

Cientific Paper

## Abstract

Bandeirantes is an essentially agricultural municipality standing out in soybean and maize harvesting among a wide variety of crops. It was aimed to define the producers profile concerning their knowledge about pests and useful insects in the field. It was used a form divided into four parts covering up the social aspects, way of conducting the crop, pest occurrence and recognition of harmful and beneficial insects to the plants of soybean and maize. It was concluded that farmers are aware of technological innovations, however, the pest control is made exclusively with chemical insecticides. Few farmers recognize the common natural enemies to pests which occur in soybean and maize.

**Keywords:** Natural enemies; crop management; *Glycine max* (L.) Merr; *Zea mays* L.

## Profile of producers regarding the knowledge of pests and beneficial insects in soybean and maize in Bandeirantes-Paraná

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## Perfil dos produtores quanto ao conhecimento de pragas e insetos úteis em soja e milho no município de Bandeirantes-Paraná

### Resumo

Bandeirantes é um município essencialmente agrícola destacando-se entre várias culturas na produção de soja e milho. Buscou-se definir o perfil dos produtores desses grãos no tocante ao conhecimento sobre insetos pragas e úteis na lavoura. Utilizou-se um formulário dividido em quatro partes abordando-se aspectos sociais, forma de condução da lavoura, ocorrência de pragas e reconhecimento de insetos prejudiciais e benéficos às plantas de soja e milho. Concluiu-se que os agricultores estão atentos às inovações tecnológicas, entretanto o controle de pragas é feito exclusivamente com inseticidas químicos. Poucos reconhecem os inimigos naturais comuns às pragas que ocorrem em soja e milho.

**Palavras-chave:** Inimigos naturais; manejo; *Glycine Max* (L.) Merr; *Zea mays* L.

## Perfil de los productores sobre el conocimiento de las plagas y de los insectos benéficos en la soja y el maíz en Bandeirantes Paraná

### Resumen

Bandeirantes es un municipio esencialmente agrícola destacándose entre diferentes cultivo la producción de soja y maíz. Se buscó definir el perfil de los productores de estos granos en relación con el conocimiento de las plagas y insectos útiles en el cultivo. Se utilizó un formulario dividido en cuatro partes considerando cuestiones sociales, método de conducción de la agricultura, ocurrencia de plagas y el reconocimiento de insectos perjudiciales y beneficiosos para la soja y maíz. Se concluyó que los agricultores están atentos a las innovaciones tecnológicas, sin embargo el control de plagas es hecho exclusivamente con insecticidas químicos. Pocos reconocen los enemigos naturales comunes a las plagas que se producen en la soja y el maíz.

**Palabras clave:** Enemigos naturales; manejo; *Glycine max* (L.) Merr.; *Zea mays* L.

## Introduction

The soybean crop occupies a great place in the agribusiness of the South America. Together, Brazil,

Argentina and Paraguay correspond to 50% of the world production. Brazil occupies the second place in the world ranking and can be the first in a near future if the current growth trend maintained (DEMARCHI,

Received at: 11/04/2013

Accepted for publication: 17/11/2013

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2011b). The soybean, in comparison with other crops, mainly with its main competitor, which is the maize, has been preferred by the producers because it has as advantages: greater liquidity, lesser expenses than the maize, mainly to acquire seeds and fertilizers, crop traits and the harvest is easier to perform. The production of maize in Brazil, along with the soybean, contributes to 80% of the country grains production (VILAS BOAS and GARCIA, 2007).

The Paraná state is the greater national producer of maize with an average of 13.39 millions of tons. The state corresponded, in the last five years, for 21% of the quantity offered in the 1<sup>st</sup> Brazilian harvest and for 30% of the offered 2<sup>nd</sup> harvest (DEMARCHI, 2011a).

