IICA

Consultant Final Report
IICA/EMBRAPA-PROCENSUL II

SOYBEAN INSECT PEST MANAGEMENT

ESCRITÓRIO NO BRASIL

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

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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: *Marcos Kogan*

2. Specialist in: *Soybeans Insect Pest Management*

3. Title of IICA Project: *2.SB.3*

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CONSULTANT CONTRACT PERIOD	DUTY LOCATION (Center)
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CONSULTANT FINAL REPORT

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Location: Centro Nacional de Pesquisa de Soja
Londrina, Paraná, Brazil

Consultancy period: February 9 to March 3, 1989

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COOPERATING STAFF AT THE CENTRO NACIONAL DE PESQUISA DE SOJA

Decio Gazzoni - Entomologist and Chief, CNPSoja
Clara Beatriz Hoffmann Campo - Entomologist, soybean resistance, soil arthropods
Beatriz S. Correa Ferreira - Entomologist, biological control of stink bugs
Ivan C. Corso - Entomologist, bioramcs, chemical control, cultural control
Flavio Moscardi - Entomologist, biological control, microbials
Antonio R. Panizzi, Entomologist, ecology of stink bugs; nutritional ecology of arthropods
Roberto Caio Machado, Plant Pathologist
Maria Cristina N. Oliveira, Statistics and data processing
Jose Francisco F. de Toledo, Quantitative genetics, plant breeding

Contacts were established also with entomologists of the Instituto Agronomico do Paraná, and agronomists of agricultural cooperatives in Paraná.

ACTIVITIES DEVELOPED

The consultancy was schedulec to permit ample contact with individual researchers. The time was divided between discussions of specific research projects at the office and visits to laboratory facilities and field experiments. Two extended trips were taken to Campo Mourao and to Maua to observe incidence of localized new pest problems (see below), and several trips were taken to WARTA, the site of the new CNPSoja headquarters.

General Impressions: The following comments stem from a comparison between the present state of entomology at CNPSoja and the state I found in 1976-77, during my previous consultancies with the Center. Having accompanied the evolution of CNPSoja since its establishment I sensed that the Center was going through a transition phase within a period of

considerable uncertainty about future political and economical developments in Brazil. During this 12-year time span, entomology at CNPSoja seems to have gone through several more or less well-defined phases:

1. Phase of establishment: The period from the establishment of the Center through 1976-77 was characterized by much enthusiasm, confidence, and a pioneering spirit. The Center had a young cadre of recently graduated agronomists with good basic training in entomology and a strong desire to learn.

2. Phase of consolidation: During this phase (1976-1982) the entomology group made some major strides and projected itself as one of the most productive within the Center as well as nationally (within EMBRAPA). Major successes were achieved in the IPM program under the leadership of Decio Gazzoni and Edilson B. de Oliveira, and later in the use of *Baculovirus anticarsia* for the control of the velvetleaf caterpillar under the leadership of Flavio Moscardi.

3. Phase of maturity: This phase extends from the mid-1980s to the present. After the euphoria of the early successes the staff was faced with new and more challenging problems, as well as the need to expand and to deepen the knowledge base in order to respond to rapidly changing economical and agroecological circumstances in the nation and in the crop. During this phase the team lost some key members. The economic crisis has eroded the economic status of the staff and caused an array of difficulties in the good performance of the work. There seems to be a tendency to individualize the research projects as opposed to a greater integration of efforts.

4. Phase of renovation: I suggest that the next phase should be characterized by a spirit of renewal of goals and reassessment of priorities, both personal and programmatic.

There are obvious sources of dissatisfaction that carry the risk of affecting productivity and morale of the group. These sources, at the time of my visit, were (1) the unsettled situation regarding the transfer to the new facilities at WARTA; (2) the serious financial constraints within the institution that imposed restrictions at all levels of activity, from transportation to field locations, to the purchase of supplies, library materials and availability of field hands; and (3) the loss of key elements for the team foremost among whom Edilson B. de Oliveira, for tragic reasons, and Decio Gazzoni, for his upward move to the Center's headship. Also during this period, Geni Villasboas was transferred to another center and of the remaining five entomologists. Antonio Panizzi spent several years on a Ph.D. program in the U.S.A., and Beatriz Correa Ferreira is currently working towards her Ph.D. at the Universidade do Paraná in Curitiba. As a consequence, the entomology team that counted with eight professionals in 1981 is now down to 5 active researchers. This drop left obvious gaps in the coverage of much needed programs, a marked increase in the responsibilities and workload of certain staff, and a decline in the overall productivity of the group (Figure 1), particularly when measured in the number of publications in refereed journals or major reviews.

