REPORT OF THE ACTIVITIES AT THE NATIONAL SOYBEAN RESEARCH CENTER OF EMBRAPA (LONDRINA, PARANÁ, BRAZIL) ON SOYBEAN ENTOMOLOGY AND INSECT PEST MANAGEMENT.[1]

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The National Soybean Research Center (CNPSo) was created in April, 1975 and it is a research unit of EMBRAPA. The work in Soybean Entomology started in the 1975/76 season and two Entomology consultants, Dr. Sam G. Turnipseed and Dr. Marcos Kogan, strongly cooperated in its early organization.

Today the CNPSo has a staff of 6 entomologists plus supporting personnel. Dr. Gary Newman was a consultant for the program from September, 1975 to June, 1977. During the last two years, Drs. Gerald Carner, Merle Shepard and Gerald Greene assisted the program on an informal basis.

ENTOMOLOGY PROGRAM

The major effort of the CNPSo Entomology team is directed towards the development and implementation of a Pest Management Program. Our research is designed to improve this program, to provide growers with the best possible information on control of insect pests.

1/ Paper presented on the annual meeting of the Regional Project S-74. "Control Tatics and Management Systems for Arthropod Pests of Soybeans". Atlanta, GA, March 7-10, 1978

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In addition to the Pest Management Program we have the following research programs:

1. Insect biology
2. Geographic distribution and seasonal abundance of soybean pest and their natural enemies
3. Economic damage thresholds
4. Relationship between soybean spacing, density and planting date, and arthropod populations
5. Insects as vectors of soybean diseases
6. Insect pathology
7. Insecticide tests
8. Effect of insecticides on predators and parasites of soybean pests
9. Host plant resistance.

A C H I E V E M E N T S

With the Pest Management Program it was possible to reduce insecticide applications up to 83% on the first year and 45% on the second year, in the states of Paraná and Rio Grande do Sul. Based on these excellent results, obtained during the 1974/75 and 1975/76 seasons, the CNPSo started last season the expansion of the Program. A micro-region of North Paraná was selected and several growers were trained to use the Program under CNPSo supervision. On a research basis, the Program was tested all over the soybean production area of Brazil (between 16° and 32° latitude).

In the current growing season the Program was adopted as a standard extension method in Brazil. Extension agronomists were trained in 16 short courses. Detailed instructions, bibliography and sampling equipment were provided to the extensionists. We expect the Program to reach approximately 50.000 growers in up to 900.000 ha, where the Pest Management principles will be used, at least partially, as a basis for treatment decisions.

We also started an "Alert System" as a part of the Pest Management Program. It provides weekly information to growers about soybean pest status and the occurrence of natural enemies. This is a joint program of researchers and extensionists. Television, radio and newspapers are involved. The results have been excellent and an average of 90% of the soybean growers of the 12 counties covered by the "Alert System" are supposed to have been influenced on their pest control decisions by the information delivered through the media.

Insect surveys have been made covering the entire soybean growing regions of Brazil. Results show that lepidopterous caterpillar attacks start from North to South, with a difference of approximately a month between population peaks. Epzootics of *Nomuraea rileyi* start just after these caterpillar populations peak. The major soybean defoliator is *Anticarsia gemmatalis* wich occurs in all areas surveyed. *Plusia (Pseudoplusia)* spp. seems to be mantained under control by several parasites, but, in some locations, the use of broad spectrum insecticides has allowed the build up of large populations of loopers.

The stink bug complex includes some of the most important brazilian soybean insect pests. Surveys showed that *Nezara viridula* is the most commom stink bug, but *Piezodorus guildinii* is increasing and, in some locations, it is more serious than *N. viridula*. *Euschistus heros* is of minor importance, and occurs mainly in the northern region. Species of *Acrosternum* are very low in population.

The work on insect damage threshold is being done with *P. guildinii* and *Epinotia aporema*. Results so far show that *P. guildinii* damage is very similar to that obtained with *N. viridula*. *E. aporema* is an insect that recently has become important on brazilian soybeans. It attacks terminal buds, stems and branches. Preliminary results show no effect on yield when 30% of terminal buds were attacked.

The use of a nuclear polihedrosis virus in the Pest Management Program is being studied. Several trials have been conducted to establish the relationship between the rate of dead larvae applied in the field and the control of caterpillars. First results show the possibility of an effective use of the virus in an integrated program.

Other work related to insect pathology is the attempt to antecipate *N. rileyi* epizootics. Infected larvae were collected in Central Brazil and distributed in soybean fields in the more Southern states, before incidence of natural epizootics.