The planting of maize in the 2<sup>nd</sup> season, in succession to soybean, was initiated during the 80s and, for showing to be a viable option of cultivation for this time of the year, expanded expressively in the regions of Paraná causing migration of the plating of maize 1<sup>st</sup> harvest to soybean, with increment of 2.0 millions of hectares for almost 4.5 millions cultivated in the season 2010/11 (DEMARCHI, 2011b).

Bandeirantes has in the agriculture one of its main economical activities. It reached in the sugar cane, soybean and maize crops the production of 767,372; 49,207 and 19,267 tons in 2011 (IPARDES, 2012). The soybean and maize crops serve as food and shelter for many species of insects, this factor can interfere negatively in the production. The objective of this study was to characterize the profile and the knowledge of soybean and maize producers about pests and natural enemies in these crops.

## Material and Methods

The study was done in 2011 in the municipality of Bandeirantes (latitude 23° 06' 36"S, longitude 50° 22' 03" O and altitude 420m), located in the north of the Paraná. The target group was composed by 75 members of a cooperative, rural producers of soybean and maize, who were informed about the research theme and its objective and verbally consented in participate, necessary ethical requirement for the realization of the consultation.

The research is of descriptive character and quantitative nature. It was used as instrument a semi structured formulary with questions of fact, questions with dichotomous alternatives and questions of multiple choice. The information in the instrument was organized in four parts: The first relative to

general data about the producer and the property; the second about the cultivation system, choice of seeds and defensives and technologies used. In the third part, it was aimed to list the insects which appear in the soil and aerial part of the maize and soybean crops and its importance for the crop through the vision of the producers. The fourth and last part was the approach on the knowledge of pests and natural enemies, for this, the producers were invited to observe entomological boxes (one for each crop) only insects in adulthood, conserved in the dry.

The obtained data were organized in the form of tables and analyzed through descriptive statistic.

## Results and Discussion

In this research, from a total of 75 rural producers, 35 cultivated soybean and 40 cultivated maize.

The soybean cultivation in Bandeirantes in properties with more than one hundred hectares corresponds to 18%, from fifty to one hundred ha to 20% and properties with until fifty ha to 62%. In the case of the maize the situation is similar, with 13% for properties larger than one hundred ha; 26% for areas of fifty to one hundred and 61% in properties of until fifty ha. The Paraná state is with its agricultural border practically exhausted, being that around 85% of the properties have below 50 hectares, burdening the unit cost of production and decreasing the competitiveness in face of the great properties of the country Midwest (CENSO AGROPECUÁRIO, 2006).

A contingent of 18% of the farmers produced up to 2,479 kg ha<sup>-1</sup> of soybean; 67% from 2,479 to 3,718 kg ha<sup>-1</sup> and 15% produce more than 3,718 kg ha<sup>-1</sup>.

The Paraná state, collected 0.37 million tons of soybean in 1970, with average yield of 1,210 kg ha<sup>-1</sup> in 2011 reached the record volume of 15.31 millions of tons, with an average yield of 3,417 kg ha<sup>-1</sup> (DEMARCHI, 2011b).

In the results of average yield of winter crops (off season), it is verified that there is variability, yet with a greater concentration at the range of 1,260 to 4,980 kg ha<sup>-1</sup>, which affects about 80% of the producers. Only 12% of the farmers presented yields superior to 4,980 kg ha<sup>-1</sup>. Now for the maize of 1<sup>st</sup> season (season) the yield between 4,980 to 6,180 kg ha<sup>-1</sup> was registered in 36% of the producers, while 29% obtained yields in the range of 3,720 to 4,980 kg ha<sup>-1</sup>.

The average age of the soybean farmers was 42 years, being that 44.4% went to elementary school, the

same percentage went to high school and only 11.11% have college education. As for the maize producers, the average is 53 years. A percentage of 41.18% of the farmers and to elementary school; 47.06% to high school and it is also low the percentage which completed the high school (11.76%).

The meetings for application of the formularies occurred in rainy days, when there is impossibility of activities in the crop and the producers gather at the cooperative where they exchange experiences.

