. Nautilus 80(3):108-109. 1967. (079

_____. Veronicellids still on the move in the Gulf Coast States. Nautilus 85(2):72. 1971. (080

DUNN, E. The slug problem in arable crops. Scottish Agriculture 43(2):101-104. 1963. (081

* DURON ANDINO, E. et al. Control de la babosa (*Vaginulus* spp.) y otras plagas del frijol con aplicaciones de M sfolán (CYTROLANE 2 G) al suelo. Tegucigalpa, Honduras, Secretaría de Recursos Naturales, 1981. 21 p. (082

Para evaluar el control de la babosa con Mesfolán (CYTROLANE 2 G), se llevaron a cabo seis (6) experimentos en igual número de localidades en el departamento de Olancho durante el ciclo de postrera 1980-1981. Para estos experimentos se usó un diseño cuadrado latino 5 x 5 con los siguientes tratamientos: a) Testigo; b) 1/4 g producto comercial de CYTROLANE por postura sin contacto con la semilla; c) 1/2 g producto comercial por postura en contacto con la semilla; d) 1/2 g producto comercial por postura sin contacto con la semilla; y e) 1/2 g producto comercial por postura en contacto con la semilla. Se tomaron las siguientes observaciones: número de plantas a los siete y veintiún días de germinado el frijol, ninfas de empoasca por trifolio a floración, daño foliar, porcentaje daño de *Apion godmani* y rendimiento en kg/ha.

Se encontró que en los tratamientos de CYTROLANE 2 G (Mesfolán), a razón de 0.5 kg i.a./ha sin contacto con la semilla dieron fitoprotección significativa en cuanto a número de plantas defoliadas por babosas y a ataques de *Empoasca* spp. hasta los 45 días. Los tratamientos con CYTROLANE mostraron mayor número de plantas sin daño y fueron significativamente superiores al testigo. Mejor

resultado se obtuvo cuando el insecticida se depositó sin contacto con la semilla, ya que los tratamientos en los cuales la semilla se puso en contacto directo con el producto, mostraron problemas de toxicidad, reduciendo la germinación especialmente con la dosis de 1/2 g del producto comercial (1 kg i.a./ha). Se logró una mejor población con la dosis de 1/4 g por postura (0.5 kg i.a./ha). Los niveles de empoasca variaron entre localidades, todos los tratamientos con CYTROLANE mostraron menor número de ninfas por trifolio, sobresaliendo 1/2 g producto comercial por postura en contacto con la semilla (1 kg i.a./ha). En cuanto a rendimiento, los mejores tratamientos fueron 1/2 y 1/4 g de CYTROLANE sin contacto con la semilla que rindieron 39 y 29% más que el testigo. El producto no mostró ningún efecto en el control de *Apion godmani* comportándose igual que el testigo.

* DUTHOIT, C.M. Assessing the activity of the field slug in cereals. Plant Pathology 10(1):165. 1961. (083

* _____. Slugs and food preferences. Plant Pathology 13(2):73-78. 1964. (084

Large and small specimens of *Agriolimax reticulatus*, *Arion fasciatus*, *A. hortensis*, *A. ater*; *Milax budapestensis*, *M. sowerbyi* and *M. gagates* were tested in the laboratory with various foods, which included fungus mycelium, oats, wheat and barley seeds, wheat seedlings, carrot roots and ryegrass seeds and seedlings. The slug species reacted in different ways to these as food, and to their parts, and a comparison throws light on the behaviour of these species in field crops, the degree to which they can be held responsible for damage, and the way the information can be utilized for field assessment.

DUVAL, G. Now one can finish off snails and sea-snails. Coopercotia (Brasil) 17(120):35-36. 1959. (085

EATON, H.J. y TOMPSETT, A.A. Avoiding slug damage to lily bulbs at Rosewarne Experimental Horticulture Station, Camborne, Cornwall. In Lilies 1976 and other Liliaceae. London, Royal Horticultural Society, 1976. pp. 63-65. (086

Root and bulb damage by *Arion fasciatus* was greatly reduced in the lily cv. Enchantment in a slug-infested site when the bulbs were planted with sharp sand surrounding and above them. None of the 3 chemical treatments (a preplanting liquid metaldehyde dip at 1 or 2 fl. oz/2 gal. or Draza (methiocarb) pellets at 5 lb/acre placed around the bulbs) persisted sufficiently to prevent a serious attack on the bulbs. Symptoms of slug damage are described. (Horticultural Abstracts 49:3600. 1979).

* EDWARDS, C.A. y STAFFORD, C. Insecticides and slugs. Rothamsted Experimental Station. Report for 1970. Harpenden, England, 1971. Part 1, pp. 199-200. (087

EDWARDS, C.A. The uptake of two organophosphorus insecticides by slugs. Bulletin of Environmental Contamination and Toxicology 16(4):406-410. 1976. (088

EL-OKDA, M.M. Local laboratory formulations. V. The importance of bait wetting and irrigation applications on the molluscicidal activity of 4% aldicarb and methomyl bran baits. Tanta Journal of Agricultural Research 4(2):355-362. 1980. (089

Land mollusca are economic chewing pest on ornamental plants, vegetable crops and orchard pear, orange and apple trees, in Egypt.

* ESTRADA HURTARTE, R. Algo sobre la babosa *Vaginulus occidentalis* Guild. Revista Cafetalera (Guatemala) no. 183:18-20. 1979. (090

Ofrece descripción general sobre biología de la babosa, daños y medios de combate.

EVANS, H.C. New developments in black pod epidemiology. Cocoa Growers' Bulletin no. 20: 10-16. 1973. (091

Observations are reported on the insect species involved in the life cycle of *Phytophthora palmivora* and the methods of transport of inoculum within and between cacao trees. The role of ants, particularly *Crematogaster striatula* is discussed. Radioactive studies have shown that certain flying insects and beetle, caterpillar and snail species are involved in the spread of the pathogen from tree to tree. The findings endorse recommended methods of cultural control. (Horticultural Abstracts 44(1):793. 1974).

EXPERIMENT STATION FOR VEGETABLE GROWING IN THE OPEN IN THE NETHERLANDS. Annual Report 1963. Alkmaar, 1964. 141 p. (092

Diseases and pests of cabbages, leeks, carrots, chicory, brussels sprouts, lettuce and endive; control of slugs. (Horticultural Abstracts 34:4623. 1964).

* FAIX, J.J., KAISER, C.J. y GRAFFIS, D.W. Evaluation of pesticides for improving alfalfa establishment in conventional and no-till sod planting. DSAC Dixon Springs Agricultural Center (no. 8):104-109. 1980. (093

Pillbugs and slugs.

FENNER, T.L. The gardener's oldest enemies, slugs and snails. South Australia.Department of Agriculture Journal 65(8):347, 359. 1962. (094

_____. Slugs and snails. South Australia. Department of Agriculture. Lealfet no. 3686. 1962. s.p. (095

* FISHER, T.W. y ORTH, R.E. Differential susceptibility of brown garden snail to metaldehyde. California Agriculture 29(6):7-8. 1975. (096

* _____. et al. *Ocypus olens*: a predator of brown garden snail. California Agriculture 30(3):20-21. 1976. (097

/*Helix aspersa*, biological control/

* _____., ORTH, R.E. y SWANSON, S.C. Snail /*Rumina decollata*/ against snail /*Helix aspersa*/. California Agriculture 34(11-12):18-20. 1980. (098

También en: Pest Control Circular no. 529. 1982. 2 p.

* FOSTER, G.N. Problems in cucumber crops caused by slugs, cuckoo-spit insect, mushroom cecid, hairy fungus beetle and the house mouse. Plant Pathology 26(2):100-101. 1977. (099

FOX, C.J.S. y SMELTZER, G.G. Note on the effect of three fungicides on slug injury to potatoes. Phytoprotection 45(1):36-37. 1964. (100

Bordeaux mixture, copper, and zineb.

FRASE, W.C. How to control scale, snails and slugs. Journal Bromeli Soc. 24(5):177. 1974. (101

FRUEHSCHUETZ, H. Means for the defense or for the elimination of such molluscs as snails, maggots or the like; an implement for the application of these means (En alemán). Patentblatt 99(39):6590. 1978. (102

* FUNDACION SHELL. Control de plagas en fresas. Noticias Agrícolas (Venezuela) 6(14):54-55. 1972. (103

Tabulated recommendations for the control of slugs, mites, aphids, moths and coleopterous larvae. (Horticultural Abstracts 43:107. 1973).

* FURNESS, G.O. Survey of snails on citrus in the Riverland of South Australia. Australian Journal of Experimental Agriculture and Animal Husbandry 17(89):1036-1039. 1977. (104

A survey of snails and snail damage to 95 blocks of citrus in the Riverland of South Australia was made during 1974 and 1975. The owners of each block were interviewed to determine the cultural practices used and to find out if control measures were applied. An examination of the orchard was made to determine the amount of snail damage to the crop and the species of snails present. The European brown snail *Helix aspersa* (Muller) was the only species causing significant damage.

Snail damage was most severe on orchards irrigated by overhead sprinklers, less severe where undertree sprinklers were used, and rarely a problem on furrow irrigated orchards ($P < 0.01$). Cultivation did not significantly affect the snail problem. In 1974 an estimated 43% of orchards either had more than 10% crop damage or were sprayed to control snails. In 1975 there were an estimated 9% of orchards affected to that extent.

GAIR, R. Cereal pests. In British Insecticide and Fungicide Conference, 8th, s.1., 1975. Proceedings. s.1., 1975. v.3, pp. 871-874. (105

GARCIA B., U. y MUÑOZ C., F. Chemical control of /the snail/ *Helix aspersa* Mueller (Gastropoda, Helicidae) in *Strelitzia reginae* Banks (Musaceae) plantings. Revista Peruana de Entomología 19(1):108-110. 1976. (106

* GETZIN, L.W. Control of the grey garden slug, *Deroceras reticulatum* Muller, with bait formulations of a carbamate molluscidide. Journal of Economic Entomology 58:158-159. 1964. (107

Brain baits containing 1,2 and 3% of Bayer 37344 were applied at rates of 1,2 and 4 lb./1.000 sq. ft. for the control of *Deroceras reticulatum* on rhubarb. Control ranged from 76% with the 1-lb rate of the 1% bait to 95% with all rates of the 3% bait; it increased with higher concentrations of the toxicant. (Horticultural Abstracts 35:5811. 1965).

* _____. y COLE, S.G. Evaluation of potential molluscicides for slug control. Washington State Agricultural Experiment Station. Bulletin 658. 1964. 9 p. (108

Deroceras reticulatum (Muller), *Prophysaon andersoni* (Cooper), and *Arion ater* (Linnaeus), the principal slug species of agricultural crops in Washington, are normally controlled with baits, sprays, and dusts of metaldehyde. Cost and the danger of residues on food crops sometimes prohibit the use of this toxicant. Because of these limitations, a search was initiated for possible molluscicides to supplement metaldehyde on agricultural crops.

Dinitrocresol, zinophos, phorate, carbaryl, and several experimental carbamate insecticides gave 100% mortality of *P. andersoni* held for 3 days on filter paper treated with 10 $\mu g/cm^2$. As a group, the carbamate cholinesterase inhibitors were molluscicidal. Chlorinated hydrocarbon insecticides and organophosphorus insecticides were poor molluscicides with the exception of zinophos and phorate. Dermal applications of most chemicals were ineffective because the slugs removed the toxicants by secreting excess amounts of slime.

The toxic compounds were formulated as 2-5% bran baits and offered to slugs in screening trials. Slugs accepted Bayer 37344, Dimetilan, Zectran, and SD 8530 baits in varying degree, but none of the baits equalled the effectiveness of the standard metaldehyde bait.

Bran baits attracted more slugs than apple pomace baits. The addition of molasses did not make the baits more attractive. Bran baits of metaldehyde and Bayer 37344 provided good control of *D. reticulatum* and *P. andersoni* in experimental field trials. On fallow land, a broadcast application of 4% Bayer 37344 bait equalled 4% metaldehyde bait for control of the gray garden slug. Sprays and dusts of Bayer 37344 at 4 lb/acre and calcium cynamid broadcasted at 400 lb/acre to the soil surface gave partial control. Metaldehyde, Zectran, and Bayer 44646 failed as spray or dust treatments.

Effective control of the recitulated slug was obtained in strawberries with 4% bait applications of metaldehyde and Bayer 37344 at 100 lb/acre. Slug damage to the fruit was reduced to 3 and 4% respectively, with the bait treatments while 13% of the crop was damaged in the non-treated controls. Sprays of metaldehyde, Bayer 37344, Zectran, and Bayer 44646 did not reduce the slug population in the strawberry plots, partially because the spray was not deposited below the foliage canopy where the slugs were active.

GETZIN, L.W. Control of slugs. Washington Agricultural Experiment Station. Circular 451. 1965. pp. 40-41. (109

GILERT, B. et al. Field tests of hexabutyldistannoxane (TBTO) in slow-release formulations against *Biomphalaria* spp. Bulletin of the World Health Organization 49(6):633-636. 1979. (110

GILLES, G.L. La parasitologie du fraisier. Fruit Belge 35:427-432. 1967. (111

Short notes, including some control measures, on virus diseases, grey mould (*Botrytis cinerea*), powdery mildew (*Sphaerotheca humuli*), leaf spot diseases (*Mycosphaerella fragariae* and *Diplocarpon earliana*), mites (*Tarsonemus pallidus* and *Tetranychus urticae*), blossom weevil (*Anthonomus rubi*), aphids (*Myzus ascalonicus* and *Pentatrichopus fragaefolii*), ants, slugs, ground beetles (especially *Harpalus* spp.), soil insects, nematodes and soil sickness. (Horticultural Abstracts 38:5258. 1968).

GLAESER, G. y SCHONBECK, H. /Common diseases and pests of field-grown cucumbers/. Flugbl. Bundesanst. PflSch., Wien. 17:1-10. 1968. (112

Notes on the occurrence, symptoms, causes, spread and control of mildew (*Erysiphe cichoracearum*), leaf spot (*Pseudomonas lachrymans*), scab (*Cladosporium cucumerinum*), wilt, mosaic non-parasitic disorders, spider mites, aphids, bean fly (*Phorbia platura*) and slugs. (Horticultural Abstracts 39:4737. 1969).

