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Consultant Final Report
IICA/EMBRAPA-PROCENSUL II

BIOLOGICAL CONTROL IN SOYBEAN PESTS

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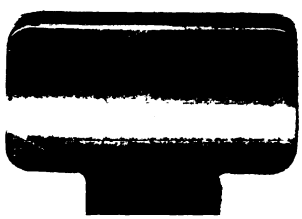

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Série Publicações Miscelâneas No.A4/BR-88-005
ISSN-0534-0591

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Leopoldo E. Caltagirone

Brasília, março de 1988

INSTITUTO INTERAMERICANO DE COOPERAÇÃO PARA A AGRICULTURA
EMPRESA BRASILEIRA DE PESQUISA AGROPECUÁRIA

IICA
MIS A4/BR-88-005

Caltagirone, Leopoldo E.
Biological control in soybean pests. An evaluation of the program being conducted at the CNPSo. - Londrina, Brasília, Brasil: Instituto Interamericano de Cooperação para a Agricultura, 1988.
9 p. (IICA - Publicações Miscelâneas, A4/BR-88-005)
ISSN 0534-0594

1. Pesquisa - Controle biológico - Praga de planta - Soja - Brasil. I. Título. II. IICA (Brasil). III. Série.

AGRIS A50;
H10
CDU 632.937:635.655.001.5(81)

APRESENTAÇÃO

A reprodução e difusão dos Relatórios de Consultores, no âmbito restrito das Diretorias das Unidades do Sistema Nacional de Pesquisa Agropecuária, vinculado à EMBRAPA, tem como objetivo principal o de divulgar as atividades desenvolvidas pelos consultores e as opiniões e recomendações geradas sobre os problemas de interesse para a pesquisa agropecuária.

As atividades de consultoria são realizadas no âmbito do Projeto de Desenvolvimento da Pesquisa Agropecuária e Difusão de Tecnologia na Região Centro-Sul do Brasil-PROCENSUL II, financiado parcialmente pelo Banco Interamericano de Desenvolvimento-BID e a EMBRAPA conforme os contratos de Empréstimo 139/IC-BR e 760/SF-BR, assinados em 14 de março de 1985 entre o Governo brasileiro e o BID.

As opiniões dos consultores são inteiramente pessoais e não refletem, necessariamente, o ponto de vista do IICA ou da EMBRAPA.

A coordenação dos Contratos IICA/EMBRAPA agradeceria receber comentários sobre estes relatórios.

Horacio M. Stagno
Coordenador Contratos IICA/EMBRAPA

INTER-AMERICAN INSTITUTE FOR COOPERATION ON AGRICULTURE
IICA/EMBRAPA CONTRACT

CONSULTANT FINAL REPORT

1. Consultant's full name: Leopoldo E. CALTAGIRONE
2. Specialist in: BIOLOGICAL CONTROL IN SOYBEAN PESTS
3. Title of IICA Project: 2.SB.3

4. EMBRAPA Program for which consultancy is provided:

SUBPROG II - PRESQUISA VEGETAL (PROCENSUL II)

IICA Project Activity Code: 2.SB.3.02	Administrative Code: A4874B1B03102
Title of Activity of IICA Project corresponding to this consultancy	Cooperation with EMBRAPA on research activities in the field of crop production

CONSULTANT CONTRACT PERIOD	DUTY LOCATION (Center)
September 1st to 19th 1987	CNPSoja - LONDRINA
CONTRACT EXTENTION PERIOD (If any)	DUTY LOCATION (Center)

5. Financial support: PROCENSUL II

6. ACTIVITIES UNDERTAKEN BY THE CONSULTANT AND RESULTS

6.1 RESEARCH DONE UNDER DIRECT RESPONSIBILITY OF THE CONSULTANT

Research activities developed	Results Achieved

BIOLOGICAL CONTROL IN SOYBEAN PESTS

An evaluation of the program being conducted at the National Center for Soybean Research (CNPSo), Londrina, Paraná, Brasil.

by

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1. INTRODUCTION

The evaluation was conducted from 1 to 19 September 1987. During this period I interacted with my counterpart at CNPSo, Dra Beatriz Spalding Corrêa-Ferreira, who is conducting research to implement and evaluate biological control of chinch bugs (Hemiptera:Heteroptera: Pentatomidae), especially the southern green stinkbug, *Nezara viridula*, using the parasitoid *Trissolcus basalis* (Hymenoptera: Scelionidae). I also obtained information from other researchers at CNPSo as indicated below:

- Dra. Clara Beatriz H. Campo, on plant resistance to the three principal chinch bugs in soybean;
- Dr. Ivan Carlos Corso, on effect of pesticides on natural enemies, especially predators and parasitoids;
- Dr. Flávio Moscardi, on viruses and other pathogens for control of lepidopterous pests such as *Anticarsia gemmatalis* and *Pseudoplusia includens*;
- Dr. Antonio Ricardo Panizzi, on nutrition of the three principal chinchs bugs, and on their various host plants.