When asked how they receive information about the soybean crop, being able to answer more than once, 77.14% of the participants referred to the labor on the field, followed by technical assistance (57.14%). The technical meetings, as well as the "talk" with other farmers were the answer in 25.71% of the cases. The courses and programs of television and radio appeared in 2.85% and 14.28% respectively, as a form of instruction.

The percentage of farmers who chose field day and technical assistance to improve their knowledge about the maize crop was 61.29%; the exchange of information with other farmers was 41.94%; courses 4.5% and radio programs 9.9%.

This study showed that the soybean and maize producers are unanimous regarding the choice

of the no tillage production. In the same way, all of them use seeds treated with insecticides and it is made triple washing and disposal of the packaging materials. In Paraná, during the period of 2008 to 2011, from the total of devolution of pesticide containers, 16,089,618 Kg are of triple washing and 1,872,945 Kg are contaminated packaging, this is due to the farmer recently adhere to educational campaigns, becoming an ecologically aware producer (OLIVEIRA, 2012).

The transgenic seed is preferred by 85% of the soybean producers, only 9% use conventional seeds and 6% have no defined preference.

It is also observed expressive levels of maize transgenic seeds (81%), only 10% sow conventional seeds, 6% did not answer and 3% are indifferent as for the choice.

One of the alternatives that aim to minimize the action of pests in order to avoid yield losses in maize crops, is the use of insecticides via seeds treatment. This practice is becoming widely used, because it allows the initial development of the crop and the maintenance of the aimed stand (BAUDET; PESKE, 2007). BIANCO (2007) points out that around 90% of the areas use treatment of maize seeds in the Paraná, aware of this, the respondents cultivate soybean and maize seeds treated with insecticides.

**Table 1.** Percentage of citations of soil and aerial part pests according to producers of soybean and maize in the municipality of Bandeirantes-PR.

Crops	Soil Pests	% of citations	Aerial Part Pests	% of citations <sup>1</sup>
Soybean	White grub	15	Defoliating caterpillars	47
	Anteater	8	Stink bugs	36
	Millipedes	8	Spider mites	7
	Pill bug	15	Anteater	4
	Corn borer	8	Torrãozinho*	5
	Black cutworm*	15	Southern corn rootworm	1
	Does not occur	31		
Maize (season)			Armyworm	60
	Corn borer	29	Earworm	10
	Black cutworm *	43	Mosca da espiga*	10
	White grub	14	Green stink bug	14
			Percevejo gaúcho*	20
Maize (off season)	Corn borer	17	Armyworm	55
	Black cutworm	31	Earworm	26
	Earworm	4	Brown stink bug	19
	Pill bug	7	Green stink bug	16
	White grub	14	Mosca da espiga*	3
	Does not occur	17		

<sup>1</sup>With base on the number of answered questions, from a total of 34 (soybean), 6 (maize in season) and 29 (maize in offseason) questionnaires.

\* Brazilian nomenclature for the insects.

GASSEN (2005) reports that in the no tillage planting with straw cover has occurred the population increase of unknown species in the agriculture. The no tillage, on other hand, favors high densities of invertebrate scavengers and predators, fundamental for nutrients cycling in the system and control of pests (KREMER; MILES, 2012).

Some authors refer to millipedes and gastropods causing damage to the soybean in no tillage system (MARTIN et al., 2009; SALVADORI; et al., 2007).

In a similar way, the interviewed reported that in soybean crops they found millipedes, snails, pill bugs and even spider mites, and many farmers take them as insects (Table 1). However, 31% of soybean farmers in the survey claimed that they did not observe occurrence of this organisms in the plants.

The corn borer and the black cutworm were cited by the farmers as soil pests with the greatest occurrence in Bandeirantes. To these two worms, it was added in importance the armyworm, according to observation of 80% of the producers in the Paraná state (BIANCO, 2007).

In soybean, as pests of leaves and pods, predominate the worms and stink bugs.