GOBLE, H.W. Slugs. Ontario Department of Agriculture and Food Factsheet AGDEX 610. 1970. s.p. (113

GODAN, D. Common names of snails and slugs in plant protection. Zeitschrift fuer Pflanzen-Krankheiten Pflanzenpathologie und Pflanzenschutz 77(1):38-58. 1970. (114

_____. y KURSAWE, G., comps. Library of phytomedicine (a selection of monographs and periodicals). 11. Snails as pests and their control. Merkblatter Biologische Bundesanst fur Land-und Forstwirtschaft in Braunschweig 50(11):8. 1978. (115

GOIX, J. Slug control /*Agrolimax reticulatus* Mull; *Arion hortensis* Ferr.; *Arion rufus* L.; *Milax budapestensis* Hazay; molluscids, baits, repellents; France/ (En francés). Phytoma no. 321:5-6, 8. 1980. (116

GOODYEAR, G.J. Snails and slugs. New South Wales Department of Agriculture. Entomological Branch. Insect Pest Bulletin no. 1. 1976. 6 p. (117

GOUGH, H.C. A review of the incidence, importance and control of cereal pests. In Britain Insecticide, Fungicide Conference, 2nd., s.l., 1963. Proceedings. s.l., s.e., 1963. pp. 45-50. (118

* GOULD, H.J. Observations on slug damage to winter wheat in East Anglia from 1957-1959. Plant Pathology 10:142-146. 1961. (119

The surveys have shown that in certain years, particularly after wet summers, slugs can be a serious problem on winter wheat in the heavy land areas. Underground damage by grain hollowing is usually one of the most important causes of failure and the most difficult to control with existing materials and methods. There is good evidence that damage is most likely when winter wheat follows dry harvesting peas, leys, cereals and brassica seed crops, damage seems less likely after fallows, potatoes or sugar beet. Seedbed conditions may also be related to the extent of slug damage, which often seems more severe where the seedbed is very rough and cloddy.

* _____. Tests with seed dressings to control grain hollowing of winter wheat by slugs. Plant Pathology 11(4):147-152. 1962. (120

Laboratory and field trials with seed dressings of copper salts and metaldehyde at rates of 5-10 oz per bushel showed that, while the dressings gave some control of grain hollowing, the effect was limited and a considerable loss of seed might still occur. Metaldehyde and Paris green dressings at 10 oz per bushel gave the best reduction of seed hollowing in the laboratory trials, but copper oxychloride at 10 oz per bushel was consistently the best material in the field. In two trials, in the presence of large numbers of *A. reticulatus*, dressings of metaldehyde and copper oxychloride at 10 oz per bushel failed to protect the young shoots which were severely grazed below ground soon after germination.

* GOULD, H.J. Trials on the control of slugs on arable fields in autumn. Plant Pathology 11(3):125-130. 1962. (121

Six trials were done to compare standard metaldehyde and bran baits with other materials, known to have molluscicidal properties, used as sprays or dusts for the control of slugs before drilling wheat on heavy soils in the autumn. None of the treatments gave a complete control of slugs and none was better than the standard metaldehyde and bran baits or a proprietary pelleted meta bait. Of the spray treatments, DNOC and metaldehyde showed some promise, and copper sulphate applied as a powder also gave a good result in one of the trials. Soil conditions often make control measures difficult on heavy land in autumn and treatments would almost certainly have to be applied before ploughing. Because of weather and soil conditions, wheat could not be drilled on two of the trials. In the three trials where wheat was drilled and slug populations were high enough to cause damage there was no evidence that less damage had occurred on the treated plots.

* _____. Observations on the susceptibility of maincrop potato varieties to slug damage. Plant Pathology 14:109-111. 1965. (122

Observations on four maincrop variety trials during three years suggested that under the conditions of these trials there were some differences in varietal susceptibility to slug damage. The Ulster varieties included in the trial were most heavily attacked. Redskin also seemed more susceptible than the other varieties. In all three years, King Edward was more heavily damaged than Majestic but this was significant ($p=0.05$) only in 1961. There was some indication from two trials that the newer varieties, Pentland Falcon and Pentland Dell, might be less susceptible to damage than King Edwards, and in 1963 they also had less damage than Majestic but this was not significant. The information obtained from the trials does not help to determine the reasons for the apparent varietal differences in slug damage.

* _____. y WEBLEY, D. Field trials for control of slugs on winter wheat. Plant Pathology 21(2):77-82. 1972. (123

In a series of field trials during 1968-1970, 4% methiocarb or 3% metaldehyde baits, applied to plots before drilling winter wheat, effectively reduced the numbers of slugs found by various methods of trapping after treatment. In the dry conditions prevailing at most of the sites, there were few consistent differences between methiocarb and metaldehyde. Little grain damage occurred on the control plots at any of the sites as weather conditions after drilling did not favour slug activity. Small increases in plant stand were obtained on the treated plots but differences between treatments were not significant.

GRAVES, W.E. Exterminating bush snails. American Orchid Society Bulletin 30(11):884. 1961. (124

/GREEN MANURING trial with tulips at the Horticultural Experimental Farm at Oudkarspel/. Weekblad voor Bloembollen Cultuur 77:201. 1966. (125

Yields of tulip bulbs from a heavy clay soil appeared to be unaffected by 5 different green manure crops ploughed in during the autumn before bulb planting. The risk of slug damage was reduced if the cover crops were ploughed in during mid-August rather than in mid-September. The effects of 4 levels of N (0, 0.7, 1.4 and 2.1 kg per acre) were also investigated, the fertilizer being applied in October before planting. When the bulbs were later forced, the best results were obtained from those that had been grown at the 2 higher levels of N. (Horticultural Abstracts 37:1387. 1967).

GUL, H. y CHAUDHRY, M.I. Attractancy of granular insecticides for land snail (*Helix aspersa*, Gastropoda, Mollusca). Pakistan Journal of Forestry 31(1):29-32. 1981. (126

/Temik 10%, Thiodan 3%, Diazinan 14%, Disyston 15% and NaCl (Sodium chloride), juniper/

GUPTA, G.P., GAUTAM, S.S.S. y ABBAS, S.R. Integrated control of giant African snail in Andaman Jail and consequent reduction in the snail population. Indian Journal of Entomology 40(1):92-93. 1978. (127

_____., ABBAS, S.R. y SRIVASTAVA, P.D. Feasibility of the use of *Achatina fulica* Bowdich, 1882 as manure/fertilizer in kitchen gardens. Indian Journal of Entomology 42(pt. 4): 794-795. 1980. (128

HAEHNLE, H.O. y KNOERINGER, W. Pests and snails rejecting implement (En alemán). Patentblatt 99(44):7446. 1979. (129

HAMMAN, P.J. House and landscape pests: slugs and snails. Texas Agricultural Extension Service. Texas A&M University. Leaflet L 1737. 1979. 2 p. (130

HAMMER, O.H. Zectran pesticide-some chemical and physical properties and some results from use on pests of ornamental plants. Down to Earth 17(4):9-13. 1962. (131

This new insecticide, 4-dimethylamino-3,5-xylylmethylcarbamate, has been tested and found effective against a wide range of insects, including among others, the eastern tent caterpillar (*Malacosoma americanum*) on wild cherry, leaf miners on ornamentals, the common flower thrips (*Frankliniella tritici*) and the tobacco thrips (*Frankliniella fusca*), scale insects, leafhoppers, aphids, the clover mite (*Bryobia praetiosa*) on honeysuckle, the maple bladder-gall mite (*Vasates quadripedes*) on maple, and also slugs and snails. (Horticultural Abstracts 32: 6796. 1962).

* HASAN, S. y VAGO, C. Transmission of *Alternaria brassicicola* by slugs. Plant Disease Reporter 50:764-767. 1966. (132

Slugs (*Arion ater* L.) were found in nature associated with cabbage leaf spot caused by *Alternaria brassicicola* (Schw.) Wiltsh. After experimental contamination by feeding, spores of *A. brassicicola* were recovered in viable stage from various parts of the digestive tract and from the excrements of slugs during a period of more than 1 week. The viability of spores was tested by direct germination, by their growth on artificial medium, and by infection of plants. Histological preparations located the different phases of the transition of fungal spores in the gut.

HENDERSON, I.F. y NEWELL, P.F. Molluscicidad activity of plastic sheet. Zeitschrift fuer Angewandte Zoologie 53:499-500. 1966. (133

_____. Studies on the laboratory assessment of the toxicity of chemicals to slugs especially *Agriolimax reticulatus* (Muller). Ph.D. Thesis. London, University of London, 1966. s.p. (134

* _____. Laboratory methods for assessing the toxicity of contact poisons to slugs. Annals of Applied Biology 62(3):363-369. 1968. (135

Two techniques for comparing the activity of different contact poisons to slugs in controlled conditions were used to measure the relative toxicities of five substances. A laboratory immersion test rated their median lethal concentrations as follows: ioxynil 8.3 ppm, sodium pentachlorophenate 22.0 ppm, copper sulphate 68.1-75.3 ppm, acetaldehyde 4822.0 ppm. Metaldehyde gave inconsistent results with this method but, using a dry-contact method, metaldehyde (42370 ppm) was much less toxic than copper sulphate (2027 ppm). The materials giving practical control in the field were not the most toxic of those tested.

* _____. Arthropods, molluscs and pasture productivity. In Rothamsted Experiment Station. Report for 1968. Harpenden, England, 1969. Part 1, p. 222. /Sólo sumario/. (136

An experiment that will continue for several years was started to study the effects of pests on the productivity of pasture, a subject hitherto neglected. The slugs, snails, mites and insects of various classes were killed selectively with metaldehyde, chlorbenside, BHC and "Posdrin" in plots in a field sown 25 years ago with a mixture of rye-grass, cocksfoot, timothy and clover, but now containing other grasses and broad-leaved plants. The treatments did not change the botanical composition of the sward or its yield.

* _____. A laboratory method for assessing the toxicity of stomach poisons to slugs. Annals of Applied Biology 63(1):167-171. 1969. (137

A method is described that allows the toxicity of stomach poisons to the grey field slug, *Agriolimax reticulatus* (Muller), to be

measured in the laboratory. The relative toxicities of three commonly used molluscicides, as expressed by the median lethal dose values, were: sodium pentachlorophenate most toxic with a median value of 22.9 ± 2.5 µg/slug, metaldehyde next with one of 85.2 ± 4.0 µg/slug, and copper sulphate least toxic with one of 129.2 ± 5.9 to 131.6 ± 5.6 µg/slug. The technique allows a given dose of any poison, however repellent, to be administered, but does not measure the repellency or attractiveness.

* HENDERSON, I.F. The fumigant effect of metaldehyde on slugs. Annals of Applied Biology 65(3):507-510. 1970. (138

The fumigant effect of metaldehyde on slugs is confirmed and shown almost certaintly to be caused by impure metaldehyde breaking down to the volatile parent monomer, acetaldehyde. Acetaldehyde was slightly more toxic to *Agriolimax reticulatus* than to *Arion hortensis*.

HERING, M. [Slug damage on grapes]. Weinberg und Keller 16:201-204. 1969. (139

Evidence of damage by the slugs *Deroceras agreste* and *Arion hortensis* was found in certain vineyards which were severely infected by *Botrytis*. Is was suggested that this damage, especially to the grape pedicels, could provide points of entry for *Botrytis*. However, it was concluded that the severity of the *Botrytis* infection was due mainly to the high rainfall in 1968 and that the role of the slug damage was insignificant. Direct control of the slugs by metaldehyde preparations would be possible, but it is questionable whether the expenditure would be economic, since neither the slug damage alone nor its effect on the occurrence of *Botrytis* are sufficiently serious to warrant control measures. (Horticultural Abstracts 39: 6623. 1969).

HERNANDEZ PAZ, M. Slugs [as coffee plantation pests and their control]. Revista Cafetalera (Guatemala) no. 148:43-46. 1975. (140

HESKETH, K.A. y MOORE, W.S. Snails and slugs in the home garden. University of California. Cooperative Extension Service. Leaflet no. 2530. 1979. 6 p. (141

_____., MOORE, W.S. y TENNEY, I. Snails and slugs in the home garden. University of California. Cooperative Extension Service. Leaflet no. 21228. 1981. 5 p. (142

HEYMANS, P. y LIEKENS, F. [Some pests of strawberries and their control]. Fruitteeltblad 16(6):201-207. 1972. (143

También en: Tuinbouwberichten 36(4):151-157. 1972.

Details are given of the damage caused and the measures recommended for controlling: leaf and bud nematodes (*Aphelenchoides*

ritzema-bosi and A. *fragariae*), stem and bud nematodes (*Ditylenchus dipsaci*), root nematodes (*Pratylenchus penetrans* and *Longidorus elongatus*), strawberry mites (*Tarsonemus pallidus* and *T. fragariae*), strawberry aphids (*Pentatrichopus fragariae*), ground beetles (various species), red spider mite (*Tetranychus urticae*), slugs and the common green capsid (*Lygus pabulinus*). (Horticultural Abstracts 42(4):7555. 1972).

HILDEBRANDT, H. /Clean healthy strawberries with *Styropor* wool/. Obst. u. Garten 88:174-176. 1969. (144

Compared with chopped straw, the use of *Styropor* wool as a mulch for strawberries has the following advantages: fruit health was improved (the material did not become wet through, even in periods of continuous rain, and it dried immediately); slug damage was reduced; soil evaporation was restricted; weed growth was suppressed; runner development was less affected; it could be easily worked into medium or heavy soils or re-used in the following year on light soils; and its low weight made handling easy. (Horticultural Abstracts 40:3299. 1970).

HODA, Q. Snails on your garden crops. Intensive Agriculture 9(7):9, 11. 1971. (145

HONDURAS. SECRETARIA DE RECURSOS NATURALES. Campaña nacional para el control de la babosa en los cultivos de frijol. Tegucigalpa, 1980. 6 p. (146

HOWITT, A.J. The slug problem on strawberries. In West Washington Horticultural Society. Annual Meeting, 15th., 1960. Proceedings. s.l., s.e., 1960. s.p. (147

* _____. Chemical control of slugs in orchard grass-ladino white clover pastures in the Pacific Northwest. Journal of Economic Entomology 54(4):778-781. 1961. (148

Experiments were conducted in Western Washington on the control of slugs affecting orchard grass-ladino white clover pastures. Slug populations for the most part consisted of *Deroceras agreste* (Linnaeus) and *Arion ater* (Linnaeus) although several other species were found. The best method of determining slug populations in pastures involved the use of boxes. It was found that slugs would seek shelter under upturned boxes during the day if the boxes were made light-proof. It was demonstrated that slugs could destroy ladino white clover in a single growing season. Slug populations varied greatly within a season. The slug population was greatly increased at the surface by overhead irrigation. When colloidal suspensions of metaldehyde were pumped into the irrigation system at this time, seasonal control of slugs was obtained.

* HOWITT, A.J. y COLE, S.G. Chemical control of slugs affecting vegetables and strawberries in the Pacific Northwest. Journal of Economic Entomology 55(3):320-325. 1962. (149

Experiments were conducted in western Washington on the control of slugs affecting vegetables and strawberries using metaldehyde baits, sprays, and dusts. Slug populations for the most part consisted of *Deroceras reticulatum* (Muller) and *Arion ater* (Linnaeus); although other species including *Prophysaon andersoni* (Cooper), *Milax gagates* (Linnaeus), *Arion circumscriptus* (Johnston), and *Limax maximus* Linnaeus were present. The best method of determining slug populations was to establish bait stations in plots. Baits were placed under boards; then dead slugs were collected from the bait stations. Metaldehyde dusts and sprays reduced slug populations in bean and corn plantings. In strawberry plantings, metaldehyde sprays and dusts were superior to baits in reducing populations. Metaldehyde sprays and dusts were effective only when the boom was lowered to within a few inches of the ground. No control was obtained when the materials were applied above the foliage.