This report consists of an evaluation of and recommendations for the following aspects of the on going research:

6. ACTIVITIES UNDERTAKEN BY THE CONSULTANT AND RESULTS

6.1 RESEARCH DONE UNDER DIRECT RESPONSIBILITY OF THE CONSULTANT

Research activities developed	Results Achieved

A. Mass culture of *Nezara viridula*;
B. Mass culture of *Trissolcus basalis*;
C. Population dynamics in the *Nezara/Trissolcus* system.

Although *Anticarsia gemmatalis* is another important pest on soybean, I am not including comments on it except that the on going research by Dr. Flávio Moscardi on the use of *Baculovirus* is already in the implementation phase. In addition, this pest can be also controlled with *Bacillus thuringiensis*, so there are alternatives to synthetic chemical pesticides that would not interfere with the use of natural enemies to control chinch bugs.

A. Mass culture of *Nezara viridula*

The procedures being utilized at CNPSo are basically the ones generally used to mass culture these insects. The yield should be increased, though, because a successful program of mass culture of the parasitoid *Trissolcus basalis* depends on an abundants, steady supply of *N. viridula* eggs. I find the facility for green stink bug culture inadecuate as far as space and lighting is concerned.

Recommendations

1 - Test food supplement such as sunflower seeds, both shelled and unshelled, dried figs, etc. to determine whether they influence fecundity.
2 - Devote a larger area to culture the chinch bug, where the cages can be better illuminated. It is understood that the new CNPSo at the Warta District will provide the necessary space for this aspect of the program.
3 - Modify the lighting system so as to include at least one plant growth fluorescent tube per lighting unit.

B. Mass culture of *Trissolcus basalis*

T. basalis is a species that normally has a biased sex ratio of four females for each male. The culture at CNPSo shows a deficient sex ratio of 1.9 female to 1 male, which means that much of the resources (host), are being used to produce unneeded males. I also noticed that an excessively large number of ovipositing females is being used to parasitize the available chinch bug egg masses.

6. ACTIVITIES UNDERTAKEN BY THE CONSULTANT AND RESULTS

6.1 RESEARCH DONE UNDER DIRECT RESPONSIBILITY OF THE CONSULTANT

Research activities developed	Results Achieved

Preliminary studies that Dr. Corrêa-Ferreira and I conducted at CNPSo during this consultantship reveal that although an ovipositing female *Trissolcus* deposits its eggs in a discriminating fashion (i.e. she will not lay an egg in an already parasitized egg) in confinement she will superparasitize when the great majority or all of the hosts have been parasitized. When a second female is exposed to an already parasitized egg mass, she will lay her eggs rather unhesitantly in this mass. This would explain why samples of parasitized eggs from the CNPSo show high level of superparasitism, indicating that a large proportion of the reproductive capacity of *T. basalis* is being wasted. It also may be the reason for the less than desirable sex ratio referred to above. This would be the case if there is differential mortality in the superparasitized host in which the males will win the competition for the host.

Recommendations

1 - Modify the host: parasite ratio so that the minimum number of *Trissolcus* females per *Nezara* egg mass that will yield ca 100 percent parasitization is used. Not only the number of females should be changed, but also the time of exposure. As a starting point masses should be exposed to gravid *Trissolcus* females for ca 4 h at the rate of one 100-egg mass per female.

2 - Study if there is differential mortality in superparasitize eggs. Chinch bug egg masses should be exposed to *Trissolcus* females as indicated above. The eggs in these masses should be separated and individually placed in small vials. The females emerging from these eggs will be unmated and, as long as they remain so, will lay unfertilized eggs that will develop into males. Next, prepare egg masses of ca 50 eggs each. Expose two of these masses, one at a time, to each of six normal (mated) females, noting which mass was exposed first and which was exposed second. Then expose the first mass of the first pair, the second mass of the second pair, the first mass of the third pair, and so forth, each to an unmated female. Thus six masses will be parasitized by mated females only (these will be the checks) and six masses will have been parasitized first by a mated female and then by an unmated one. If the sex ratio of there progenies differs significantly ($♀:♂ = 4$ vs < 4) this will be a strong

Research activities developed	Results Achieved

suggestion that in those cases where a host egg is superparasitized, if there is a male larva he will win the competition.