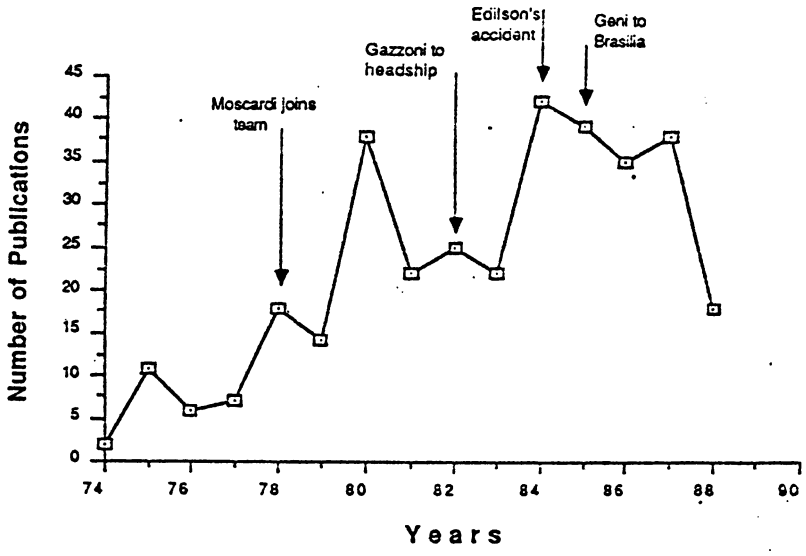


Figure 1. Number of publications authored by the staff of the Entomology Section of CNPSoja. Numbers from 1974 to 1986 are based on references in the "World Bibliography of Soybean Entomology" by J. Kogan, M. Kogan, E. Brewer, and C. Helm, University of Illinois, College of Agriculture, Special Publication 73, Vol. I, 665 pp., Vol. II, 291 pp. (1988). Data for 1987 and 1988 was based on entries in "Resultados de Pesquisa de Soja," annual reports of CNPSoja, as well as reprints from refereed journals. Jenny Kogan, Librarian, Soybean Insect Research Information Center (SIRIC), from the University of Illinois and Illinois Natural History Survey, compiled the data used to produce this graph.

RESEARCH PROGRAMS

Despite some of the problems mentioned above, the overall level of the research projects is excellent. Experiments are well designed with the support of a statistical consultant (M. C. de Oliveira), and the field plots were generally in excellent condition. The pay-off of the investment in training is reflected in the fact that the group of entomologists at CNPSoja is perhaps one of the most impressive both nationally and internationally, not only among the EMBRAPA centers, but also considering the academic personnel in the major Brazilian universities. This is reflected in the level and quality of presentations in meetings of the Brazilian Entomological Society and other measures of professional excellence.

Priority Areas: In the basic and applied areas of research there is a sense that priority is given to the most urgent problems. Table 1 summarizes my assessment of the main areas of activity and the estimated effort currently devoted to each of them.

Table 1. Research Areas and Allocation of Effort by the Entomologists (my assessment).

Target Pest	% Effort	Applied Research	% Effort	Basic Research	% Effort
Stinkbugs	50	Biological Control	50	Bionomics	30
		(parasitoids)		Nutritional ecology	30
		Plant Resistance	30	Host relationships	30
		Insecticides	10	Behavior	10
		Cultural control	10		
Lep. caterpillars	30	Biological control	75	--	
		(microbials)			
		Insecticides	25		
Thrips	8	Cultural control	50	Population dynamics	100
		Insecticides	50		
Sternechus	8	Cultural control	100	Bionomics	100
Scarabaeid larvae	2	-	-	Bionomics	100
Other pests[1]	2	Chemical control	100	Bionomics	100

[1] *Epinotia aporema; Elasmopalpus lignosellus*, mealybugs, and others.