HUNT, S. Slugs feeding on Cronartium in British Columbia. Bi-monthly Research Notes (Canada) 34(4):21. 1978. (150

* HUNTER, P.J. The distribution and abundance of slugs on an arable plot in Northumberland. Journal of Animal Ecology 35:543-557. 1966. (151

The distribution and abundance of *Agriolimax reticulatus* (Mull.), *Arion hortensis* Fér. and *Milax budapestensis* (Hazay) were investigated in a study based on routine sampling from an arable plot in Northumberland. Vertical distribution in the soil varied throughout the year, slugs of all three species being deeper underground during frosty and dry weather. There were also differences between species. *Agriolimax reticulatus* being found nearer the surface than *Arion hortensis* and the latter nearer than *Milax budapestensis*. Horizontal distribution of slugs on the plot was fairly uniform but *M. budapestensis* was slower than the other two species at recolonizing an area in which the population had been depleted. All three species exhibited aggregation, especially just after hatching.

There was a general reduction in the density of slug generations shortly after breeding, i.e. senescence is short. Decreases in the numbers of immature *Agriolimax reticulatus* and *Arion hortensis* occurred during the winter (probably due to the effects of frost) and of young *Milax budapestensis* during autumn (possibly due to a local shortage of food).

Estimates of the capacity for increase of *Arion hortensis* and *Milax budapestensis* were obtained from field cultures. *Arion hortensis* has a higher capacity than *Milax budapestensis*, but neither of these species is able to reproduce so quickly as *Agriolimax reticulatus*. It was concluded that the most important factor to influence the density of populations was the length of generation interval. It was noted during the study that the density of the population was affected by the severity of the previous winter, which regulated the maturation time of preceding generations.

* HUNTER, P.J. The effect of cultivations on slugs of arable ground. Plant Pathology 16:153-156. 1967. (152

The effect of various cultivations on populations of *Agriolimax reticulatus* (Muller), *Arion hortensis* Férussac and *Milax budapestensis* (Hazay) was assessed. Reduction in numbers of all species was obtained in three separate experiments. 1) The ground was ploughed once during winter; 2) The soil was broken up into a fine tilth and firmly compacted; grass was then sown and kept at a height of 1 to 3 in. for three and a half months; 3) The soil was broken up into a fine tilth but not later compacted or sown with grass.

The second method was the most effective in reducing numbers. It is concluded that slugs may become increasingly serious pests as cultivations become less necessary to growing arable crops.

* _____., SYMONDS, B.V. y NEWELL, P.F. Potato leaf and stem damage by slugs. Plant Pathology 17:161-164. 1968. (153

Foliage damage to potatoes in the laboratory and field is described. Field observations showed that leaves of the cultivar Maris Piper were more extensively damaged than those of Majestic.

_____. Studies on slugs of arable ground. I. Sampling methods. Malacologia 6:369-377. 1968. (154

_____. An estimate of the extent of slug damage to wheat and potatoes in England and Wales. National Agricultural Advisory Service. Quarterly Review 85:31-36. 1969. (155

_____. Slugs and their control. In British Insecticide and Fungicide Conference, 5th., s.l., 1969. Proceedings. s.l., s.e., 1969. v. 3, pp. 715-719. (156

* _____. y SYMONDS, B.V. The distribution of bait pellets for slug control. Annals of Applied Biology 65:1-7. 1970. (157

Observations were made on the movement and mortality of *Agriolimax reticulatus* (Muller) on plots with various densities of metaldehyde and methiocarb pellets. The optimum density of pellets was found to lie between 25 and 100/m^2 (pellets 20 and 10 cm apart). This confirmed an estimate derived from a theoretical model.

_____. y JOHNSON, D.L. Screening carbamates for toxicity against slugs. Journal of Economic Entomology 63(1):305-306. 1970. (158

* _____. y RUNHAM, N.W. Slugs: a world problem. Tropical Science 13(3):191-198. 1971. (159

* En español en: Revista de la Facultad de Agronomía (Zulia, Venezuela) 2(1):93-101. 1972.

HUSSEY, N.W., READ, W.H. y HESLING, J.J. The pests of protected cultivation. The biology and control of glasshouse and mushroom pests. New York, American Elsevier, 1970. 404 p. (160

INDIA. RUBBER BOARD. Report of the activities of the Rubber Board for the period from 1st October, 1965 to 31st March, 1966. India, 1967. pp. 50-62. (161

Pathology: studies on *Phytophthora palmivora*, pink disease and powdery mildew; studies on nursery leaf-spot disease (*Corynespora* sp.), including fungicide evaluations; studies on insect pollinators, termites infesting hevea, cover crop pests and snails and slugs infesting hevea. (Horticultural Abstracts 38:2169. 1968).

_____. Report of activities, 1 October 1968 - 31 March 1969. India, 1971. pp. 64-73. (162

Includes control of snails, slugs and pests of rubber wood.

_____. Report of activities for April-September 1969. Kottayam, Kerala, 1971. pp. 61-71. (163

Mycology/plant pathology: studies on abnormal leaf fall (*Phytophthora* sp.), powdery mildew (*Oidium heveae*), nursery leaf spot diseases (*Corynespora cassiicola*, *Pestalotia* sp. and *Curvularia* sp.), pod rot (*Gloeosporium alborubrum*) patch canker, pink disease (*Pellicularia salmonicolor*), insect pollinators, pests of cover crops and their control, and snails and slugs and their control. (Horticultural Abstracts 42(1):2575. 1972).

INGLATERRA. MINISTRY OF AGRICULTURE. Agricultural chemicals. Approval Scheme, List of Approved Products, 1962. 2nd. ed. London, 1962. 103 p. (164

Lists of insecticides, fungicides, herbicides, seed dressings, growth regulators, slug killers, soil sterilizers, grease-banding materials and wound-sealing materials are given, with their proprietary names as marketed in the U.K. The scheme is voluntary and its purpose is to enable users to select efficient materials. (Horticultural Abstracts 32:4132. 1962).

INOUE, T. Molluscicidal properties of 4-(phenylazo) phenol derivates on snails and slugs. Japanese Journal of Applied Entomology and Zoology 27(2):84-91. 1983. (165

INSTITUTO NICARAGUENSE DE TECNOLOGIA AGROPECUARIA. Las babosas o lipes (*Vaginulus plebeijus* (mollusca gastrópeda). Managua, 1977. 4 p. (166

INTRODUCED SLUGS still spreading. Nautilus 80(3):108. 1967. (167

INVESTIGATIONS 1962-1963. Jamaica, Ministry of Agriculture and Lands. Bulletin no. 62. 1963? pp. 14-24. (168

Control of red spider mite (*Tetranychus* spp.), slugs, grasshoppers and crickets on bananas; control of red spider mite (*Tetranychus* spp.) on cacao; control of slug-caterpillar (*Alarodia nana*), fruit-piercing moth (*Gonodonta* spp.), rust mite (*Phyllocoptruta oleivora*) and slugs on citrus; control of leaf miner (*Leucoptera coffeella*) on coffee; control of the nematodes *Radopholus similis* on bananas and *Tylenchulus semipenetrans* on citrus. (Horticultural Abstracts 38:6962. 1968).

* IWATA, Y. et al. Metaldehyde residues on and in citrus fruits after a soil broadcast of a granular formulation and after a spray application to citrus trees /preparation for the control of *Helix aspersa*/. Journal of Agricultural and Food Chemistry 30(3):606-608. 1982. (169

The molluscicide metaldehyde (2,4,6,8-tetramethyl-1,3,5,7-tetroxocane) is used in California citrus groves to suppress populations of the brown garden snail *Helix aspersa* Muller. After a 56 kg ha^{-1} soil broadcast application of a 7.5% AI granular formulation, the 3-day rind samples showed a maximum residue level of 0.02 ppm of metaldehyde. The 10-and 17-day rind samples and 10-day pulp (edible portion) samples contained <0.01 ppm of metaldehyde. After an unregistered-use spray application, metaldehyde dissipated from unwashed rind with a half-life of 4.6 days during the initial 33 days of the test. Dissipation was somewhat slower during the subsequent 26 days of the test period with a half-life of 14 days. The 10-,31-, and 59-day-pulp samples contained <0.01 ppm of metaldehyde. Residue methodology developed for citrus is given in detail.

JAMAICA. MINISTRY OF AGRICULTURE AND LANDS. Annual report of the Ministry of Agriculture and Lands for the year ended 31st December, 1961. Kingston, 1964. 130 p. (170

The investigational work of the Ministry is reported under Crops and Soils (pp. 52-71) and includes: studies on the control of fruit piercing moths (*Gonodonta* spp.), slug worm (*Alarodia nana*), slugs (*Veronicella laevis*) and gummosis (*Phytophthora parasitica*) on citrus. (Horticultural Abstracts 35:4981. 1965).

JAMET, P. Classification et structure des pesticides /herbicides, insecticides, fongicides, fumigants, substances de croissance, molluscicides, rodenticides, acaricides/. In Fournier, E. y Bonderf, J., eds. Les produits antiparasitaires a usage agricole. Conditions d'utilization et toxicologie. Parfs, Lavoisier, 1983. pp. 19-80. (171

JENKINS, C.F.H. Slugs and snails. West Australia. Department of Agriculture. Bulletin no. 2776. 1960. (172

JENKINS, C.F.H. Snails and slugs. West Australia. Department of Agriculture Journal (Ser. 4) 1(7):615-619. 1960. (173

* JESSOP, N.H. The effects of simulated slug damage on the yield of winter wheat. Plant Pathology 18:172-175. 1969. (174

Winter wheat plants were removed by hand in December to simulate loss caused by different levels of slug attack. As a rule, the more severe the thinning, the greater the number of tillers, ears, and weight of grain produced per plant. The effect of plant loss on grain yield varied, but in three cases out of five where attempts were made to remove 75% of the plants (between 56 and 72% achieved), there was no significant difference in grain yield compared with the control plots. This level of thinning gave an average of stand of five plants per feet of row (16.4 per m).

* JEWERS, K. et al. Swartziagenin: a mixture of oleanolic and O-acetyloleanolic acids. Phytochemistry 10(9):2263-2265. 1971. (175

Obtained from the seed pods of *Swartzia madagascariendis* and used as molluscicide. (Horticultural Abstracts 42(2):4737. 1972).

* JOBIN, W.R. e IPPEN, A.T. Ecological design of irrigation canals for snail control. Science 145(3638):1324-1326. 1964. (176

The snail hosts of schistosomiasis have found ideal conditions for rapid colonization in many irrigation and drainage canal systems. By studying the hydrodynamic aspects of snail dislodgment it may be possible to devise a control method based on engineering the snail's microenvironment. For *Australorbis glabratus*, a velocity exceeding 33 cm/sec at shell height produces a hydrodynamic drag force sufficient to dislodge the snail from its position on the solid boundary of a canal.

* JOHNSON, G.V.y SMITH, F.F. Insects and related pests of house plants: how to control them. USDA. Home and Garden Bulletin no. 67. 1970. 16 p. (177

Chiefly chemical control; includes slugs and snails.

JONES, R.K. Control of slugs on bananas. Information Bulletin - South Africa, Citrus and Subtropical Fruit Research Institute no. 101:9-12. 1981. (178

Data are presented from a slug (*Urocycles flavescens*) control trial comparing the effects of copper sulphate (1% solution) sprayed onto the banana pseudostems and bunch poles, and baits of methiocarb (2%) or carbaryl (2%) + metaldehyde (3%), each at 5 g of pellets/mat, applied in October. The baits were spread on the ground around the base of each mat with a bunch, or mats likely to flower within the next 2 months, and around the base of bunch poles, all trash being cleared away from these areas. The 2 bait treatments were equally effective and gave protection for at least 7 weeks. In another trial baits applied after the first spring rains remained effective for up to 3 months. (Horticultural Abstracts 52(3):1844. 1982).

* JONES, T.P. The effect of aldrin on yield and slug damage in carrots in South Wales. Plant Pathology 14:39-40. 1965. (179

In trials at 3 sites there were significant differences in yield between treated and untreated plots, but no substantial differences between the 3 rates of aldrin tested. On one site γ-BHC seed dressing (1 oz/lb seed) was compared with aldrin dust at 484 lb/acre, untreated plots giving a mean yield of 13.3 oz roots per sample compared with 21.5 oz from the seed dressing and 30.9 oz from the aldrin-treated plots. There was no consistent growth increment associated with increased aldrin concentration in sterilized or unsterilized compost. Further investigation showed that there were no consistent differences in mineralizable N or in bacterial counts in the treated soils. (Horticultural Abstracts 35:5825. 1965).

JUDGE, F.D. Preliminary screening of candidate molluscicides. Journal of Economic Entomology 62:1393-1397. 1969. (180

JUILLET, J. Notes on the dispersion of the slug *Arion ater* (L.) (En francés). Phytoprotection 49(1):38-40. 1968. (181

* KALMBACHER, R.S., MINNICK, D.R. y MARTIN, F.G. Destruction of sodseeded legume seedlings by the snail (*Polygyra cereolus*). Agronomy Journal 71(2):365-368. 1979. (182

Florida's perennial forage grasses, dormant during winter and early spring, provide little new forage unless overseeded with a cool-season crop such as clover (*Trifolium* spp.) or alfalfa (*Medicago sativa* L.). Sod-seeding legumes in bahiagrass (*Paspalum notatum* Flugge) has resulted in poor establishment unless areas were desiccated with 0.28 kg/ha of paraquat and burned 48 hours later. Poor stands were believed to be due to seedling loss by the snail (*Polygyra cereolus* Muhlfeld). These experiments were designed to test this hypothesis and determine if burning killed snails.

Five experiments were conducted: 1) Populations were estimated by counting snails in 0.3 m^2 areas and by tallying snails in traps; 2) To determine legume mortality rate, 0, 1, 3, 5, and 7 snails were placed in enclosures with 20 white clover (*T. repens* L.) seedlings; 3) In a similar experiment two or four snails were exposed to 40 white clover seedlings drilled in rows; 4) Alfalfa, red (*T. pratense* L.) and white clover were exposed to snails to determine differences in legume susceptibility; 5) Finally, the temperature was recorded 2.5 cm above, 2.5 cm below, and at soil surface during the burning of bahiagrass. Snails were placed on the soil before the burn and their mortality was determined.