The brown and green stink bugs, typical pests of soybean, were also cited mainly in the off season maize, because they migrate from the soybean and attack the maize seedlings.

In soybean and maize, great part of the producers daily visit the crop (Table 2), and around 60% attribute to the insects losses smaller than 5%. They also report that many perform two pulverizations for worms in soybean and maize.

This tactic of management in maize compares to that described by WAQUIL (2005), where for the black cutworm it has been necessary two applications of insecticides, preferably selective, in crops where it is used seeds treated with carbamates.

It was also registered up to two pulverizations for stink bugs in soybean. An average of 4.5% of losses and 2.3 applications of insecticides for control of stink bugs has occurred in soybean crops in the North of Paraná, where the losses are greater and the control of pests is harder when compared to colder regions (COAMO, 2010).

When observed the insects in the entomological boxes, a greater number of soybean farmers recognized the Pentatomidae stink bugs (Table 3).

The *Nezara viridula* specie was the one which presented higher recognition rate. A group of 67.6% soybean producers recognized the acrosterno stink bug, however, due to the great diversity of this taxon in the American continent and the similarity of the general morphology between its species with the soybean green stink bug *Nezara viridula* (Linnaeus), it is possible that the part of the percentage attributed to this stink bug actually corresponds to the *N. viridula* (SCHWERTNER and GRAZIA, 2007).

The losses by stink bugs in soybean can reach 30% when the attack occur during the development of the pods, this result in the appearing of empty, malformed pods and which may become dry. If the attack occurs during the grains formation, there is the possibility of appearing deformations, wilting and stains. When the attack occurs in the already formed grains there is loss of seeds quality (BELORTE et al., 2003; DEGRANDE and VIVAN, 2010).

**Table 2.** Characterization of soybean and maize producers in the municipality of Bandeirantes-PR.

Variables	Soybean					Maize					
	daily	1*	2*	others	n.a1	daily	1*	2*	others	n.a	
Crop visitations	41%	20%	18%	12%	9%	45%	19%	19%	7%	10%	
Use level of control	yes		no			yes		no			n.a
	44%		32%			45%		29%			26%
Percentage of losses by the insects	<5%		10 to 20%			<5%		10 to 20%			others
	59%		32%			9%		58%			29%
Responsible for losses in the crop	caterpillars		stink bugs			others			caterpillars		stink bugs
	35%		49%			16%			71%		26%
Pulverizations (caterpillars)	Up to 2		>2			n.a		Up to 2		>2	
	42%		23%			35%		50%		26%	
Pulverizations (stink bugs)	Up to 2		>2			n.a		Up to 2		>2	
	50%		21%			29%		-		-	

**Table 3.** Species of insect pests and natural enemies recognized by farmers of soybean. Bandeirantes-PR.

Soybean pests	Number of informants	Recognition (%)
Chinavia spp.	23	67.6
Pantomorus sp.	5	14.7
Omiodes indicatus	8	23.53
Oebalus poecilus	10	29.41
Epicauta atomaria	6	17.65
Anticarsia gemmatalis	22	64.70
Atta sexdens rubropilosa	18	52.94
Lagria villosa	6	17.65
Liogenys spp.	5	14.7
Neomegalotomus parvus	4	11.76
Sternechus subsignatus	11	32.35
Nezara viridula	25	73.53
Megascelis sp.	3	8.82
Urbanus proteus	11	32.35
Leptoglossus zonatus	18	52.94
Dichelops melacanthus	11	32.35
Cerotoma arcuata	4	11.76
Maecolaspis sp.	9	26.47
Aracanthus mourei	17	50.00
Pseudoplusia includens	6	17.65
Euschistus heros	18	52.94
Diphaulaca sp.	3	8.82
Piezodorus guildini	7	20.58
Diabrotica speciosa	10	29.41
Edessa meditabunda	9	26.47
Proxys albopunctatus	6	17.65
<b>Natural enemies</b>		
Harmonia axyridis	10	29.41
Rasahus hamatus	4	11.76
Podisus nigrispinus	7	20.58
Chrisoperla externa	5	14.07
Calida scutellaris	3	8.82
Zelus sp.	9	26.47
Alchaeorhynchus grandis	8	23.53
Toxomerus floralis	6	17.65
Calossoma sp.	9	26.47
Geocoris sp.	4	11.76
Lebia concinna	3	8.82
Cycloneda sanguinea	11	32.35