C. Population dynamics the *Nezara/Trissolcus* system

The parasitoid *Trissolcus basalis* is recognized as the most important natural enemy of *Nezara viridula* in many areas in the world. Work done at CNPSo by Dra. Beatriz S. Corrêa-Ferreira and collaborators suggests that this parasite can be manipulated, through periodic releases, to control the southern green stink bug.

It is evident that under the prevailing agricultural and economic conditions, the natural populations of *T. basalis* do not control *Nezara* to levels below the economic injury level. However, the high levels of parasitization that the second and third generations of the bug suffer warrant an expanded research program to investigate whether early inoculative releases of *T. basalis* would be sufficient to maintain populations of *Nezara*, during the whole soybean cycle, below the economic injury level.

Although there is still little understanding of the colonization process by *Nezara* from the overwintering sites to the soybean fields early in the season (first and second generations?), it would be possible to study the potential of *Trissolcus* by purposely inoculating experimental plots with *Nezara* egg masses and *Trissolcus* adults.

Recommendations

1 - Inoculate soybeans with *Nezara* egg masses.
Subsequently release *Trissolcus* and follow the fate of the inoculated egg masses and of a sample of those that will be laid by colonizing *Nezara*.
The readings of the effect of the parasite should continue through the reprodutive stages of the planta (R_8).
For example, the experimental design could be:
Size of plot: 0.5 ha
Replications: 3
Cultivar: mid season, or early and mid season
Distribution of egg masses: when plants are in late vegetative and/or early reproductive (R_1 - R_3) stages

6. ACTIVITIES UNDERTAKEN BY THE CONSULTANT AND RESULTS

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Research activities developed	Results Achieved

Density of egg masses: 400 masses per plot, in two lots of 200 each one week apant, at random.

Checks: three plots receiving neither chinch bug eggs nor parasites.

Reading of data: once a week. Check for the fate of the released egg masses (nymphs emerged, parasitized not emerged, parasitized emerged, infertile, dead by unknown causes, destroyed by predators), and also of the masses of naturally colonizing *Nezara*. Each egg mass should be flagged for ease of finding it next time. The population of nymphs and adults should be sampled in the usual manner (drops cloth).

The above scheme could be modified if it is logistically too difficult (lack of personnel?), but every effort should be made to implament it as suggested.

2 - The work on the influence of trap crop on the incidence of parasitism by *Trissolcus* should be continued taking data on the fate of the egg masses found.
Sampling for egg masses should be done on the plants on the 1m next to where the drops cloth seample is taken.

Further I recommend that the major effort during the 1987-1988 season should be directed toward improvement of mass production of *Nezara* and *Trissolcus*. In subsequent years for at least three more seasons the effort should be directed mainly to field work.

This research should be conducted keeping in mind that the aim is to develop a program that will be implemented by farmers, and that farmers will not adopt any program of pest control if they are not convinced that the programs are clearly economically advantageous and have a low risk factors. Funthermore, although the externalities of various pest control programs may be very important from the ecological and sociological points of view (e.g. pollution), they do not yet enter in the decision-making equation used by farmers.

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6.1 RESEARCH DONE UNDER DIRECT RESPONSIBILITY OF THE CONSULTANT

Research activities developed	Results Achieved

ACKNOWLEDGMENTS

I am very grateful to Dra. Beatriz S. Corrêa-Ferreira not only for her giving me, in a thorough, candid way the information I needed to carry out my assignment, but also for being a most gracious hostess. Drs. C.B.H. Campo, I.C. Corso, F. Moscardi, and A.R. Panizzi gave me generously of their time and expertise helping me to get a better idea of the pest control problems of soybeans in Paraná; to each one of them I am most grateful. I thank also Dr. Décio Luiz Gazzoni, Head of CNPSo for his making my stay at the CNPSo possible and for his invaluable help. Finally my gratitude to the administrative personal at the NCPSo who, I am sure, had to deal with various essential administrative details prior and during my visit.