During a 44-day trapping period in newly seeded legume plots there was an average total of 13.6 snails found vs. 14.0 snails in unseeded bahiagrass. The number of snails per 0.3 m^2 was 0.9 vs. 0.84 snails in the respective areas. Greenhouse studies

indicated that P. *cereolus* was responsible for legume mortality. White clover was more susceptible to loss than red clover or alfalfa. More than one snail per 20 seedlings constituted a threat to legume establishment particularly when added to losses from other causes. Burning bahiagrass after desiccation with paraquat resulted in 98% mortality of P. *cereolus*. Temperatures at the soil surface rose from 27 to 83 C in 75 sec then dropped to 37 C after 5 min.

KENNEL, W. /Integrated plant-protection measures against parasitic fungi in fruit growing/ (En alemán). Zeitschrift fur PflanzenKrankheiten und Pflanzenschutz 79(7):400-406. 1972. (183

In apple orchards the earthworm *Lumbricus terrestris* degraded not only leaf litter, but also remnants of prunings by either burying them in the soil or eating the bark. Endogenous fungi were thus effectively destroyed. Various snail spp. (*Cepaea hortensis*, *Deroceras agreste*) performed the same beneficial activities. Systemic fungicides such as captan, thiabendazole, thiophanate and benomyl were toxic to earthworms; however, the toxicity of ethyl parathion was comparatively low. Dodine and wettable sulphur had no ill effects. (Horticultural Abstracts 43(4):1752. 1973).

KLOOS, H. y McCULLOUGH, F. Molluscicidal effects of eucalyptus /correspondence/. Veterinary Research 111(7):148. 1982. (184

KRAUSS, N.L.H. Biological control investigations on insect, snail and weed pests in Tropical America, 1961. Hawaii Ent. Soc. Proc. 18(1):131-133. 1961. (185

* KUEH, T.K. y KHEW, K.L. Survival of *Phytophthora palmivora* in soil and after passing through alimentary canals of snails. Plant Disease 66(10):897-899. 1982. (186

Vertical distribution of propagules of *Phytophthora palmivora* morphological form (MF) 4 (cause of foot rot of *Piper nigrum*) in the field decreases with increasing soil depth and is highest at 0.5-15 cm and very low at 30-45 cm. Soil moisture and pH greatly affected survival of P. *palmivora* MF 4. The optimum soil moisture for survival was 25-45% water-holding capacity, at soil pH 6.5-7.0. The pathogen survived a maximum of 18 mo in its natural habitat, as assessed by continuous baiting. Fungal propagules were found in snail *Achatina fulica* feces in three pepper plantations. Sporangia survived and remained infective after passage through the alimentary canals of two snail species (*A. fulica* and *Hemiplecta crossei*).

LAL, O.P. Note on damage by the snail, *Macrochlamys* sp. (Gastropoda: Stylommatophera: Ario phantidae) to field crops. ornamentals and fruit trees in Kulu Valley, Himachal Pradesh /India/. Current Agriculture 1(3):65-67. 1977. (187

* LAURENCE, G.A. Pests and pest control in lawns and improved pastures. Journal of the Agricultural Society of Trinidad and Tobago 76(1):57-61. 1976. (188

* LE PELLEY, R.H. Gastropoda. In _____. Pests of coffee. London, Longmans, Green, 1968. p. 406. (189

LESLIE, W.R. Slugs. Prairie Gard. 1960:155-156. 1960. (190

LEVINE, N.D. Integrated control of snails. American Zoologist 10:579-582. 1970. (191

* LINDQUIST, R.K. y KRUEGER, H.R. Slugs: a touch problem for home gardeners. Ohio Report on Research and Development 61(2):24-27. 1976. (192

> Of several poison baits compared for the control of slugs 2% Mesurol /methiocarb/, at 2 lb/1000 ft^2, was the most effective. Data are also presented on the harvest residues of Mesurol and its toxic metabolites on radishes, lettuces and carrots, after 2-9 applications at 1 or 2 lb/1000 ft^2. (Horticultural Abstracts 47(4):3532. 1977).

* _____. et al. A bibliography of terrestrial slugs (Gastropoda: Stylommatophora and Systellommatophora) for agricultural researchers in North America. Ohio Agricultural Research and Development Center. Research Circular 232. 1977. 59 p. (193

LOGSDON, G. How to control slugs - or at least keep them from controlling you. Organic Gardening and Farming 23(9):121-126. 1976. (194

LUTMAN, J. The role of slugs in an *Agrostis* - Festuca grassland. Ecol. Stud. Anal. Synth. 27:332-347. 1978. (195

MALLET, C. y BOUGARAN, H. Determination of attractive valve of poisoned baits to slugs (En francés). In International Symposium on Phytopharm. and Phytiat., 1968. /Proceedings/. s.n.t. pp. 769-776. (196

* MANCIA, J.E. Biología de la babosa del frijol (*Vaginulus plebeius* Fisher), en El Salvador. In Reunión Anual del PCCMCA, 17a., Panamá, 1971. Frijol; documento de discusión. s.n.t. pp. 1-5. (197

* _____. Combate de la babosa del frijol, *Vaginulus plebeius* Fisher en El Salvador. In Reunión Anual del PCCMCA, 17a., Panamá, 1971. Frijol; documento de discusión. s.n.t. pp. 1-35. (198

* _____. Biología y control de la babosa del frijol, *Vaginulus plebeius* Fisher, en El Salvador. El Salvador. Ministerio de Agricultura y Ganadería. Circular no. 96. 1974. 12 p. (199

* MARICONI, F.A.M. Snails and the coffee tree (En portugués). Sao Paulo. Superintendencia dos Serviços do Cafe. Boletím 37(420):6-8. 1962. (200

Includes use of metaldehyde for control.

MARTIN, A.W. The shell-less snail: biology and control of slugs /garden pests/. Arboretum Bulletin 45(1):2-6. 1982. (201

MARTIN, N.A. Introduced slugs and snails. In New Zealand Weed Pest Control Conference, 31st, s.l., 1978. Proceedings. s.l., s.e., 1978. pp. 124-126. (202

MARTYR, R.F., ed. Modern techniques in nursery production. In Refresher Course for Nurserymen, 5th, Pershore Coll. Hort., Wores, 1970. Proceedings. s.l., s.e., 1970. s.p. (203

Includes a molluscicide with useful effects against certain other pests, by K.J. Bottrell.

MEAD, A.R. The giant African snail: a problem in economic malacology. Chicago, University of Chicago Press, 1961. 257 p. (204

_____. A flatworm predator of the giant African snail *Achatina fulica* in Hawaii. Malacologia 1:305-309. 1963. (205

MEIER, W. /Some comments on the relation between infestation (attack) and disease consequences due to pest in field crops/. Mitteilungen fuer die Schweizerische Landwirtschaft 29(1-2):1-19. 1981. (206

* MELLANBY, K. Slugs at low temperatures. Nature 189:944. 1961. (207

Slugs can move and feed at low temperatures, so are well fitted to be agricultural pests in winter. *Agriolimax reticulatus* is active below 0.8°, *Arion hortensis* is seldom active below 5°. No acclimatisation to high or low temperatures was found in slugs, which thus differ from many insects, amphibia and fish. (Compendiado en: Report of the Rothamsted Experimental Station for 1960. Harpenden, England, 1961. p. 309).

* MENESES R., R. Las babosas como plaga. Turrialba, Costa Rica, Centro Agronómico Tropical de Investigación y Enseñanza, Programa de Cultivos Anuales, 1978. 14 p. (208

* METCALF, C.L. y FLINT, W.P. Slugs. In _____. Destructive and useful insects, their habits and control. 4a. ed. New York, McGraw Hill, 1962. pp. 885-886. (209

MILLER, R.L. y RODRIGUEZ, J.G. Insecticide recommendations for the home garden. University Kentucky Cooperative Extension Service. Miscellaneous Publication no. 286-C. 1966. 2 p. (210

Recommended insecticides for pests of 20 vegetable crops are tabulated, with advice on general-purpose sprays, seed treatments, disease control and the control of grasshoppers, cutworms and slugs. (Horticultural Abstracts 37:787. 1967).

MIRA, A. DE. Biología y dinámica de población del molusco *Orthalicus fisheri* en cítricos. In Reunión Anual del PCCMCA, 25a., Tegucigalpa, Honduras, 1979. Memoria. Tegucigalpa, Secretaría de Recursos Naturales, 1979. v.4, pp. H26-1/H26-7. (211

MISTIC JUNIOR, W.J., MORRISON, D.W. y CLARK, G.B. Control of slugs in Burley tobacco fields in the Appalachian Mountains of North Carolina. International Tobacco 181(4):60-61. 1979. (212

MOENS, R. Progrés accomplis dans la lutte contre les limaces. Revue de l'Agriculture 13: 3-11. 1960. (213

After a brief review of injuries caused by various species of slug to field, market-garden, ornamental and fruit crops, mushrooms and aquatics, an account is given of trials of various materials, including quicklime, sylvinite, sylvinite plus copper sulphate, metaldehyde, calcium cyanamide, DNOC and some insecticides. Of 3 metaldehyde preparations granulated bait was the best. It remained effective for up to 2 weeks and, like 4% bran, was effective for the protection of young crops in summer against *Arion rufus*, A. *hortensis* and A. *subfuscus*. Non-oily calcium cyanamide was effective against all surface species when applied at 300-500 kg dust per ha. Spraying a suspension of 30 g dust in 2.1 water per sq. m. gave complete control of all species on the surface and partial control of those in the upper layers of the soil. For example, spraying against A. *hortensis* at the end of November gave 100% control on the surface, 80-90% at a depth of 0-2 cm, 60-80% at 2-5 cm and 20-40% at 5-10 cm. The ammonium salt of DNOC gave control of certain species, e.g. A. *hortensis* and *Milax gracilis*, and remained effective for 1-2 weeks. Parachloronitrobenzene has an immediate action but no residual effect. Chlorthion, Isochlorthion and Gusathion sprays controlled *Lymnaea peregra* water-cress beds. (Horticultural Abstracts 31:1832. 1961).

_____. Studies on the subterranean slug *Milax budapestensis* Hazay (En francés). In International Horticultural Congress, 16th, Brussels, 1962. Proceedings. s.l., s.e., 1963. v.2, pp. 373-376. (214

The life cycle of this slug is described; it can do considerable damage to potatoes, carrots and various ornamental plants. Metaldehyde baits (4-5%) are attractive to the slugs; ground sprays of DNOC applied in the autumn to ground which has no

plant cover have destroyed slugs, which travel on the soil surface at this time. When the slug is underground, soil watering with calcium cyanamide has given the best control. (Horticultural Abstracts 33:6560. 1963).

MOENS, R. *Hydrobia yenkinsi* Smith (gastéropode prosobranche) et autres organismes nuisibles au cresson de fontaine. Effet de l'application préventive de la cyanamide liquide. Mededelingen van de Rijks Faculteit Landbouwwetenschappen Te Gent 32:565-571. 1967. (215

A 40% a.i. solution of cyanamid was applied at 266 l/ha to the bottom and sides of watercress beds in mid-August, 2 weeks before seed was sown. *Hydrobia yenkinsi* snails were almost completely eliminated and the re-infestation level in the winter was too low to be injurious to the crop. Competing weeds were also destroyed, as was *Callitriche* sp. The cyanamid broke down to release the equivalent of 70 kg N per ha; this exceeded the level required by the crop, but surface decomposition resulted in some loss. (Horticultural Abstracts 39:2887. 1969).

_____. et al. A mechanical barrier against terrestrial gasteropods. Parasitica 23(1):22-27. 1967. (216

_____. Efficiency tests of some new molluscicide preparations for control of slugs. Mededelingen van de Rijks Faculteit Landbouwwetenschappen Te Gent 36(1):216-223. 1971. (217

_____. La lutte contre les limaces en cultures d'orchidees. In International Symposium over Fytofarmacie en Fytiatrie, Belgium, 1980. /Proceedings/. s.l., s.e., 1980. v.32, pt. 2, pp. 613-625. (218

También en: Mededelingen Faculteit Landbouwwetenschappen Rijksuniversiteit Gent 45(2).

_____. Le probleme des limaces dans la protection des végétaux. Revue de l'Agriculture 33(1):117-132. 1980. (219

Factors determining slug populations are discussed, including climate and season, ecology, and natural control agents, and the economic importance of damage is examined. Control methods suggested are ecological (clearing) and chemical with the use of metaldehyde, carbamates such as methiocarb, and baits containing a small dose of oxamyl or methomyl at 0.15%. Horticultural crops mentioned include carrots, celeriac, ornamental bulbs and *Cymbidium* in greenhouses. (Horticultural Abstracts 50(12):8661. 1980).

MONEY, S.P. Insect pests of vegetable crops. New Zealand Journal of Agriculture 104:231-241. 1962. (220

Descriptions of, and control measures for, insect and other arthropod pests, eelworms, slugs and snails. (Horticultural Abstracts 32:6498. 1962).

* MURRAY, D.A.H. Strawberry pests /insects and slugs/. Queensland Agricultural Journal 106(3): 248-254. 1980. (221

MUSICK, G.J. Efficacy of phorate for control of slugs in field corn. Journal of Economic Entomology 65(1):220-222. 1972. (222

* NAEGELE, J.A. Insect and other pests of floricultural crops /slugs/. In Pfadt, R.E., ed. Fundamentals of applied entomology. New York, McMillan, 1962. pp. 458-465. (223

NAIR, R.B. y SADANANDAN, A.K. Giant African snail - a pest of plantation crops in Andaman. Arecanut Spices Bulletin 6(1):7-9. 1974. (224

NAKAO, H.K., FUNASAKI, G.Y. y DAVIS, C.J. Introduction for biological control in Hawaii, 1973. Proceedings of the Hawaii Entomological Society 22(1):109-112. 1975. (225

NATIONAL FRUIT AND CIDER INSTITUTE (Long Ashton, Bristol). AGRICULTURAL AND HORTICULTURAL RESEARCH STATION. Annual report 1964. Long Ashton, 1965. pp. 41-44. (226

Entomology: Control of black currant gall mite; changes in the fauna in black currant plantations associated with the application of sprays; the significance of insects in fruit pollination; trials of a new ovicide (nitrated toluene) for the control of fruit tree red spider mite; evaluation of non-persistent derris emulsions for the control of aphids and tortrix moths on apples; earthworm gut enzyme action on plant waxes; the changes of DDT content in soil, herbage, foliage, earthworms and slugs in a sprayed apple orchard throughout the year; spray techniques and machinery. (Horticultural Abstracts 36:192. 1966).

