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Carraro Formentini, Aline; Sosa-Gómez, Daniel Ricardo; Vieira de Paula-Moraes, Silvana;
Monteiro de Barros, Neiva; Specht, Alexandre
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CROP PROTECTION

Lepidoptera (Insecta) associated with soybean in Argentina, Brazil, Chile and Uruguay

Lepidópteros (Insecta) associados à cultura da soja na Argentina, Brasil, Chile e Uruguai

Aline Carraro Formentini[I] Daniel Ricardo Sosa-Gómez[II] Silvana Vieira de Paula-Moraes[III] Neiva Monteiro de Barros[I] Alexandre Specht[I*, III]

ABSTRACT

The present research updates the systematic position and nomenclature of Lepidoptera associated with soybean crops in Argentina, Brazil, Chile and Uruguay. Scientific literature lists 69 species of Lepidoptera feeding on soybean plants. These species are representatives of the Superfamilies ***Noctuoidea*** *(31),* ***Pyraloidea*** *(13),* ***Hesperioidea*** *(12),* ***Tortricoidea*** *(5),* ***Geometroidea*** *(5), and* ***Bombycoidea*** *(3). Diversity of Lepidoptera associated to crop, injury in different parts of the plant, and changes in species composition are discussed considering the changes in plant disease management, introduction of plants expressing Bt proteins, and the recent introduction of* ***Helicoverpa armigera*** *(Hübner) as a new crop pest.*

Key words: *caterpillars, inventory, taxonomy, systematic, lepidopterous pests*.

RESUMO

O presente estudo atualiza a posição sistemática e a nomenclatura dos lepidópteros associados com a cultura da soja na Argentina, Brasil, Chile e Uruguai. A literatura científica relaciona 69 espécies de Lepidoptera cujas larvas se alimentam de soja. As espécies incluem representantes das Superfamílias ***Noctuoidea*** *(31),* ***Pyraloidea*** *(13),* ***Hesperioidea*** *(12),* ***Tortricoidea*** *(5),* ***Geometroidea*** *(5), and* ***Bombycoidea*** *(3). A diversidade dos lepidópteros associados com a cultura, as injúrias em diferentes partes da planta e alterações na composição das espécies são discutidas considerando mudanças no manejo de doenças da cultura, a introdução de plantas expressando proteínas Bt e a recente introdução de* ***Helicoverpa armigera*** *(Hübner) como uma nova praga da soja.*

Palavras-chave: *lagartas, inventário, taxonomia, sistemática, lepidópteros-praga.*

INTRODUCTION

Soybean is originated on the Asian coast, expanding first to Europe and later to the Americas. In Brazilian soils, the first crop was harvested in São Paulo in 1892 and produced only a few pounds of seed (EMBRAPA, 2004). In the 2013/2014 crop season, the largest production of soybean was in United States, with approximately 107 million tons (O'BRIEN 2014), Brazil with approximately 90 million tons (CONAB 2014), and Argentina with 56 million tons (INTA 2014).

Although soybean is an exotic plant, the crop has been established in different locations and increasing areas. Many arthropods species in the American continent gradually adapted to the crop, sometimes causing injury or becoming pests. These included Lepidoptera, such as ***Anticarsia gemmatalis*** Hübner, ***Chrysodeixis includens*** (Walker), ***Spodoptera cosmioides*** (Walker), and ***Spodoptera frugiperda*** (J.E. Smith) (MOSCARDI et al., 2012).

Several Lepidoptera associated with soybean crops have been reported in Brazil (e.g. SILVA et al., 1968; LINK & TARRAGÓ,1974; BERTELS,1975; CORRÊA & SMITH,1976; LOURENÇÃO et al.,1980) and in other countries in South America, including Argentina (PASTRANA, 2004), Uruguay (BIEZANKO et al., 1974; BENTANCOURT & SCATONI, 2006) and Chile (ANGULO et al., 2008). The accurate identification of the species is extremely important for proper management and

[I]Programa de Pós-graduação em Biotecnologia, Universidade de Caxias do Sul (USC), CP 1352, 95070-560, Caxias do Sul, RS, Brasil. E-mail: alexandre.specht@embrapa.br. *Corresponding author.
[II]Embrapa Soja, Londrina, PR, Brasil.
[III]Embrapa Cerrados, Planaltina, DF, Brasil.