7. OTHER NATIONAL SYSTEM CENTERS, APART FROM DUTY STATION CENTER, ASSISTED BY THE CONSULTANT

Research center	Area of assistance provided by the consultant

8. CONSULTANT'S SUGGESTIONS AND TECHNICAL OR INSTITUTIONAL RECOMMENDATIONS FOR THE IMPROVEMENT OF THE RESEARCH SERVICE

9. AGREEMENTS OR COMMITTMENTS ESTABLISHED WITH EMBRAPA RESEARCHERS IN-SERVICE OF THE FUTURE DEVELOPMENT OF RESEARCH IN THE CONSULTANT'S FIELD OF SPECIALIZATION

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10. CONSULTANT'S COMMENTS ON CIRCUMSTANCES WHICH AFFECTED THE CONSULTANCY WORK

Date:

18 - September 1987

Signature

Programa II. Geração e Transferência de Tecnologia

O Programa de Geração e Transferência de Tecnologia é a resposta do IICA a dois aspectos fundamentais: (i) o reconhecimento, por parte dos países e da comunidade técnico-financeira internacional, da importância da tecnologia para o desenvolvimento produtivo do setor agropecuário; (ii) a convicção generalizada de que, para aproveitar plenamente o potencial da ciência e da tecnologia, é necessário que existam infra-estruturas institucionais capazes de desenvolver as respostas tecnológicas adequadas às condições específicas de cada país, bem como um lineamento de políticas que promova e possibilite que tais infra-estruturas sejam incorporadas aos processos produtivos.

Nesse contexto, o Programa II visa a promover e apoiar as ações dos Estados membros destinadas a aprimorar a configuração de suas políticas tecnológicas, fortalecer a organização e administração de seus sistemas de geração e transferência de tecnologia e facilitar a transferência tecnológica internacional. Desse modo será possível fazer melhor aproveitamento de todos os recursos disponíveis e uma contribuição mais eficiente e efetiva para a solução dos problemas tecnológicos da produção agropecuária, num âmbito de igualdade na distribuição dos benefícios e de conservação dos recursos naturais.

INSTITUTO INTERAMERICANO DE COOPERAÇÃO PARA A AGRICULTURA

O Instituto Interamericano de Cooperação para a Agricultura (IICA) é o organismo especializado em agricultura do Sistema Interamericano. Suas origens datam de 7 outubro de 1942, quando o Conselho Diretor da União Pan-Americana aprovou a criação do Instituto Interamericano de Ciências Agrícolas.

Fundado como uma instituição de pesquisa agronômica e de ensino; de pós-graduação para os trópicos, o IICA, respondendo às mudanças e novas necessidades do Hemisfério, converteu-se progressivamente em um organismo de cooperação técnica e fortalecimento institucional no campo da agropecuária. Essas transformações foram reconhecidas oficialmente com a ratificação, em 8 de dezembro de 1980, de uma nova convenção, que estabeleceu como fins do IICA estimular, promover e apoiar os laços de cooperação entre seus 31 Estados membros para a obtenção do desenvolvimento agrícola e do bem-estar rural.

Com um mandato amplo e flexível e com uma estrutura que permite a participação direta dos Estados membros na Junta Interamericana de Agricultura e em seu Comitê Executivo, o IICA conta com ampla presença geográfica em todos os países membros, para responder a suas necessidades de cooperação técnica.

As contribuições dos Estados membros e as relações que o IICA mantém com 12 Países Observadores, e com vários organismos internacionais, lhe permitem canalizar importantes recursos humanos e financeiros em prol do desenvolvimento agrícola do Hemisfério.

O Plano de Médio Prazo 1987-1991, documento normativo que assinala as prioridades do Instituto, enfatiza ações voltadas para a reativação do setor agropecuário como elemento central do crescimento econômico. Em vista disso, o Instituto atribui especial importância ao apoio e promoção de ações tendentes à modernização tecnológica do campo e ao fortalecimento dos processos de integração regional e sub-regional.

Para alcançar tais objetivos o IICA concentra suas atividades em cinco áreas fundamentais, a saber: Análise e Planejamento da Política Agrária; Geração e Transferência de Tecnologia; Organização e Administração para o Desenvolvimento Rural; Comercialização e Agroindústria, e Saúde Animal e Sanidade Vegetal.

Essas áreas de ação expressam, simultaneamente, as necessidades e prioridades determinadas pelos próprios Estados membros e o âmbito de trabalho em que o IICA concentra seus esforços e sua capacidade técnica, tanto sob o ponto de vista de seus recursos humanos e financeiros, como de sua relação com outros organismos internacionais.

Esta publicação foi reproduzida na Gráfica do Escritório do IICA no Brasil, em Brasília, em março de 1988, numa tiragem de 200 exemplares.

Responsáveis pela reprodução: Jadir José dos Santos e Murillo Sodré da Silva.