Given the reduced size of the entomology group and the strong commitment to major priority areas (e.g., stink bugs, microbial control of caterpillars), the group is stretched to the maximum in its capacity to respond to new demands in a timely fashion (e.g., new pests, outbreaks of minor pests, or localized outbreaks of common pests).

Summary of Research Projects and Some Highlights

1. Microbial Control of Lepidopterous Pests - Principal investigator Flavio Moscardi

The use of *Baculovirus anticarsia* in the control of *Anticarsia gemmatalis* has become one of the programs of CNPSoja with highest national visibility. During my stay in Londrina, negotiations were underway to release the patent of the semi-industrial production of the virus to the private sector. In addition to the practical success of this program, some very imaginative basic research projects were under way, among them: (a) monitoring of possible changes in genomic structure and virulence of *B. anticarsia* after 10 years of widespread use of the virus under diverse agroecological conditions (in collaboration with the University of Florida and the Universidade de Brasilia); (b) studies of a granulosis virus of *Epinotia aporema*; and (c) surveys of viruses of Plusiinae.

2. Resistance in Soybean to Major Pests - Principal investigator: Clara Beatriz Hoffmann Campo

This program was initiated by Edilson B. de Oliveira and it was taken over by Clara Beatriz after Edilson's accident. The program counts with considerable support from CNPSoja's breeders Romeo Kiihl and Jose F. F. de Toledo. One of the sources of resistance to stink bugs is PI 274454, apparently because of its late flowering. Under high stink bug pressure this PI still produces good quality seed. Two lines that stood out in experimental plots in Tumbiara, M.S., resulted in the release of the variety 'Goiania'. This variety is being used as a resistant parent in more recent crossings conducted to improve seed quality. The program is very active and with the input of Dr. Toledo, a quantitative geneticist, is taking some novel approaches in breeding for resistance to insects. The program counts with two large field cages to test lines in advanced stages of the breeding program. The program generates an impressive volume of data and it seems to be making important strides toward the development of high yielding resistant varieties.

3. Biological Control (parasitoids) of Stink Bugs - Principal investigator Beatriz Correa Ferreira

The main focus of this program is the use of parasitoids in the control of stink bugs. Several projects are being developed as part of the principal investigator's thesis research for a PhD degree at the Universidade do Parana. The program is extremely well balanced with both applied and basic aspects of the *Trissolcus/Nezara* interactions being covered in depth. Some of the most salient studies include: (a) colonization patterns of Pentatomidae associated with soybean to determine the optimal time to release *Trissolcus*; (b) use of trap strips for stink bugs as sites for augmentation of *Trissolcus* and potential of the trap crop technique in the control of *Nezara viridula*; (c) improve mass production techniques of soybean Pentatomidae; (d) viability of *Nezara viridula* eggs kept under various storage conditions; (e) superparasitism of *Trissolcus* and its effect on sex ratio. Data on colonization patterns of stinkbugs were brought to Illinois to attempt certain techniques of graphical representation available at the university.

4. Cultural Control of Thrips - Principal investigator Ivan Corso

Two species of thrips, *Frankliniella schultzei* and *F. rodeos* have been implicated in the transmission of the causal organism of bud blight. Some 400,000 ha of soybean are threatened by the disease in Parana alone. Chemical control of the vectors is not feasible. Successful control has been achieved with late planting of soybean. Late planted fields escape the attack by the thrips. Increasing plant density also leads to compensation and attenuation of the impact of the virus. Studies on plant resistance to the virus and alternate hosts for both virus and thrips have been conducted. Given that in areas of high incidence the virus is a limiting production factor, farmers are apt to adopt the cultural control methods as a viable alternative. Ivan Carso is also in charge of the insecticide screening program. Recently, tests were conducted on the effectiveness of common table salt, NaCl, as an additive in the chemical control of stink bugs (claims to this effect had been made by certain growers).