* NAVARRO, E. Control de babosa *Vaginulus* sp. con cebos envenenados. In Reunión Anual del PCCMCA, 26a., Guatemala, 1980. Resúmenes. Guatemala, 1980. p. 101. /Sólo sumario/. (227

En el ciclo de postrera (octubre-enero) de 1979, se efectuó un ensayo de control de babosa *Vaginulus* spp. en frijol, con cebos envenenados en el municipio de Salamá, departamento de Olancho. El objetivo del ensayo fue determinar qué ingredientes al ser

mezclados conformaban el cebo más eficiente y económico para el control de babosa. Se realizaron dos aplicaciones, la primera al momento de la emergencia de las plantas y la segunda 6 días después. Todos los tratamientos redujeron la población de moluscos; sin embargo, el tratamiento constituído por Ortho-B y afrecho de trigo en proporción de 6.5 y 26 kg respectivamente fue más eficiente y al realizar el análisis económico resultó ser de bajo costo. Otros tratamientos que mostraron eficiencia similar al mencionado pero a un costo más elevado fueron los siguientes:

a.	Afrecho de trigo	26 kgs+
	Dipterex sp 95	0.2 kgs+
	Miel	7 lts+
	Cerveza	5 lts
b.	Afrecho de trigo	26 kgs+
	Ortho-B	6.5 kgs+
	Cerveza	5 lts

Debido a la escasez de maquinaria agrícola, lo que limita la buena preparación del suelo como medida cultural para el control de esta plaga, el control químico a base de cebos envenenados ofrece alternativas positivas de eficiencia y economía.

NEIJZING, M.G. y ZEVEN, A.C. Anther eating by snails and slugs in Streptocarpus /in relation to its pollination/. Acta Botánica Neerlandica 25(5):337-339. 1976. (228

NELDER, J.A. The spacing of lettuce in Dutch light frames and cold structures. Experimental Horticulture no. 4:20-30. 1961. (229

In several spacing experiments with May Queen and May Princess it was shown that where growing conditions were conducive to a heavy crop the optimum spacing was closer than where conditions were less favourable. In 5 of 6 experiments involving the widest range of spacings, the proportion of plant losses from *Botrytis* and slugs did not increase with population density. Changes in spacing above 7 1/2 in. square had little effect on the average cutting date. Market values in all experiments reached a maximum at a spacing of about 7 in. square, and relative profits were highest at about 7 1/2 in. square. (Horticultural Abstracts 31:6364. 1961).

NEW SOUTH WALES. DEPARTMENT OF AGRICULTURE. ENTOMOLOGY BRANCH. Snails and slugs. New South Wales, 1975. pp. 5, 3. (230

* NEW YORK STATE AGRICULTURAL EXPERIMENT STATION. 86th Annual report 1967. Geneva, New York, 1968. pp. 8-15. (231

Studies on the period during which petroleum oils can be applied to apple trees; sprays programmes for pest control on apples; slug control; control of an aphid virus vector on raspberries. (Horticultural Abstracts 39:4117. 1969).

* NEWELL, P.F. Soil pest control. In Rothamsted Experiment Station. Report for 1962. Harpenden, England, 1963. pp. 157-158. (232

* _____. Assessing slug populations. In Rothamsted Experimental Station. Report for 1964. Harpenden, England, 1965. Part 1, pp. 188-189. (233

* _____. y HENDERSON, I.F. Slug population and their control with ioxinyl. In Rothamsted Experimental Station. Report for 1964. Harpenden, England, 1965. Part. 1, p. 189. (234

* NICARAGUA. MINISTERIO DE AGRICULTURA Y GANADERIA. Guía de control integrado de plagas de maíz, sorgo y frijol. 2a. ed. Managua, Nicaragua, Proyecto Control Integrado de Plagas, MAG/FAO/PNUD, 1976. pp. 51-53. (235

1964 RESEARCH progress. Washington State University. Statistical circular no. 429. 1965. pp. 42-48. (236

Entomology: slug control in rhubarb.

1965 RESEARCH progress. Washington State University. Statistical circular no. 451. 1966? pp. 37-41. (237

Slugs on strawberries.

1969 VEGETABLE production recommendations. Ontario Department of Agriculture and Food Publication 363. 1969. 48 p. (238

Recommendations are given on varieties, cultural operations, fertilizer applications, weed control and measures for controlling the common pests and diseases of a wide range of vegetables. Notes are also given on various soil management practices, fertilizer placement, starter solutions, minor element deficiencies, the control of cutworms, slugs, white grubs, wireworms and nematodes, chemical and hot water seed treatment and the control of damping-off of seedlings. A list is included of the fungicides, insecticides, acaricides, nematicides and herbicides commonly used. (Horticultural Abstracts 40:3477. 1970).

NORTHEN, R.T. Slugs and beer: some can take it and leave it. American Orchid Society Bulletin 39(3):221-223. 1970. (239

O'KEEFFE, M. y PIERSE, C. Exposure of seed pelleting plant workers to methiocarb /a carbamate insecticide, acaricide and molluscicide/. Bulletin of Environmental Contamination and Toxicology 25(5):777-781. 1980. (240

* ORTH, R. E. et al. A rove beetle, *Ocypus olens*, with potential for biological control of the brown garden snail, *Helix aspersa*, in California, including a key to the nearctic species of *Ocypus*. Canadian Entomologist 107(10):1111-1116. 1975. (241

A female rove beetle (*Ocypus olens* Muller) in the laboratory consumed 20 small-sized brown garden snails (*Helix aspersa* Muller) in 22 days, eating almost its weight in snail bodies daily. *H. aspersa* is a serious agricultural and residential plant pest. Field observations from an area where *O. olens* was well established had a smaller snail population than similar areas lacking the beetle. *O. olens* appears to be a promising candidate species for biological control of *H. aspersa*. Mass production of *O. olens* has not yet been attempted. A tabular key to the nearctic species of *Ocypus* is presented. In North America its distribution is limited to California for which a map is included.

* PAPPAS, J.L. y CARMAN, G.E. Control of European brown snail in citrus groves in southern California with Guthion and metaldehyde sprays. Journal of Economic Entomology 54:152-156. 1961. (242

Metaldehyde and Guthion (0,0-dimethyl S-(4-oxo-1,2,3-benzotriazin-3-(4-H)-ylmethyl) phosphorodithioate) sprays were evaluated in field tests for their control of European brown snail (*Helix aspersa* Muller) on citrus in southern California. Metaldehyde, at higher dosages, was effective against snails infesting lemons. There was no measurable difference between snail mortality from metaldehyde wettable powder and that from aqueous suspension treatments when compared on the basis of metaldehyde equivalents. Against snails infesting Valencia oranges metaldehyde was only partially effective. The dense foliage of Valencia orange trees appeared to protect the snails falling beneath the trees from the desiccating influence of sun and wind, with the result that many snails recovered from the effects of the metaldehyde treatment. Guthion was highly effective against snails infesting both Valencia oranges and lemons. Among snails infesting Valencia oranges, mortality rates obtained with Guthion were comparable with those obtained with a standard treatment of tartar emetic and sugar. Among snails infesting lemons, mortality rates in Guthion plots were superior to those obtained in plots treated with proprietary bait composed of tricalcium arsenate, metaldehyde, and bran. Because of its demonstrated effectiveness, Guthion appears to be a promising molluscicide. Its use on citrus for other purposes or as an additive to other combined materials used in citrus spray treatments applied during periods of high snail activity would provide adequate snail control without involving prohibitive costs.

* _____., CARMAN, G.E. y WOOD, G.F. Weather effects on baits for controlling European brown garden snails in citrus. California Agriculture 27(11):13-15. 1973. (243

Weather conditions following bait treatments for the control of the European brown garden snail in citrus groves substantially influenced the ultimate effectiveness of carbamate molluscicides.

Baits containing Mesurol were more effective under unfavorable conditions than the other carbamates used in the tests. Under optimum treatment conditions, all of the carbamate baits were effective, particularly those with metaldehyde inclusions.

PAPPAS, J.L. y CARMAN, G.E. New treatment programs for brown snail control /citrus grove pests; California/. Citrograph 65(8):235-238. 1980. (244

PARISI, R. Daños producidos por babosas (*Milax gagates* L.) en cultivos de alcahuciles (*Cynara scolymus*). Fitosanitarias 2(5-6):26-27. 1963. (245

PAULINI, E. y CAMEY, T. New type of molluscicide with systemic action (En portugués). Revista Brasileira de Malariologia e Doenças Tropicais 17(4):349-353. 1965. (246

Diquat and paraquat tested on snails.

PEAR AND cherry slug. New South Wales Department of Agriculture. Entomology Branch. Insect Pest Bulletin 124. 1977. 4 p. (247

* PEREIRA, H.F. y GONÇALVES, L.I. Caramujos, caracóis e lesmas nocivos e meios de combate. O Biológico (Brasil) 15(4):65-73. 1949. (248

* PEREZ IBAÑEZ, T. et al. Ensayo aéreo con el producto "Mesurol" contra caracoles. Boletín Informativo de Plagas 112:81-86. 1973. (249

PISNAMAZON, G. y BAHYSOV, D. /Slugs in vegetable crops/ (En ruso). Zashchita Rastenii 12(3):23. 1967. (250

Excellent control of *Parmacella ibera* and other slug species in cabbages, tomatoes and cucumbers was obtained by applying Vapam to the soil at 15 kg/1,000 l/ha 15 days before these crops were planted out in the open. Baits and sprays containing metaldehyde gave good control in cabbages without reducing yields. (Horticultural Abstracts 37:6772. 1967).

PLANTENZIEKTENKUNDIGE DIENST, WAGENINGEN. /Yearbook of the Phytopathological Service, Wageningen, 1959/. Mededelingen van de Plantenziekten Kundigen dienst te Wageningen 134. 1960. 178 p. (251

There are also reports on the biological testing of insecticides, acaricides, slug-killers, rodenticides and materials for bird control. (Horticultural Abstracts 31:1670. 1961).

POPOSKI, R. Small slug, a new pest of tobacco seedlings. Duvan 1962(2):36. 1962. (252

PORTUGAL. MINISTERIO DA AGRICULTURA E PESCAS. DIRECCAO GERAL DE PROTECCAO DA PRODUCAO AGRICOLA. Actualização do volume LF2 do guía dos produtos fitofarmaceuticos. v.1: Insecticidas, acaricidas, moluscicidas e raticidas. Oeiras, Portugal, 1979. 81 p. (253

* POUCHER, C. Eradication of the giant African snail in Florida. Proceedings of the Florida State Horticultural Society 88:523-524. 1975. (254

The giant African snail (*Achatina fulica*) one of the most serious plant pests known, has been eradicated from Florida. This is the first time eradication has ever been achieved anywhere in the world following an established infestation. It was introduced into Florida by a young boy who carried 3 snails in his pocket while on a return flight from Hawaii in June 1966. He released them in his yard with the resulting infestation coming to the attention of the Division of Plant Industry in September 1969, a full 3 years later. Nine major areas (all residential) were found infested in Dade and Broward counties. More than 25,680 cumulative properties were treated, some more than 70 times. A total of 128 tons of arsenate-metaldehyde bait was applied in treatments over a period of 4 1/2 years. Almost one million properties were surveyed in a period of 5 1/2 years. Eradication was achieved with an expenditure of $700.000 in state and federal funds and with an input of 67,183 manhours of effort.

/PRACTICAL CONTROL of slugs/. Mededelingen van het Proefstation voor de Groenten - en Fruitteelt onder Glas 15:92. 1961. (255

Slug damage to the lowest trusses of tomatoes was effectively controlled by spraying the plants morning and evening through the irrigation pipes with a metaldehyde suspension. (Horticultural Abstracts 32:1141. 1962).

PRAKASH AGRAWAL, H. Estimation of the population in the land snail, *Bensonia monticola* (Hutton). Food Farming Agric. 8(2):31-32. 1976. (256

Pests of agricultural and horticultural crops.

PROTA, R. *Milax gagates* Drap. (Mollusco Gasteropode). Brevi osservazioni etologiche e prove di lotta. Studi Sassaresi Sez. III 8:160-173. 1960. (257

The pest was successfully controlled in glove artichoke crops with poisoned bait consisting of 36-43 g of 50% metaldehyde per kg of bran applied between the plant rows at 40 kg/ha. Baits with a higher concentration of metaldehyde were less attractive to the slugs but more persistent. (Horticultural Abstracts 32:2865. 1962.

RAMAKRISHNAN, T.S. y PILLAY, P.N.R. Snails and slugs. Rubber Board Bulletin 6:26-28. 1962. (258

For use in hevea a bait of metaldehyde, rice bran, slaked lime and cement in the proportions 1:2:6:6 is recommended. Calcium arsenate baits are less effective. Metaldehyde may also be used as a spray. (Horticultural Abstracts 33:6274. 1963).

* RANAIVOSOA, H. Lutte biologique contre les escargots phytophages a Madagascar et aux Comores. Agronomie Tropicale 26(3):341-347. 1971. (259

Los caracoles fitófagos (*Achatina fulica*) atacan la vainilla, las hortalizas y los frutales, especialmente en Madagascar, la Isla Mauricio y las Comoras. La recogida y el empleo de cebos envenenados no constituyen medidas insuficientes para limitar las poblaciones de dichos moluscos. Se ha recurrido por lo tanto a la lucha biológica utilizando otros caracoles para eliminar los primeros. En Mauricio, se introdujeron *Euglandina rosea* y *Gonaxis* sp. procedentes de América. La primera especie se adaptó fácilmente, por lo cual fue objeto de varias introducciones en Madagascar (1962, 1965 y 1968) y en Gran Comora (1970). *E. rosea* fue liberada sobre todo en la región de Tamatave, y parece haberse adaptado, aunque los resultados no son espectaculares.

Se tropieza con mayores dificultades en el caso de *Gonaxis*, que se ha liberado únicamente en la Isla Mauricio (habiéndose recuperado sólo un ejemplar después de seis años) y en Gran Comora (operación en vías de realización). *Edentulina ovoidea*, especie originaria de Mayote, parece ser más agresiva y voraz que *Euglandina*, según las observaciones realizadas. El estudio biológico de este caracol se ha iniciado con su introducción en Gran Comora y en Madagascar (Tamatave). Teniendo en cuenta el ritmo muy lento de multiplicación de dichos moluscos, no podrá hacerse un balance antes de varios años.

RAWAT, R.R., DHAMDHERE, S.V. y MISRA, U.S. Snails and slugs as crop pests and their control. Rural India 20(276):31-34. 1967. (260

* RAYNER, J.M. Experiments on the control of slugs in potatoes by means of molluscicidal baits. Plant Pathology 24(3):167-171. 1975. (261

Field experiments in several counties in England in 1968-70 demonstrated that 3% metaldehyde or 4% methiocarb baits applied in the spring, before or soon after planting potatoes, could reduce slug damage to the ware crop by 50%. Better control was achieved by applications made in July, August or September, although this was not always adequate.

* RAYNER, J.M. et al. Further experiments on the control of slugs in potatoes by means of molluscicidal baits. Plant Pathology 27(4):186-193. 1978. (262

This further series of field trials in 1972-75 at sites in England and Wales confirmed that a useful, but not wholly adequate, degree of control of slugs in maincrop potatoes could be achieved with one application to the growing crop of 5.6 kg/ha of methiocarb pellets from mid-July. Increasing the rate of application to 11.2 kg/ha improved control marginally, as did the addition of a second application of 5.6 kg/ha later in the season. Measurement of rainfall and slug activity did not provide a basis for improving control by more appropriate timing of applications, although bait-trapping slugs gave some indication of the level of crop damage to be expected.