Interessados em receber mais exemplares deste e de outros Relatórios de Consultores poderão solicitá-los a:

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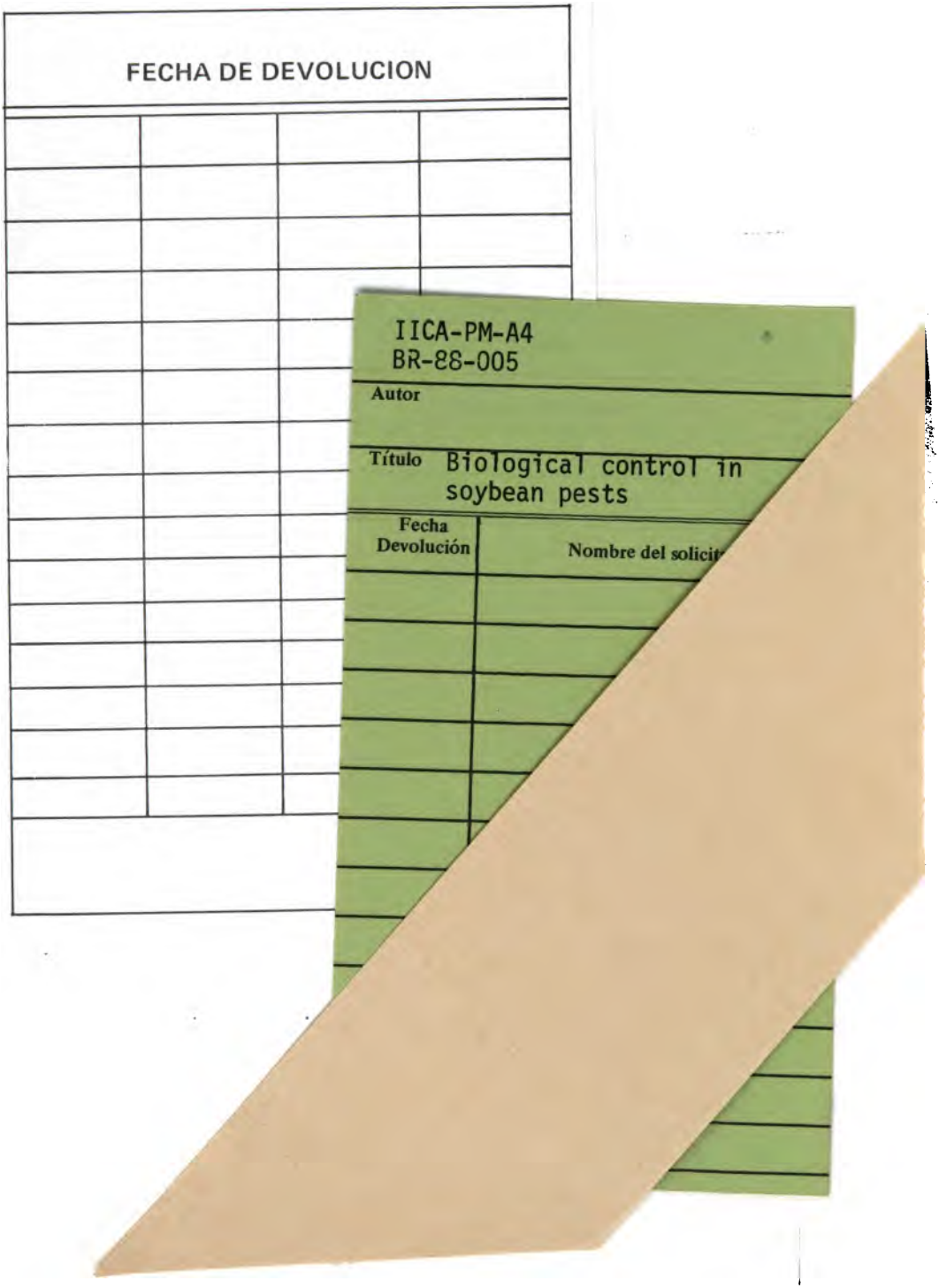
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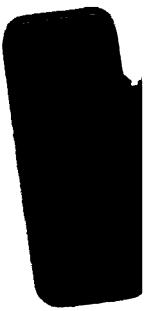

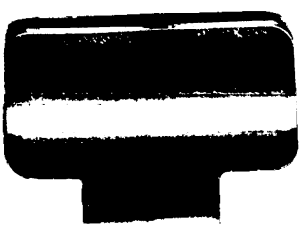

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