5. Nutritional Ecology of Seed Sucking Insects - Principal investigator: Antonio R. Panizzi

Antonio Panizzi has taken a very basic approach to elucidate the population dynamics and host relationships of the principal species of Pentatomidae associated with soybean. This research has potentially far reaching applications in the control of stink bugs by behavioral manipulations and cultural control procedures. Specific research projects include: (a) evaluation of the effect of alternate hosts on the biology of stink bugs [e.g., parasitization of *N. viridula* by *Eutrichopodopsis nitens* is higher on *N. viridula* colonizing *Leonurus sibiricus* (Labiatae) than on *N. viridula* colonizing *Ricinus communis* (Euphorbiaceae)]; (b) evaluate the nutritional value of various soybean plant parts on the biology of Pentatomidae; (c) determine the seasonal profile of lipid accumulation in *Nezara viridula* (lipid accumulation usually indicates the physiological status of an insect in its capacity to disperse and its potential for progeny production); (d) biological studies on species of Hemiptera newly recorded on soybean.

6. New Pests of Soybean

Because soybean cultivation is expanding into new areas in Brazil, and even in regions of established production in Rio Grande do Sul, Parana, and Sao Paulo, cultivation undergoes constant changes, new pests flare up and outbreaks of secondary pests become regionally serious. The entomology team has made a major effort to remain abreast of these occurrences and provide growers and extension specialists the essential information to cope with the problems. Basic biological research has been conducted on some of the most prominent of these pests (e.g., *Sternechus subsignatus, Myochrous armatus*, soil arthropods) and control recommendations are usually made on an interim basis until further experimentation leads to better control procedures.

Sternechus subsignatus (studied by Clara Beatriz H. Campo): Biological studies are being conducted in the laboratory. Studies in the region of Maua on planting date and rotation with corn, suggest that rotation may be the most efficient control method.

Larvae of Scarabaeidae (studied by Clara Beatriz H. Campo): Patches of fields in the region of Campo Mourao, Parana, were being decimated by extremely large populations of species of the genera *Phytalus* and *Diloboderus*. Plans were being developed to establish a cooperative research program with agronomists of COAMO (Cooperativa Agropecuaria Mouraoense). There seems to be some relationship between severity of infestations and certain crop rotations. Development of an intensive research program is hampered by the distance of infested areas from Londrina, and the difficulties in establishing a laboratory colony of the insects.

Myochrous armatus (studied on site by local entomologists in Dourados, MS, under the guidance of A. Panizzi): Good studies on the biology of this sporadic pest have been conducted.

SOME GENERAL PROBLEMS

The following are some general problems that I perceived as capable of affecting performance, productivity or morale of the staff. Although this consultancy was short (ca. three weeks), the staff was open and sincere, thus providing an opportunity of an objective assessment. However, there is always the risk that I may have misinterpreted some comments or misjudged some observations. In any case, these comments are made to offer a basis for further internal discussions.

1. Personal development of researchers: During this phase of maturation of CNPSoja there are many positive developments. Researchers have striven to define their individual areas of excellence. In so doing, several have followed their intellectual interests and are highly self-motivated to work and study. Most have achieved broad national and international recognition and have made significant scientific and practical contributions. Some negative developments have resulted, however, from the tendency to stress

individual inclinations. There is an apparent decline in the "esprit de corps" and team research; there is greater emphasis on individual projects although many could benefit from greater interaction. There is a need to better define who is responsible for "neutral zones". Who is responsible for new pests? How are new priorities discussed and reassigned?

2. Dispersal of researchers' energy, time and efforts: A key function of the administration is to protect researchers from all that distracts them from their main research activities. Granted, there is always a minimum that all members of a community have to concede for the proper functioning of the community. However, administrators should spare as much as possible their research staff of demands for excessive reporting, paperwork to secure field help, travel permits, requisitions of transportation or supplies. Researchers should be also protected against excessive demands for public relations and relations with the public. I noticed that several of the research staff were performing functions of extensionists to the detriment of their ability to perform research.