RICH, E.R. y ROUSE, W. Mass producing a tropical snail for biological control. Weed Science Society Proceedings 23:288-298. 1970. (263

* RICHARDSON, H.H. y ROTH, H. Ethylene oxide fumigants to eliminate quarantinable snails (*Cochlicella barbara*) or *Theba pisana* in cargo. Journal of Economic Entomology 56(6):836-839. 1963. (264

Ethylene oxide 10%-carbon dioxide 90% mixture (Carboxide) showed good efficiency, penetration, and stability as a suitable substitute for methyl bromide fumigation against the very resistant estivated *Cochlicella barbara* (L.) and other snails on military cargo from Mediterranean areas. Methyl bromide at 8 lb. per 1,000 cu. ft. for 72 hrs. has been satisfactory for most fumigants, but objectionable odors sometimes developed in some household goods. Carboxide at 20 lb. for 72 hrs. was effective under normal atmospheric pressure near 70°F or above (or at 25 lb. near 52°) in steel chambers or under tight tarpaulins with substantial loads of wood present. Efficiency was much greater under high vacuum. *C. barbara* appeared much more resistant to Carboxide than *Theba pisana*. Ethylene oxide 11%-Freon 89% mixture appeared similar to Carboxide in efficiency. Thermal-conductivity (T/C) apparatus gave a useful analysis of Carboxide, probably sufficient for practical fumigation use, including leakage tests. Tests with ethylene oxide-sensitive chemical "sachets" supported the T/C results. Either polyethylene film or vinyl-coated nylon appeared suitable for tarpaulin fumigation.

* _____. y ROTH, H. Methyl bromide, sulfuryl fluoride, and other fumigants against quarantinable *Cochlicella* and *Theba* snails. Journal of Economic Entomology 58(4):690-693. 1965. (265

In tests conducted during 1958-63, estivated snails proved very resistant to fumigation. *Cochlicella barbara* (L.) and related species required 8 lb methyl bromide/1000 ft^3 for 72 hr at 55°F or above in tight chambers or under plastic tarpaulins. Very

long exposure appeared especially important for complete kill. Estivated *Theba pisana* (Muller) were much less resistant than *C. barbara*, with 6 lb for 10 hr being sufficient. Vacuum fumigation was much more effective against both snails. Methyl bromide at 40° to 55° F also appeared promising. Sulfuryl fluoride at 3 lb for 72 hr was effective at warm temperatures, but some *Cochlicella* survived 6 lb near 55° F. Hydrogen cyanide showed much promise at 2-3 lb for 72 hr, as did chloropicrin in preliminary tests at 1.5 lb for 48 hr. Survivors occurred with 5 lb acrylonitrile-carbon tetrachloride (34 to 66% by vol) for 72 hr. Results with carbon disulphide, carbon tetrachloride, ethylene dibromide, methallyl chloride, hydrogen phosphide and other chemicals are discussed. Resistance of estivated snails varied from year to year and was greatest the first 3 months after field collection. Some snails survived 18 months under warm, dry conditions, without food or water, when resistance was at a minimum.

RICOU, G. y MARRE, R. Essais de traitements contre les limnees des cressonnieres. Phytoma 12(118):15-20. 1960. (266

_____. The control of slugs in horticulture (En francés). Phytoma 16(162):17. 1964. (267

_____. Les limaces et leur elimination /slugs and their control/. Fermes Mod. no. 68: 37-39. 1978. (268

_____. Limaces et escargots: les mollusques et l'agriculture. France Agricole 36(1843): 53. 1980. (269

* RIMES, G.D. y O'DONNELL, W.M. Super spreader distributes snail baits. Journal of Agriculture - Western Australia 11(12):279-281. 1970. (270

* RIVERO, J.M. DEL y ROCA, M. Ensayos para conocer la eficacia de algunos plaguicidas contra el caracol *Helix (Cryptomphalus) aspersa* Muller. Anales del Instituto Nacional de Investigaciones Agronómicas 16:269-276. 1967. (271

Se estudia la eficacia como helicidas de plaguicidas actualmente en uso o en estado muy avanzado de introducción en el mercado, especialmente insecticidas y acaricidas. La selección de los posibles helicidas se hace mediante la preparación de cebos de salvado de trigo con el 1 y 2% de sustancia activa, partiendo de los productos preparados para su aplicación en la defensa de las plantas cultivadas. Los productos que resulten prometedores se someterán a nuevos ensayos mediante cebos convenientemente preparados con atractivos, etc. y sin materias inertes que pueden ser contraproducentes, como la carga de los productos en forma de polvo mojable. También se ensayarán en pulverización para la destrucción o eliminación de los caracoles subidos a los agrios o a los árboles y plantas en general. A este fin se observa el posible efecto repelente

de algún plaguicida respecto de los caracoles, lo que podría permitir averiguar la existencia de posibles helifugos. Los productos se ensayan en caracoles *Helix (Cryptomphalus) aspersa* Muller y *Theba (Euparypha) pisana* Muller. En un trabajo anterior se comunicó la acción helicida de dos nuevos insecticidas Matacil y Ultracid. En esta comunicación se presenta la acción helicida de un nuevo insecticida, el Folimat. Resultan asimismo altamente prometedores el Imidan y el Brestan. Estos ensayos se han efectuado en el laboratorio mediante la técnica de cebos y utilizando el caracol *Helix aspersa* Muller. Los ensayos prosiguen utilizando nuevos productos.

* RIVERO, J. M. DEL y ROCA, M. Preliminary screening trials of pesticides for the control of snails. Boletín de Patología Vegetal y Entomología Agrícola 31:61-70. 1969. (272

Trials of pesticides as possible molluscicides have been conducted in Spain against the snails *Theba pisana* and *Helix aspersa* by using bran baits poisoned with trade marks of pesticides used at the dosage of 1 and 2% of active substance in the finished bait. Work has been conducted in the laboratory using 50 adult snails for each test. The results are encouraging. Mesurol and Gusathion have been confirmed to be molluscicides, being promissing materials against both snails. Our work with both insecticides against *Theba pisana* is original. The same is true also for Actril, which has been found effective against both snails. We have found two pesticides that are promissing new molluscicides: Matacil and Ultracid. Both are also effective against the two snails used in the experiment. Our preliminary work in search of new molluscicides is encouraging. More research is needed and we proceed our work.

* _____. Nuevos ensayos preliminares para averiguar la posible acción helicida de algunos plaguicidas. Anales del Instituto Nacional de Investigaciones Agrarias. Serie Protección Vegetal 2:287-294. 1972. (273

Han proseguido en el laboratorio y siguiendo la técnica de Rivero y Roca ensayos para tamizar una serie de plaguicidas como helicidas contra los caracoles *Helix aspersa* Muller y *Theba pisana* Muller. Se ve que son prometedores varios plaguicidas. Se ha ensayado también en forma simple y asociada el DSMA, pero se ha estimado que la dosis utilizada ha sido muy inferior a la empleada con los demás plaguicidas. Algunos productos han sido empleados a dosis superiores a las ya utilizadas en otros ensayos. En unos casos puede ser prometedor, en otros casos ocurre lo contrario y los hay también que en las condiciones del ensayo no han reflejado nada.

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RIVERO, J.M. DEL, GARCIA MARI, F. y MARZAL, C. Ensayo de laboratorio con cebos de diversos plaguicidas y mezclas de ellos contra los caracoles "moro" (*Theba aspersa* Muller) y "avellanenc" (*Theba pisana* Muller). Agrícola Vergel no. 4:184-188. 1982. (276

* ROJAS, N. Las babosas, como combatirlas. Honduras. Secretaría de Recursos Naturales. Boletín Popular no. 59. 1979. 6 p. (277

ROGERS-LEWIS, D.S. Deciding when to apply slug pellets. Arable Farming 4(6):59, 62. 1977. (278

* _____. Slug damage in potatoes and winter wheat on silt soils. Annals of Applied Biology 87(3):532-535. 1977. (279

_____. Use of molluscicides for control of slug damage in maincrop potatoes on silt soils. Experimental Husbandry 31:125-134. 1977. (280

* ROLLO, C. D. y ELLIS, C.R. Sampling methods for the slugs, *Deroceras reticulatum* (Muller), *Deroceras laeve* (Muller), and *Arion fasciatus* Nilsson in Ontario corn field. Proceedings of the Entomological Society of Ontario 105:89-95. 1974. (281

> The recovery of slugs and their eggs by hand-washing soil through sieves is time consuming and, because slugs are aggregated in distribution, many samples must be processed to adequately estimate the population. A faster mechanical process using wringer-type washing machines was developed for processing samples from corn fields. Soil samples were placed inside double wire baskets which hung inside the tubs of the modified washing machines. Several samples could be processed with one washer within 8 hours and there was no difference in the efficiency of egg recovery between machine and manual washing. The recovery of healthy eggs was 93-98% and 53% of diseases or dead eggs were recovered. Newly emerged slugs were destroyed by washing. A flooding procedure prior to machine washing recovered these slugs and also softened the soil so less time was required in the washing machines. All aspects of the sample collection, flooding and washing of samples are described.

* ROMAN CORTES, M. Control de plagas del frijol. In Curso de producción de los principales cultivos alimenticios del distrito de Zapotitán. IICA. Informes de Conferencias, Cursos y Reuniones no. 301. 1982. pp. 37-60. (282

> Incluye babosa o ligosa (*Vaginulus plebeius* (Fisher)): pp. 40-42.
>
> Breve información sobre las características y hábitos de la babosa, daños que ocasiona al frijol, y combate de la plaga.

RONQUAYROL, M.Z. et al. Atividade moluscicida de oleos essenciais de plantas do nordeste brasileiro. Revista Brasileira de Pesquisas Medicas e Biologicas (Brasil) 13(4-6): 135-143. 1980. (283

* ROTH, H. Fumigation with ethylene oxide-carbon dioxide mixture for quarantine control of giant African snail. Journal of Economic Entomology 64(1):341-342. 1971. (284

* RUNHAM, N.W. y HUNTER, P.J. Slugs as pests. In _____. y Hunter, P. Terrestrial slugs. London, Hutchinson University Library, 1970. pp. 138-154. (285

* RUPPEL, R.F. Effectiveness of Sevin against the grey garden slug. Journal of Economic Entomology 52(2):360. 1959. (286

* _____. y POSADA, L. Estudios de molusquicidas para el control de la babosa pequeña, *Deroceras reticulatum* (Muller). Agricultura Tropical (Colombia) 15(10):643-660. 1959. (287

Se ha hecho una serie de ensayos de laboratorio para probar ciertos tóxicos, en la forma de cebos, aspersiones o espolvoreos, en el control de la babosa pequeña, *Deroceras reticulatum* (Muller). Los ensayos se hicieron en cajas de Petri, que se mantuvieron en estado de humedad por medio de láminas humedecidas de papel secante que se colocaron en sus bases. En cada caja se pusieron 500 mgs (peso seco) de cebo envenenado, 1.25 ml de aspersión, o de 30 a 60 mgs de espolvoreo. Se situaron, en cada caja, diez especímenes de babosas pequeñas recolectadas en el campo, y cada tratamiento fue replicado de 3 a 5 veces. Los recuentos del número de babosas vivas, encontradas en cada caja, se hicieron al cabo de 24, 48, 72 y 120 horas después de que las babosas habían sido colocadas en dichas cajas.

Se mostraron altamente efectivos, en el control de la babosa pequeña, los cebos de salvado de trigo con una mezcla de 2.5% de dinitrobutilfenol con dinitroamilfenol, 2.5% y 5% de metaldehido, 2.5% de dinitrobutilfenol y algunas de sus sales, una mezcla de 3% de fluorosilicato de sodio con 2.5% de metaldehido, una mezcla de 5% de arseniato de calcio con 3.25% de metaldehido, 7% de arseniato de calcio, 2.5% de dinitrocresol, 1% de Timet, 2.5% de pentaclorofenol, 2.5% de Pyrolán, 2.5% de Pyramat y 2.5% de clordano. También dieron buenos resultados los cebos similares de 5% de verde de París, 1% de cloruro mercúrico, 1% de metil paratión, 2.5% de penclorofenato de sodio, 5% de sulfato de cobre, 2.5% de heptacloro, 3.5% de arseniato de calcio, 1% de Gusatión y 5% de arseniato de sodio. Los demás materiales usados no fueron satisfactorios.

El salvado de trigo, la mogolla de trigo y la torta de ajonjolí, como diluyentes de cebos, fueron casi igualmente efectivos y mejores que la torta de alfalfa o que las hojas de repollo pulverizadas. Por otra parte, fueron altamente efectivos contra la babosa pequeña, un 0.3% de aspersión de metaldehido, 5% de metaldehido en espolvoreo y un espolvoreo de 5% de arseniato de calcio mezclado con 2.5% de metaldehido. La solución de 0.75% de cloruro mercúrico, lo mismo que el espolvoreo de 80% de arseniato de calcio mezclado con 20% de cal, un espolvoreo de 17% de arsenito de sodio on 83% de cal, y aspersiones de 0.5% de Pyrolán solo o mezclado con 0.5% de harina de soya, se mostraron igualmente efectivos contra la babosa pequeña. Los demás materiales ensayados para aspersiones o espolvoreos no ofrecieron resultados satisfactorios.

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SATPATHY, J.M. y PATNAIK, N.C. Snail depredation on cardamom in [illegible]put district of Orissa. Entomological Newsletter 7(7-8):38. 1977. (289

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A Veronicellid slug, heretofore unkown in the Gulf Coastal region, appeared in late 1960 in both Mobile and New Orleans. Since then it has spread rapidly throughout much of the area. Studies on the distribution, ecology, and behavior are being made.

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SCHENONI, P. Experimental snail farm (En italiano). Terra Vita 22(48):53. 1981. (292

SCHREAD, J.C. Control of slugs, sowbugs, centipedes, and millipedes in the greenhouse and garden. Connecticut Agricultural Experiment Station. Circular no. 203. 1958. 7 p. (293

Experiments on control of garden slugs feeding on goldenglow, plantain lily (*Funkia* sp.), lily-of-the-valley, hardy chrysanthemums and violets, indicated that a ground treatment of 5% dieldrin granules was much less effective than a foliage spray of 15% dieldrin emulsion. The best results in controlling slugs was obtained with 7% copper dust on marigolds, and with calcium arsenate dust on funkia, violet and goldenglow. Slugs did feed on plants dusted with calcium arsenate, but appeared to be repelled by the copper dust. Calcium arsenate injured some plants. A soil drench of DDT controlled woodlice (*Oniscus asellus*) on greenhouse benches where they had girdled carnation plants. Centipedes were controlled on greenhouse benches with a 10% DDT dust or a soil drench of lindane (25% w.p.). Dieldrin, heptachlor, malathion, endrin, parathion and DDT dusts applied to the soil surface destroyed millipedes that had cuased extensive injury to carnation, snapdragon and chrysanthemum plants. (Horticultural Abstracts 30:978. 1960).