Despite the diversity of stink bugs species which attack the soybean crops in Brazil, studies show that its damage can vary in function of the species, population level, used cultivar, plants development stage CORRÊA and FERREIRA, 2005; MC PHERSON et al., 2007; RIBEIRO et al., 2009; MUSSER et al., 2011), and that independent of these,

the producer must keep constant monitoring of the crop, paying attention to other species of insects which may cause damage to the crop and adopting methods of control when necessary.

The *Anticarsia gemmatalis* worm, in its adult stage, was recognized by 64.70% of the producers (Table 3). Noctuidae moths are not always

easily recognized. In the case of the *A. gemmatalis*, the coloration of the adults cannot be taken as identification characteristic, because it varies from gray to brown or yellow, assuming many tonalities. Probably the semicircular transversal line, which connects the tips of the first pair of wings and the fact that during daylight it has short and irregular flights, landing on the foliage or soil, can facilitate its recognition.

Three plagues presented the same percentage of recognition by the soybean farmers, the leafcutter ants, percevejo gaúcho<sup>3</sup> and stink bugs. The producers also cited the *Aracanthus mourei*, or torrãozinho<sup>1</sup>. In the municipality of Santa Maria, in the North of the Paraná, the *Aracanthus* sp. occurred in high populations during the season 1988/89, attacking the soybean seedlings and defoliating adult plants. Today, the *A. mourei* is recognized by half of the soybean producers of this research.

In the assessment of maize pests (Table 4), the same percentage of individuals recognized as important the green *Dichelops melacanthus* and the brown *Euschistus heros* stink bugs. From these, the *D. melacanthus* is a secondary plague to the soybean crop, and in the last years has become even more important in the maize crop, being that the greatest damages are verified when there is coincidence of high populations associated to dry periods. The problem of this plague worsens when the cultivation systems is based in the succession soybean/maize or soybean/wheat, because the insects feed of the soybean remains on the soil, and also the weeds, mainly the dayflower (*Commelina* spp.), in this way remaining in the periods of offseason.

According to CHOCOROSQUI and PANIZZI (2004), different practices of cultivations, mainly the no tillage and the sowing in alternative seasons (offseason), have resulted in important modifications in the dynamic of the agricultural pests, being that the insects previously considered of secondary importance are now the mains pests. Not for the losses, but for the appearance, the percevejo gaúcho was recognized by 75% of the participants.

The black cutworm, earworm and white grub were recognized by half of the maize producers. The black cutworm was pointed out by 29.03% of the interviewed, even being a small inconspicuous moth, the farmers already now the damage when these worms attack the maize seedlings.

<sup>1</sup> Brazilian nomenclature for the insect.

When consulted about the biological control, 71% of the soybean producers said that they never used it, 20% used and 9% did not answer. From the ones who used, 71% liked the result and for 29% the biological control was not efficient.

In the formularies of maize, 81% of the producers did not use biological control, 13% used and 6% did not answer. From the ones who used, 75% were favorable against 25% that associated the efficiency to the conditions of the year that it was used.

The first step in the sense of observing and assessing the insects considered natural enemies is the identification and recognition by the technicians and producers of the pests predators and parasitoids (WAQUIL, 2005). When the soybean producers were invited to observe the insects in the entomological boxes, few insects were named. The Lady bug *Cycloneda sanguinea* is the most recognized predator by the soybean producer (Table 3).