3. Professional renewal and training. The research staff are to be commended for their interest in exploiting opportunities to expand the scope of their programs and training in other centers of excellence abroad. Example of such activities was the trip taken by Panizzi to Japan to observe and discuss technical aspects of stink bug research with Dr. K. Kiritani, a world authority in this group of insects and the consultancy of Moscardi in Indonesia. The administration should be also applauded for supporting such initiatives. On the negative side, however, was the perceived decline in the access to the international technical literature, both periodicals and technical books. Cuts in the budget for library operations are disastrous because subscriptions are interrupted and it is often impossible to complete collections of important journals at a later time. In addition, it seems that staff were having a great deal of difficulty in obtaining financial support to attend professional conferences. Conferences are a foremost vehicle of information exchange and the technical staff should not miss key national or international conferences.

4. Reduction of the research staff: As mentioned before, the team was reduced from eight researchers in 1983 to five in 1989. The program that suffered the most was the very successful soybean IPM implementation that had been led up to 1983 by Gazzoni and Oliveira. In addition, the basic experiments on economic injury levels that had been developed by Geni Villasboas, has been discontinued with her transfer to Brasilia. There is an obvious need to reactivate these programs.

5. Uniformity of the fields of specialization: The basic training of the present staff is in the several areas of species and population ecology, with additional specialization in insect pathology and nutritional ecology. There are some areas of research that could benefit if expertise were available in mathematical ecology, chemical ecology, physiology and behavior of insects, toxicology, community ecology, and soil ecology.

GENERAL SUGGESTIONS

1. Renew the espirit of cooperation and promote team work

   a. Identify areas of common interest and develop collaborative projects.

      For example: Study the interactions of plant resistance and natural enemies in the control of stink bugs, or evaluate the use of plots of attractive alternate hosts as nursery sites for stinkbug populations to serve as reservoir of *Trissolcus*.

   b. Maintain open channels of communications with the team through frequent team meetings to discuss technical as well as personal problems. Request the presence of the Chief or the Director for research in some of the meetings.

2. Dispersal of efforts

a. It is important to reduce bureaucratic demands on researchers' time. It is essential to increase the proportion of time devoted to research during a regular workday. The administration should find means to reduce the demands that infringe on the time available to the staff to do research.

b. It would be helpful to find mechanisms to streamline the process of publication of research results. The transition from papers written for the detailed annual reports to formal publication of those same results in a refereed journal would be facilitated if the services of a competent scientific editor were made available to researchers. It would allow researchers to devote more time to the actual publication of results. Annual reports could then be based on abstracts of published papers.

c. It would be desirable to hire an "agronomo fitosanitarista" (B.S. level) to be trained by the research staff on the basic problems of soybean entomology. This individual would serve as a liaison with extension personnel and the public in general, thus reducing demands on researchers' time for public relations. This individual would also screen the consultations made by the public directing the unusual or seemingly most important ones to the appropriate researchers.

3. Professional renewal and training

a. Support an effective program of sabbatical leaves of up to one year in centers of excellence in the field of the individual researcher.

b. Make the best possible use of programs of technical exchange, selecting visiting professionals that have as much to offer to the team as the visitor is certain to receive.

c. Seek an active exchange of publications and donations of collections of scientific journals and recent books. The staff of the CNPSoja library should be involved in this process and given the full support for any initiative aimed at improving the breath and depth of the library collections.

4. Restore the lost positions.

a. It is essential to restore the team to, at least, its original strength in 1983. The programs in greatest need of leadership are the general IPM implementation systems, and soil ecology. Although there are researchers in the team capable of developing excellent programs in soil ecology (e.g., Clara Beatriz H. Campo), there are presently too many other demands on their time to properly cover this area of research. It is important also, in recruiting, to give preference to professionals with basic training in the areas not presently represented in the team (e.g., chemical ecology, community ecology, or physiology and behavior).

SPECIFIC SUGGESTIONS

The following is a sample of topics offered for the consideration of the team. There was no attempt to be exhaustive, however, and by offering these suggestions, there is no implication that current programs are not worthy. Quite the opposite, these suggestions are made in the expectation that through additions to the team and increased dedication to research through a more efficient allocation of effort, the staff will be able to expand the programs.