SCHRIM, M. y BYERS, R.A. A method for sampling three slug species attacking sod-seeded legumes /*Derocerus reticulatum*, *D. laeve*/. Melsheimer Entomological Series no. 29:9-11. 1980. (294

* SCHWARTZ, H. y GALVEZ, G.E., eds. Babosas. In _____. Problemas de producción del frijol; enfermedades, insectos, limitaciones edáficas y climáticas de *Phaseolus vulgaris*. Cali, Colombia, Centro Internacional de Agricultura Tropical, 1980. pp. 398-399. (295

SCOTT, G.C., GRIFFITHS, D.C. y STEPHENSON, J.W. A laboratory method for testing seed treatments for the control of slugs in cereals. In British Crop Protection Conference, 1st., s.l., 1977. s.l., s.e., 1977? pp. 129-134. (296

SHADAS, W.A. Land slugs and snails, and their control. USDA. Farmers Bulletin no. 1895. 1959. 8 p. (297

SIMMONDS, F.J. y HUGHES, I.W. Biological control of snails exerted by *Euglandina rosea* Fer. Bermuda Entomophaga 8(3):219-222. 1963. (298

SIMPSON, R.D. This garden snail can help you. Agricultural Gazette of New South Wales 88(4):28-29. 1977. (299

/*Strangesta capielacea* as biological control agent of the garden pest snail *Helix aspersa*/

SIMWAT, G.S. y BRAR, H.S. Control of common slug. Progressive Farming 9(6):14. 1973. (300

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* _____. y AGARWAL, R.A. Toxicity of certain pesticides to two economic species of snails in northern India. Journal of Economic Entomology 74(5):568-571. 1981. (302

Laboratory studies on toxicity of three carbamate (mexacarbate , carbaryl, and aldicarb) and three organophosphorus (trichlorfon, formothion, and phorate) compounds were made on two species of snails, *Lymnaea acuminata* Lamarck and *Pila globosa* Swainson. *L. acuminata* was more sensitive to the pesticides tested. LC_{50} values computed for different exposure periods from 24 to 240 h showed a gradual decrease as the exposure time was increased. Although trichlorfon was most toxic to *L. acuminata* and mexacarbate to *P. globosa*, the relative LC_{50}S of the six compounds varied at different exposure periods. A possible explanation on the basis of pharmacological evidences and structure-activity of these compounds has been given.

SINHA, P.K. et al. The giant African snail in tuber crops. Indian Journal of Entomology 40(pt. 3):335. 1978. (303

SIVAIAH, S. y RAMANA RAO, K.V. Effect of malathion on the excretory pattern of the snail, *Pila globosa* (Swainson). Current Science 47(23):894-895. 1978. (304

A SLUG new to the United States. FAO. Plant Protection Bulletin 16(2):34. 1968. (305

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Including summary of the current control methods. (Horticultural Abstracts 33(1)..55. 1963).

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* SLUGS AND snails - Mollusca. In Jones, F.G.W. y Jones, M.G. Pests of field crops. London, Edward Arnold, 1964. pp. 216-219. (308

Molluscs are soft bodies, unsegmented animals, able to secrete slime and having one or more protective shells. Many are marine, but the class Gastropoda contains terrestrial species including slugs and snails which are of agricultural importance.

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SMITH, P.C. The control of certain vine pests. Wynboer 32(383):13. 1963. (312

Mealybug with dieldrin, snout beetle with DDT, erinose mite with sulfur, and snails.

SNAILS AND slugs. 1a. ed. New South Wales. Department of Agriculture. Insect Pest Leaflet no. 5. 1965. 3 p. (313

SNAILS AND slugs. Rubber Research Institute of Malaya. Plant. Bull. no. 93. 1967. pp. 284-287. (314

Brief descriptions of some snail and slug pests of hevea and legume cover crops, with control recommendations. (Horticultural Abstracts 38:6657. 1968).

* SOUTH, A. Estimation of slug populations. Annals of Applied Biology 53(2):251-258. 1964. (315

It is impracticable to count slugs per unit area in the field, but both slugs and their eggs are recovered efficiently by soil washing in the laboratory. A less laborious method is described in which slugs (only) are expelled from turves progressively immersed in cold water. This method, used with samples of twelve 12 x 12 x 4 in. units of substratum, gives satisfactory estimates for *Agriolimax reticulatus* and *Arion intermedius* at population densities above 1 per sq. feet.

SPACKMAN, E.W. Garden slug control. Wyoming Agricultural Experiment Station. Bulletin 536:1-2. 1971. (316

SPENCER, G.J.A. A record of slugs in Vancouver gardens. Ent. Soc. Brit. Columbia Proc. 58: 47-48. 1961. (317

SRIVASTAVA, P.D. Integrated control of giant African snail. Pesticides 4(12):92-96. 1970. (318

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* STANGE, L.A. The slugs of Florida (Gastropoda: Pulmonata). Florida. Department of Agriculture and Consumer Service. Entomology Circular no. 197. 1978. 4 p. (320

* STEPHENSON, J.W. Slug investigations. In Rothamsted Experimental Station. Report for 1960. Harpenden, England, 1961. p. 159. (321

* _____. The molluscacidal properties of three fly repellants. Plant Pathology 11:25-27. 1962. (322

Dimethyl phthalate, dibutyl phthalate and benzyl benzoate were shown to be toxic and/or repellant to slugs, depending on the concentration used. None appeared to be superior to metaldehyde, but it is suggested that other members of the series may be worth investigation. (Horticultural Abstracts 32:4147. 1962).

* _____. The biology of soil-inhabiting pests. In Rothamsted Experimental Station. Report for 1962. Harpenden, England, 1963. p. 158. (323

* _____. Soil pest control. In Rothamsted Experimental Station. Report for 1962. Harpenden, England, 1963. pp. 157-158. (324

* _____. Biology of slugs, damage to potatoes. In Rothamsted Experimental Station. Report for 1964. Harpenden, England, 1965. p. 187. (325

STEPHENSON, J.W. The effect of irrigation on damage to potato tubers by slugs. European Potato Journal 8(3):145-149. 1965. (326

* _____. y LAPWOOD. Irrigation and slug attack. In Rothamsted Experimental Station. Report for 1964. Harpenden, England, 1965. pp. 187-188. (327

Slug damage to tubers of the varieties Redskin and Majestic was examined in crops grown with four water regimes and planted at two dates, 30 April and 1 June.

* _____. Slug parasites and predators. In Rothamsted Experimental Station. Report for 1964. Harpenden, England, 1965. Part 1, p. 188. (328

* _____. y KNUTSON, L.V. A resume of recent studies of invertebrates associated with slugs. Journal of Economic Entomology 59(2):356-360. 1966. (329

The frequency with which slugs are found to be infested by other invertebrates suggests a possibility of biological control. More than 46 species of invertebrates associated with 25 nominal species and subspecies of slugs are included in a review of 42 of the more recent (1921-65) publications. Ten species of invertebrates are known to kill 14 species of slugs. Protozoans, brachylaemid flat-worms, lungworms, lampyrid beetles, and sciomyzid fly larvae seem to be the more important natural enemies.

* _____. The distribution of slugs in a potato crop. Journal of Applied Ecology 4(1):129-135. 1967. (330

A method of detecting slugs below ground, using recoverable potato baits, is described. In two seasons, *Arion hortensis* and *Milax budapestensis* were shown to be significantly more numerous 6 and 9 in. deep in the furrows than in the ridges in a potato crop, prior to tuber ripening. The differences 15 in. deep were not significant. The structure of the subterranean slug population was shown to agree with the known facts of the life cycles of the slugs in south-east England. No slugs were seen on the soil surface after the germination of the plants but evidence of underground activity throughout the growing season was obtained. A combination of meteorological factors which result in the preferential wetting of the soil in the furrows is thought to explain the spatial distribution of the slugs in the crop. It is suggested that their distribution underground during the growing season accounts for the poor control obtained when molluscicides are applied to the soil surface.

* _____. The molluscicidal properties of ioxynil. In Rothamsted Experimental Station. Report for 1966. Harpenden, England, 1967. pp. 197-198. (331

* _____. Resistance of potato varieties to slug attack. In Rothamsted Experimental Station. Report for 1966. Harpenden. England, 1967. p. 198. (332

* STEPHENSON, J. W. The susceptibility of different varieties of potato to attack by slugs. In Rothamsted Experimental Station. Report for 1967. Harpenden, England, 1968. Part 1, p. 201. (333

* _____. y DUNNING. Control of damage by slugs to sugar beet. In Rothamsted Experimental Station. Report for 1967. Harpenden, England, 1968. Part 1, p. 200. (334

* _____. Varietal differences in susceptibility of potatoes to slugs. In Rothamsted Experimental Station. Report for 1968. Harpenden, England, 1969. Part 1, p. 221. (335

* _____. Slugs. Fertilizers and damage to potatoes by slugs. In Rothamsted Experimental Station. Report for 1969. Harpenden, England, 1970. p. 250. (336

* _____. Susceptibility of different varieties of potato to damage by slugs. In Rothamsted Experimental Station. Report for 1969. Harpenden, England, 1970. Part 1, pp. 249-250. (337

* _____. The formulation of a molluscicide. In Rothamsted Experimental Station. Report for 1970. Harpenden, England, 1971. Part 1, p. 199. (338

* _____. Formulation of baits. In Rothamsted Experimental Station. Report for 1970. Harpenden, England, 1971. Part 1, pp. 198-199. (339

* _____. Gelatin as a carrier for molluscicides. In Rothamsted Experimental Station. Report for 1971. Harpenden, England, 1972. Part 1, pp. 214-215. (340

_____. Gelatin as a carrier for S^2-Cyanoethyl N-[(methyl-carbamoyl)oxyl] thioacetimidate, an experimental molluscicide. Pesticide Science 3:1-7. 1972. (341

Gelatin and gelatin hardened by formaldehyde, were immersed in water or exposed out of doors on bare soil, and their stability assessed. The water-soluble, protein-rich, constituents of wheat bran are palatable to slugs and can be used as an arrestant. Hardened gelatin made with aqueous wheat bran extract containing the pesticide did not disintegrate in wet weather and continued to kill slugs over a long period. (Compendiado en: Rothamsted Experimental Station. Report for 1971. Harpenden, England, 1972. Part 1, p. 356).

* _____. Slugs. In Rothamsted Experimental Station. Report for 1971. Harpenden, England, 1972. Part 1, pp. 214-215. (342

Use of gelatin as carrier for molluscicides.

* _____. Slugs [the placement of slug baits]. In Rothamsted Experimental Station. Report for 1973. Harpenden, England, 1974. Part 1, p. 207. (343

STEPHENSON, J.W. y DIBLEY, G.C. Electric fence for retaining slugs in outdoor enclosures. Laboratory Practice, December 1975. p. 815. (344

* _____. Laboratory observations on the effect of soil compaction on slug damage to winter wheat. Plant Pathology 24(1):9-11. 1975. (345

When the aggregates of fairly dry, medium-coarse soil were broken down and firmed over the seed by moderate or heavy pressure, slug damage was reduced. Coarse soil aggregates did not break down so well, particularly under heavy pressure; many seeds remained exposed and were damaged. The seed was also protected by deep planting, with the penalty of late emergence of the seedlings.

* _____. Estimation of slug populations. In Rothamsted Experimental Station. Report for 1975. Harpenden, England, 1976. Part 1, pp. 129-130. (346

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/*Anacardium occidentale*, *Biomphalana glabrata*, medicinal plant useful for the control of snail populations and control of transmission of *schistosomiasis*/.

* SUNKIST GROWERS. PEST CONTROL BUREAU. Citrus pest control treatments for Santa Barbara County. California Citrograph 50(10):370. 1965. (349

Chemical control of mites, snails and brown rot.

* THE SUSCEPTIBILITY of different varieties of potato to attack by slugs. In Rothamsted Experimental Station. Report for 1967. Harpenden, England, 1968. Part 1, p. 201. (350

* SYMONDS, B.V. Early prediction of slug damage to potatoes. Plant Pathology 22(1):30-34. 1973. (351

Between 1968 and 1970 potato tubers were used to measure slug activity before planting potato crops in fields in central and southern England. Some evidence was obtained to indicate a relationship between this activity and subsequent slug damage to the ware crop.

* _____. Evaluation of potential molluscicides for the control of the field slug, *Agriolimax reticulatus* (Mull). Plant Pathology 24(1):1-9. 1975. (352

Nine candidate molluscicides were compared with methiocarb and metaldehyde in tests against the field slug, *Agriolimax reticulatus*

(Mull), in the laboratory and in small plot tests under glasshouse and field conditions. The candidate chemicals comprised two organophosphates and seven carbamates. A mixture of one of the carbamates and metaldehyde was also tested. Formulations included pellets, granules and wettable powders. Only WL21959 (S-2-cyanoethyl-N-[(methyl carbamoyl) oxy] thioacetimidate) was more effective than proprietary pellets of metaldehyde or methiocarb. In field trials, pellets of WL 21959 at 5 kg/ha consistently caused the highest slug mortality; a wettable powder formulation was also effective under ideal conditions. In laboratory experiments, WL 21959 was active as a seed treatment for slug control in wheat. The effects of the chemicals on earthworms in field trials were also recorded. WL 21959, particularly the granular formulation, was the most toxic to earthworms.

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THIYAGARAJAN, K. The giant African snail. Kisan World 5(5):62-63. 1978. (357

* THOMAS, D.C. The use of metaldehyde against slugs. Annals of Applied Biology 35(2):207-227. 1948. (358

One part of metaldehyde in thirty parts of bran by volume is the minimum effective concentration for obtaining an economic kill of slugs under average weather conditions. For use against *Milax gracilis* Leydig. heaps of bait should not be normally more than 2 yards apart and against *Arion hortensis* Fer. not more than 3 ft. apart. The mortality of slugs attracted to metaldehyde-bran baits is dependent on the drying property of the soil and atmosphere around the baits. D.D.T. flea-beetle dust and powdered pyrethrum flowers are sufficiently distasteful to slugs to prevent their consuming a lethal dose of the poison mixed with bran. The addition of 10%, by volume, of dried blood to metaldehyde-bran bait increases the catch of some slugs under certain conditions but does not increase the mortality. The addition of 10%, by volume, of dextrose increases the mortality produced by metaldehyde but does not increase the numbers attracted to the bait. A metaldehyde-bran bait

compacted into 'biscuit' form with anhydrous calcium sulphate catches more slugs than an ordinary metaldehyde-bran bait,but almost completely counteracts the effect of the metaldehyde. A metaldehyde-bran-casein glue bait in 'buiscuit' form increases the catch and kill of *Milax gracilis* and *Agriolimax reticulatus* Mull., but not of *Arion hortensis*. Metaldehyde-bran-casein glue bait broadcast in 'broken biscuit' form is effective over a longer period, thus producing a greater kill of slugs, than a broadcast metaldehyde-bran-bait.