The low percentage of recognition of useful insects (Tables 3 and 4) shows the importance given to biological control, particularly in this case, to the predators. The occurrence of natural enemies can be increased by the use of conservationist systems of soil management (SILVA et al., 2009). In soybean, the no tillage has benefited the occurrence of the main parasitoids of eggs of *Nezara viridula* and *Piezodorus guildinii* stink bugs (MOREIRA and BECKER, 1986) and of the fungi which cause diseases in worms (SOSA-GÓMEZ and MOSCARDI, 1994). The references points as one of the most efficient predators of worms and eggs, the coleopterans *Callida scutellaris* and *Lebia concinna*, however, few farmers know these insects, maybe because the size of the same hinders its observation in the crop. It also seems to occur with the *Geocoris* stink bug, one of the most expressive control agents of eggs of apple worms in cotton, and of other worms. From the insects which were placed in the box, it is highlighted the *Toxomerus floralis* fly, which in the last years has occurred in high proportions during the summer in Bandeirantes.

Characteristics such as the size (*Alchaeorhynchus grandis*); smell (*Calossoma* sp.); macules on the body (*Harmonia axyridis*); and aggressiveness (*Zelus* sp.) assists the famers in memorizing the insects.

The *Harmonia axyridis* Lady bug appeared in the soybean crops in Bandeirantes in 2007, in high populations and displacing other coccinellid species. In the municipality of Santa Mariana it has been observed during the cold months of the year,

**Table 4.** Species of insect pests and natural enemies recognized by farmers of maize. Bandeirantes-PR.

Maize Pests	Number of informants	Recognition (%)
Conoderus scalaris	0	0
Dichelops melacanthus	27	87.10
Leptoglossus zonatus	23	74.19
Elasmopalpus lignosellus	9	29.03
Astylus variegatus	16	51.61
Helicoverpa zea	22	70.97
Spodoptera frugiperda	17	54.84
Euxesta eluta	4	12.90
Euschistus heros	27	87.10

  

Natural enemies		
Doru sp.	14	45.16
Chrisoerla externa	3	9.67
Apiomerus sp.	6	19.35
Zelus sp.	4	12.90
Lebia concinna	3	9.7
Hippodamia convergens	13	41.94
Orius sp.	1	3.22

forming large clumps and pestering people. The *H. axiridis* is an Asian specie, worldwide recognized for the control of aphids (MARTINS, 2009). In the United States, these Lady bugs invade houses and buildings in the look for shelter, lading in food and water, which may cause allergic reactions and symptoms such as rhinitis, conjunctivitis, chronic cough and asthma (NALEPA et al., 2004).

Great part of the farmers who cultivate maize recognize the *Doru* sp. earwig and the *Hippodamia convergens* Lady bug as useful insects and indispensable in the crop. Where the cultivations succeed during the whole year, the *Doru luteipes* has constant presence and in certain occasions the number of plants with at least one insect comes to more than 70%. This predator eats eggs and small worms of lepidopteran (PASINI et al., 2007; SORIA and DEGRANDE, 2011).

All the stink bugs of the Reduviidae family are predators, excepting the Triatominae (GROSSI., 2012).

It has been observed countless times in the

Bandeirantes maize crops the *Apiomerus* stink bug (Table 4), during the whole crop cycle, including in plants with dry ears.

By the fact of acting discreetly, many natural enemies are not noticed by the farmers, who fail to value the importance of these agents in the regulation of populations of pest insects. So that the use of predators insects in Brazil is incremented, there is the need that the research acts in a form that enables the selection of key species and the understanding of its ecology, aiming at the preservation or even mass production for release.

## Conclusion

In Bandeirantes, Paraná State - Brazil, the producers are adept of technological innovations for the crops management. They have the chemical insecticides and main form for control of pest insects. Few know the useful insects and its importance to the ecosystem balance.

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*Applied Research & Agrotecnology* v6 n3 sept/dec. (2013)

Print-ISSN 1983-6325 (On line) e-ISSN 1984-7548

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