1. Plant resistance program:

a. Stink bugs
- intensify screening program
- investigate mechanisms of resistance (in collaboration with some other research centers in Brazil or abroad)

- nutritional ecology of stink bugs on resistant soybean of lines

b. Interactions of resistance and *Trissolcus*

c. Interactions of intermediate hosts x resistant varieties x *Trissolcus*

d. Screen germplasm for resistance to other pests (e.g., *Maruca testulalis, Sternechus subsignatus*) (the team).

2. Biological control

a. *Trissolcus* - investigate the possibility of developing a strain with high levels of resistance to insecticides commonly used to control stink bugs (the work of Marjorie Hoy, University of California, Berkeley, is proposed as a model).

b. Rearing of *Trissolcus* in artificial eggs.

c. Investigate (quantitatively) the impact of natural enemies in the regulation of various major pests. These studies are essential for the incorporation of the assessment of natural enemy populations in economic injury level evaluations (the non-action threshold concept proposed by Winfield Sterling, Texas A&M University, is a model for such studies) (the team).

3. Cultural controls

a. Search for practical uses of information on alternate wild hosts of stink bugs such as their use in traps or in nursing patches for the augmentation of *Trissolcus* (see above).

b. Investigate the effect of the elimination of wild hosts from large plots on the dynamics of stink bug populations.

c. Investigate the impact of combined effects of planting dates, variable row spacings and other practices that affect crop ecology on the dynamics of major pest populations.

4. Ecology of soil inhabiting insects

Many new pests and several established pests have at least some life stages spent below ground level. There is a need to understand the biology of soil arthropods and to establish economic injury levels for insects feeding underground (new position).

5. Ecology of Lepidoptera and Coleoptera

There is a need for basic studies on the dynamics of crop colonization, dispersal potential alternate hosts (similar to those conducted by Panizzi on stink bugs), and detailed life tables for the principal lepidopterous and coleopterous pests (the team).

6. IPM program

- There is a need to reactivate the basic IPM system with incorporation of novel techniques for monitoring populations of pests and natural control (*B. anticarsia*). For widespread adoption of IPM, it will be necessary to simplify scouting procedures and it will be necessary to establish economic injury levels and non-upsetting methods of control of sporadic or localized pests. It is essential for the success of the program to have a team member totally dedicated to its leadership.

7. Training

It is imperative to continue to stimulate the staff in the quest for professional excellence. It seems that next in line for advanced studies is Clara Beatriz H. Campo. Since her main area of interest is host plant resistance I would recommend that she pursues her PhD program in a center with active research in the area of breeding and mechanisms of resistance (Illinois or Louisiana).

Concluding remarks: New trends in the U. S. agricultural research are heavily influenced by the new techniques of molecular biology. In the holistic front the concept of "low input sustainable agriculture" (LISA) seems to be gaining momentum. I do not believe that entomologists at CNPSoja could benefit at this stage from a major retooling and redirectioning toward molecular biology. I would, however, encourage that some future recruit be trained in this area to the extent of being able to monitor the literature for potentially useful developments in this field.

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.