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An atypical strain of the *Phytophthora palmivora* group has been isolated from aerial lesions on pepper vines, *Piper nigrum* L., infested with *Achatina fulica* Bow., and recovered from snail faeces collected in the field and laboratory after inoculation into apple tissue. Zoospore suspensions of the isolated were pathogenic to pepper cuttings. Sporangia found in the faeces remained viable after passage through the alimentary tract and moist faeces remained infective for a period of 14 weeks. Strains of *P. palmivora* (Butl.) Butl. (from coconut, orchid, papaya and *Piper betle* L.), *Phytophthora parasitica* Dast. and *P. colocasiae* Rac. have also been transmitted by *A. fulica* in the laboratory.

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UPATHAN, E.S. et al. Laboratory trials of controlled release molluscicides on *Bulinus* (Ph.) *abyssinicuss*, the intermediate host of *Schistosoma haematobium* in Somalia. In Controlled release of bioactive materials: based on the symposium held at the 6th International Meeting of the Controlled Release Society in New Orleans, Louisiana, August 1979. New York, Academic Press, 1980. pp. 461-469. (365

VASVARY, L.M. About slugs. Brooklyn Botanic Garden Record Plants and Gardens 35(2):24-26. 1979. (366

VENKATESWARA RAO, P. et al. Cercaricidal action of certain common fertilizers. Rivista di Parassitologia 38(1):13-21. 1977. (367

VERGIS, P.C. This snail is a big menace. Intensive Agr. 10(3):17-18. 1972. (368

* VIEIRA, C. Lesma. In _____. Doencas e pragas do feijoeiro. Viçosa, Minas Gerais, Brasil, Imprensa Universitaria da Universidade Federal de Viçosa, 1983. pp. 224-226. (369

VOS, J. DE y LIEKENS, F. /A trial with several brands of slug bait/. Fruitteeltblad 15(9): 330-332. 1971. (370

También en: Tuinbouwberichten 35(7):281-283. 1971.

The persistence was compared of several brands of slug bait exposed on damp ground amongst beans and strawberries. Super-Slugran, metaldehyde and Arionex were the most persistent. Mesurol was the least persistent but was effective against ground beetles in strawberries. (Horticultural Abstracts 42(1):764. 1972).

* WAIN, R. L. 3:5-Dihalogeno-4-hydroxybenzonitriles; new herbicides with molluscicidal activity. Nature 200:28. 1963. (371

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WATERS, G. A beginner's guide to slugs and snails. California Horticultural Journal 37(2): 37-39. 1976. (373

* WEBLEY, D. Experiments with slug baits in South Wales. Annals of Applied Biology 50(1): 129-136. 1962. (374

0.025% endrin and 0.05% Rogor (dimethoate), when incorporated in standard metaldehyde and bran slug baits did not increase the catch of slugs. Both insecticides in bran biscuits acted as repellents. The addition of 1 part of 50% Sevin (I-naphthyl-N-methylcarbamate) to 40 parts of the standard metaldehyde and bran mixture improved the catch by 15%.

Arion hortensis did not appear to be attracted to metaldehyde to the same extent as *Agriolimax reticulatus* and *Milax budapestensis* and the latter species responded more when the nights were warm. Meteorological observations suggest that in the autumn and winter months more slugs are trapped when the night air temperature and the morning relative humidity are high. The age of the biscuits, the grass minimum temperature and the mean night air temperature accounted for 70% of the variance of the catch of metaldehyde biscuits.

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It was observed that populations of *Arion hortensis* tended to increase in indisturbed ground, and that in disturbed ground populations were at a minimum. Metaldehyde biscuits which were uncovered attracted more slugs and those which were covered with glass. In a second experiment metaldehyde biscuits under black glass were more successful traps than those under clear glass. (Horticultural Abstracts 33:4316. 1963).

* _____. Slug activity in relation to weather. Annals of Applied Biology 53:407-414. 1964. (376

Multiple regression analysis was carried out on the effect of certain meteorological factors on the numbers of slugs attracted by metaldehyde and bran biscuits at Cardiff in the autumn months. The two factors which caused the most variation in numbers were: 1) the length of time the biscuits had been exposed and 2) the average night air temperature. The percentage R.H. considered alone had little effect. *Arion hortensis* behaved differently from the other species studied, its day-to-day variation in numbers apparently being less affected by weather conditions. (Horticultural Abstracts 35:193. 1965).

* WEBLEY, D. Aspects of trapping slugs with metaldehyde and bran. Annals of Applied Biology 56(1):37-45. 1965. (377

In trapping slugs, 1 part of 30% Sevin (carbaryl) (I-naphthyl-N-methylcarbamate) to 40 parts of standard metaldehyde-and-bran mixture gave an improved catch over standard biscuits. The fungicides dazomet or zineb incorporated in biscuits repelled slugs. It was shown that the fall-off in the attraction of metaldehyde and bran did not occur until 4 days after biscuit exposure, and that black glass plates placed over pelleted baits masked their effect, the same catch being obtained with one or with sixteen pellets. Even without glass plates there was evidence to suggest that the catch of *Agriolimax reticulatus* was similar with one or sixteen pellets. The implications of these results on control measures are discussed and it is recommended that metaldehyde sprays be used for epidemics, and the baits only as long-term measures to keep down infestations already partly controlled.

* _____. Waterproofing of metaldehyde on bran baits for slug control. Nature 212:320-321. 1966. (378

* _____. Observations on the effects of distribution and numbers of slug pellets on the catch of slugs. Annals of Applied Biology 66(2):347-352. 1970. (379

Thirty comparisons were made of the catch of different numbers of slug pellets and the effect of meteorological factors on them. Ten pellets/ 2 1/2 ft. (0.75 m) gave the greatest catch although, economically, the best treatment was from two to five pellets for *Agriolimax reticulatus*; for *Arion hortensis* and *Milax budapestensis* the return per pellet was low. Throughout the year only 16.6% of the catch variance was removed by meteorological factors.

* WESTER, R.E., GOTH, R.W. y WEBB, R.E. Transmission of downy mildew (*Phytophthora phaseoli*) of lima beans by slugs. Phytopathology 54(7):749. 1964. (380

A slug that frequently feeds on spinach and lima beans in the greenhouse at Beltsville was found to be a carrier of the downy mildew fungus (*Phytophthora phaseoli* Thaxt.). This slug is a voracious feeder on young lima bean leaves and cotyledons. To study the possibility of this slug being a vector of downy mildew of lima beans, the following investigations were conducted in a growth chamber where temperatures ranged from 15-17° C at night and from 17-21° C during the day. Lima beans were germinated and grown in small plastic containers enclosed in plastic bags to maintain ample moisture. The slugs were permitted to feed on mildew infected plants and then transferred to healthy seedlings in the crookneck stage of development; after 5 days, the profuse mycelial growth of *P. phaseoli* was visible. Viable conidia of *P. phaseoli* were present in the slime that covers the slugs.

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* _____. y PEAIRS, F.B. Investigación en el control de la babosa /*Vaginulus plebeius*/ en el frijol común en Honduras. In Reunión Anual del PCCMCA, 26a., Guatemala, 1980. Memoria. Guatemala, ICTA, 1980. v.1, pp. 3.L.14-1/3.L.14-14. (383

El problema alarmante de la babosa en frijolares recién sembrados ha establecido la urgencia de encontrar un control eficaz. El propósito del trabajo fue minimizar los costos y encontrar un control superior al existente. Los cebos envenenados son bien conocidos y utilizados en Honduras. Por esto, en una forma de mitigar el peligro potencial, se quería proveer recomendaciones inmediatas, minimizando los costos del cebo. Después se dió énfasis a controles alternativos, haciendo pruebas de: 1) insecticidas foliares, y 2) sistémicos; a) tratamientos directos de la semilla, y b) formulaciones granuladas al momento de la siembra.

La metodología empleada en todos los estudios fue manipular poblaciones en parcelas artificiales infestadas. Se introdujeron 10 babosas dentro de 1 m^2 recién sembrado, rodeado por una barrera de tablas cubiertas con una capa de grasa. Dos cebos dieron buenos resultados de control a costos reducidos. Son: Ortho-B diluído 1.10 con relleno ($U.S. 2.45/50 kg) y un cebo casero de carbaryl (Sevin) 80 PM 0.45 kg + maíz molido 22.7 kg, metaldehido 99% 11.4 g y melaza 7 lt ($3.45/50 kg). El cebo diluído y el casero dieron un promedio de 81% y 90% de mortalidad respectivamente en las babosas. Los insecticidas foliares no dieron resultados positivos. Tamizados de sistémicos mostraron los resultados más sobresalientes. Mefosfalán (Cytrolane) 2G a 0.25 kg ia/ha (US$18/ha) aplicado al momento de la siembra, dio protección a 90% de las plantas contra ataques de la babosa. A la vez, combatiendo *Empoasca* spp. hasta 45 días, controla las dos plagas principales de frijol en Honduras.

_____. Trabajos de control de la babosa /*Phaseolus vulgaris*, *Vaginulus plebeius*, Honduras/. In Honduras. Secretaría de Recursos Naturales. Programa Nacional de Investigación Agropecuaria. Informe final. Transferencia de tecnología. Tegucigalpa, 1980. pp. 1-12. (384

* WHITE, A.R. Observations on slug activity in a Northumberland garden. Plant Pathology 8(2): 62-68. 1959. (385

Forty-eight weekly collections of slugs in a garden in Northumberland showed that *Milax budapestensis* was the dominant species under northern conditions on this particular site. Specific differences in populations were found on lawn and cultivated land; and some evidence was obtained which suggests that *Agriolimax reticulatus* and *Arion hortensis* are more hardy than the other species encountered when temperatures are just above freezing point.

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WILKINSON, A.T.S. Preliminary screening of pesticides for control of slugs [on lettuce]. Pesticide Progr. 1(4):100. 1963. (387

* WINFIELD, A.L., WARDLOW, L.R. y SMITH, B.F. Further observations on the susceptibility of maincrop potato cultivars to slug damage. Plant Pathology 16:136-138. 1967. (388

Observations on two maincrop potato cultivar trials have confirmed that there are marked differences between cultivars in susceptibility to tuber damage by slugs. The cultivars recommended by the N.I.A.B. (and Pentland Falcon) may be categorized as follows: least susceptible to slug damage, Pentland Falcon; moderately susceptible, Pentland Dell, Majestic; more susceptible, Record, Pentland Crown, King Edward (both paracrinkle virus free and paracrinkle infected); most susceptible, Ulster Glade and Maris Piper.

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WRIGHT, C.A. Molluscicides. In Society of Chemical Industry. Reports on the progress of applied chemistry, 1959. London, 1959. v. 44, pp. 306-311. (390

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1. Field measurements showed that *Deroceras* sp., a slug, could at times be a serious pest in pastures of Kenya white clover (*Trifolium semipilosum*) cv. Safari in southeast Queensland. At peak infestation (470 slugs m^{-2}), 60% of the leaf area of *T. semipilosum* was eaten. 2. In laboratory experiments, *T. semipilosum* was very palatable to *Deroceras* sp. and to another slug, *Lehmannia nyctelia*. The latter slug is common in south-east Queensland, but is rarely found in *T. semipilosum* pastures. Both slugs avoided eating the fourteen species of tropical grasses that were tested. 3. In pot experiments, slug damage depressed the growth rate and competitive ability of *T. semipilosum*. Slugs destroyed emerging seedlings of both *T. semipilosum* and *T. repens*. 4. In controlled temperature conditions, both slugs thrived better at 12 and 18° C than at 6 and 24° C. At 30° C *Deroceras* sp. died whereas *L. nyctelia* survived.

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INDICE DE AUTORES

ÍNDICE DE AUTORES

INDICE DE AUTORES

INDICE DE ESPECIES

ÍNDICE DE ESPECIES

INDICE DE ESPECIES

INDICE DE PLANTAS

INDICE DE PLANTAS

INDICE DE PLANTAS

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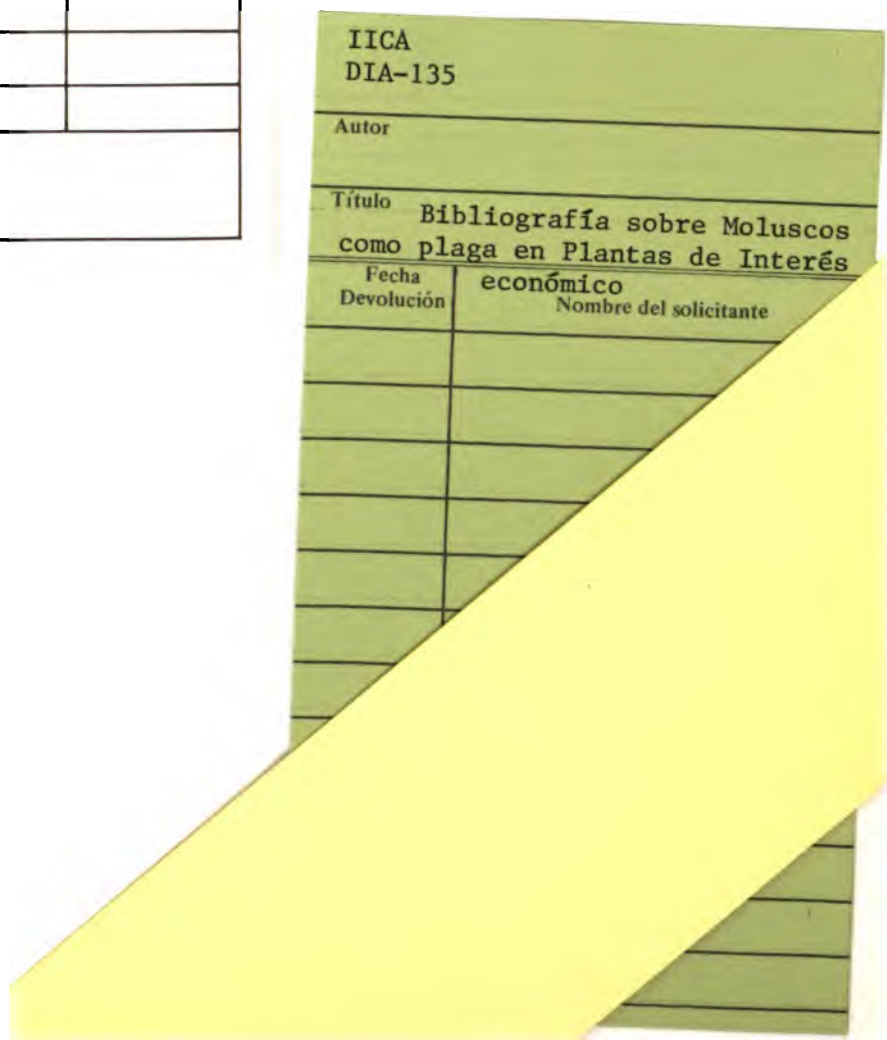

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