The association of stink bug feeding and soybean diseases incidence is being studied to determine the damage caused by stink bugs alone or by the diseases. Initial work demonstrates that stink bugs alone can cause great yield reduction, but the integration stink bugs X diseases is very important. The major disease transmited by stink bugs is the yeast-spot, caused by *Nematospora coryli*.

Insecticide evaluation test have been performed against soybean pests. Results are shown in the table 1.

Table 1. Insecticide evaluation tests for control of major soybean insect pests in Brazil.

Insect	Number of tests	Number of treatments	Number of insecticides
1. *Anticarsia gemmatalis*	19	228	65
2. *Plusia* spp	1	12	12
3. *Epinotia aporema*	13	148	40
4. *Hedylepta indicata*	10	110	45
5. *Nezara viridula*	18	198	65
6. *Piezodorus guildinii*	18	198	65
7. *Euschistus heros*	12	132	54
Total	91	1026	65

For the present season, the insecticides recommended in the Pest Management Program are shown in the table 2.

Table 2. Insecticides and rates recommended for the Pest Management Program, 1977/78 season.

Insecticide		rate (ai/ha)
1. *Anticarsia gemmatalis*		(velvetbean caterpillar)
Azimphosethyl	CE 40	400 g
Bacillus thuringiensis		500 g
Carbaryl	PM 85	300 g
Chlorpyrifos	CE 48	360 g
Diflubenzuron	PM 25	50 g
Endosulfan	CE 35	420 g
Fenitrothion	CE 50	500 g
Phosalone	CE 35	525 g
Phosphamidon	CE 50	250 g
Methidathion	CE 40	400 g
Methylparathion	CE 60	300 g
Monocrotophos	CE 60	200 g
Omethoate	CE 50	500 g
Triazophos	CE 40	400 g
Trichlorfon	PS 80	400 g
2. *Plusia* spp		(loopers)
Carbaryl	PM 85	300 g
Chlorpyrifos	CE 48	360 g
Endosulfan	CE 35	420 g
Monocrotophos	CE 60	500 g

3. *Epinotia aporema*

Chlorpyrifos	CE 48	600 g
Fenitrothion	CE 50	1000 g
Phenthoate	CE 50	1000 g
Methylparathion	CE 50	500 g
Monocrotophos	CE 60	500 g
Triazophos	CE 40	600 g

4. *Piezodorus guildinii*

Carbaryl	PM 85	850 g
Endosulfan	CE 35	350 g
Phosphamidon	CE 50	600 g
Monocrotophos	CE 60	600 g
Trichlorphon	PS 80	800 g

5. *Nezara viridula* (Southern green stink bug)

Dimethoate	CE 50	750 g
Endosulfan	CE 35	525 g
Fenitrothion	CE 50	500 g
Phosphamidon	CE 50	600 g
Methylparathion	CE 60	500 g
Monocrotophos	CE 60	400 g
Trichlorphon	PS 80	800 g

According to our Pest Management philosophy, it is very important to determine the effect of insecticides on natural enemies. Experiments conducted to determine the impact of pesticides on natural enemies are listed in table 3.

Table 3. Insecticide test to evaluate impact of insecticides on natural enemies.

Arthropod	Number of tests	Number of treatments	Number of insecticides
1. Spiders	18	198	65
2. *Geocoris* spp.	18	198	65
3. *Nabis* spp.	18	198	65
4. *Podisus* spp.	12	132	38
5. Several parasites	10	110	65
Total	76	836	65

Most of the insecticides tested have great effect upon natural enemies, mainly on the higher rates. Carbaryl endosulfan, *Bacillus thuringiensis* and diflubenzuron are the most selective ones.

In order to be recommended for the Pest Management Program the insecticides should meet the following requirements:

1. Control of 80-90% of the pest for at least 7 days
2. Low effect upon the natural enemies
3. Short to medium residual effect
4. Specificity against the pest
5. Low cost
6. High to medium mammalian LD_{50}
7. High degradability on the enviromment and absence of residues in the seed.

Finally breeders of CNPSo, jointly with entomologists, are developing several soybean lines resistant to caterpillars and stink bugs. We hope to be able to use in the near future this breeding material, in a broader Pest Management Program.

C O N C L U S I O N S

Since the establishment of CNPSo there has been continuous progress in the Entomology program, making this one of the strongest areas of activity at the Center. The program covers all soybean production areas of Brazil, mainly through development of cooperative projects with state institutions. Broader use of the Pest Management Program will allow reducing the normally used 4-5 applications of insecticides to 1-2 by the beginning of the next decade. The program should also have a very favorable effect on balance between pests and natural enemies. In addition, production costs will be reduced as will the risks of intoxication of man, farm animals and wild life.