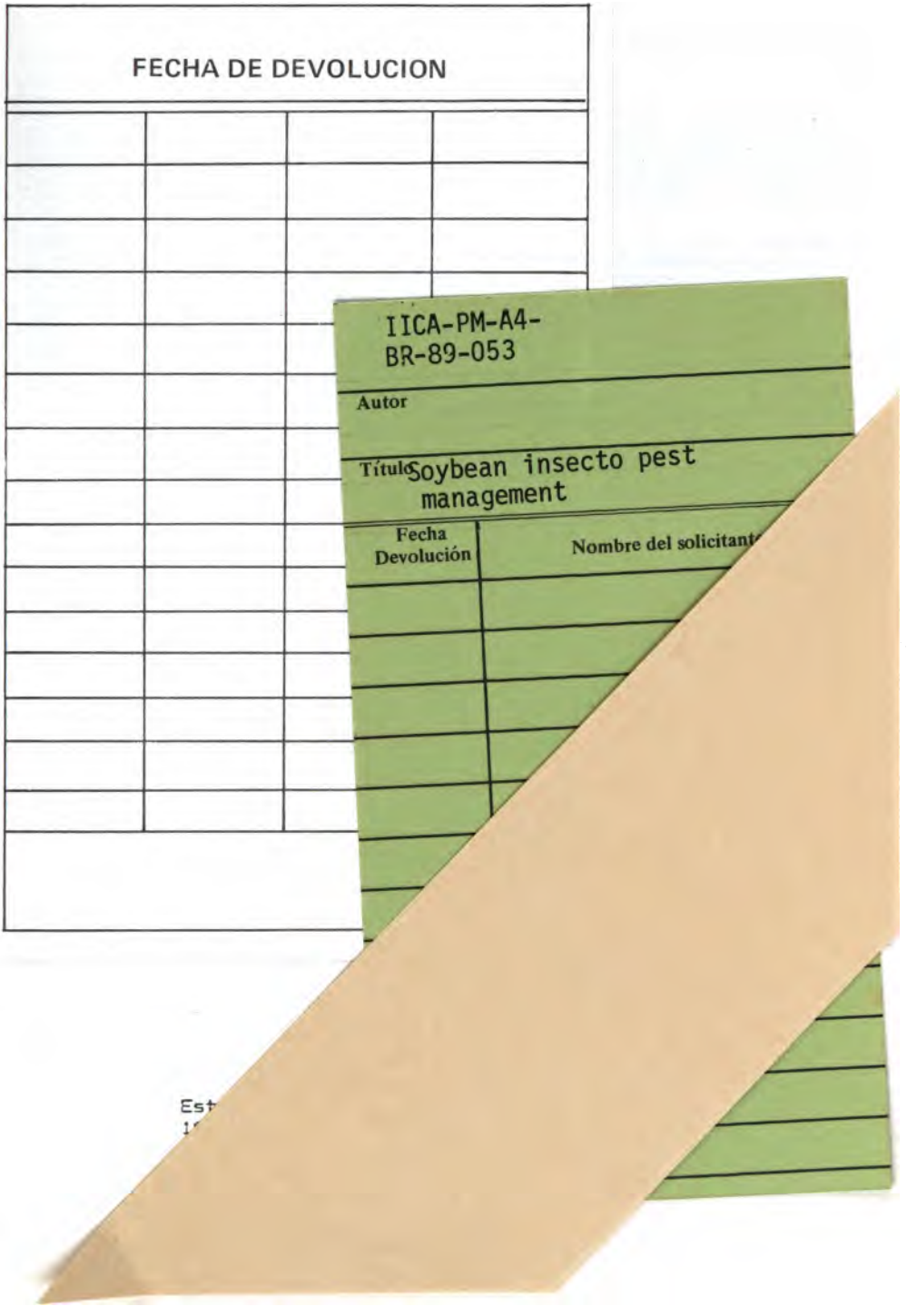
Com um mandato amplo e flexível e com uma estrutura que permite a participação direta dos Estados membros na Junta Interamericana de Agricultura e em seu Comitê Executivo, o IICA conta com ampla presença geográfica em todos os países membros para responder a suas necessidades de cooperação técnica.

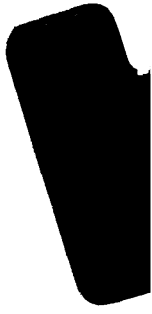
As contribuições dos Estados membros e as relações que o IICA mantém com 12 Países Observadores, e com vários organismos internacionais, lhe permitem canalizar importantes recursos humanos e financeiros em prol do desenvolvimento agrícola do Hemisfério.

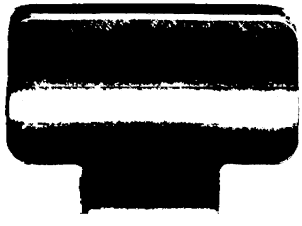
O Plano de Médio Prazo 1987-1991, documento normativo que assinala as prioridades do Instituto, enfatiza ações voltadas para a reativação do setor agropecuário como elemento central do crescimento econômico. Em vista disso, o Instituto atribui especial importância ao apoio e promoção de ações tendentes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


FECHA DE DEVOLUCION
IICA-PM-A4-
BR-89-053
Autor
Título Soybean insecto pest
management
Fecha
Devolución
Nombre del solicitant





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