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to avoid economic losses (SOSA-GOMEZ et al., 2014). However, several aspects have affected the appropriate management of this group of pests: 1) changes in systematic positions and nomenclature (LAFONTAINE & SCHMIDT, 2010); 2) changes detected in specific compositions of lepidopteran communities associated with soybean (GUEDES et al., 2010; SOSA-GÓMEZ et al., 2010; MOSCARDI et al., 2012); and 3) recent detection of ***Helicoverpa armigera*** (Hübner), which has economy impact in this crop (CZEPAK et al., 2013; EMBRAPA, 2013; SPECHT et al., 2013). This research is a review of reports of lepidoptera whose larvae were collected feeding on the soybean crop in Argentina, Brazil, Chile and Uruguay and also updates the systematic position and nomenclature of this taxonomic group. It is also discussed recent changes in species composition and abundance of the primary Lepidoptera associated with the crop, the changes in the management of soybean diseases, and the introduction of ***H. armigera*** (Hübner) as a new crop pest.

DEVELOPMENT

Lepidoptera associated with soybean crop.

The bibliographic records indicate the occurrence of at least 69 species of Lepidoptera representatives of ***Tortricoidea***, ***Pyraloidea*** (Table 1), ***Bombycoidea***, ***Hesperioidea***, ***Geometroidea*** (Table 2), and ***Noctuoidea*** (Table 3), whose larvae have been found feeding on soybean. The most species (44.9%) belong to ***Noctuoidea***, followed by ***Pyraloidea*** (18.8%), ***Hesperioidea*** (17.4%), ***Tortricoidea*** (7.3%), ***Geometroidea*** (7.3%), and ***Bombycoidea*** (4.3%).

Despite the relative diversity of species, only a small number of studies have been devoted to identifying insects, including Lepidoptera at a species level (e.g. BIEZANKO et al., 1974; LINK & TARRAGÓ, 1974; CORREIA & SMITH, 1976). Generally, publications list ***A. gemmatalis***, or the representatives of complexes ***Plusiinae Spodoptera***, without species-level identification (e.g. MORAES et al., 1991; CIVIDANES & YAMAMOTO, 2002).

Given the importance of identification for effective control of insects, many publications including identification manuals and other publications on insects associated with soybean have been published (SOSA-GÓMEZ et al., 2014; HOFFMANN-CAMPO et al., 2012). The lack of information about the diversity of insects indicates that association has not been made between diversity of insects and the "stability of agroecosystems". In addition, there is little information about the influences of regional physiography, temporal variations, and crop rotations (e.g. ALTIERI et al., 2005).

Usually, species-level identification is still done based exclusively on the morphology of adults (e.g. POGUE, 2002). The adult identification requires to rearing immature insects, which requires extensive resources, especially skilled labor. In addition, natural enemies and entomopathogens may affect the development and survival of immature insects making difficult to obtain adults. Alternatively, some studies has focused in species-level identification based on morphology of eggs, larvae, and pupae (e.g. PASSOA, 1991; POGUE, 2002; ANGULO et al., 2008; GOMEZ-ROLIM et al., 2013). Another tool is the use of molecular markers (GOMEZ-ROLIM et al., 2013). In all options, the literature describing morphological or molecular characterization of lepidopterons associated to soybean does not include all species. These deficiencies are evident in all countries, especially in South America, which has biological mega-diversity (e.g. MARQUES & LAMAS, 2006).

Over 80% of the species whose larvae have been reported feeding on soybean were recorded by the end of the 1970 decade (Tables 1-3), based on field collections and species-level identification (e.g. A.O. Angulo – Universidad de Concepción - Chile; A.M. Bertels - Embrapa Clima Temperado; C.M. Biezanko – Universidade Federal de Pelotas; D. Link – Universidade Federal de Santa Maria – Brasil and Pastrana in Argentina). These researchers have maintained entomological collections in their institutions which play an important role for several crops or for general entomology. Considering the great number of species reported in the early publications, the question remains if the diversity of Lepidoptera have decreased due to management, crop extensions, and insecticide pressure (e.g. ALTIERI et al., 2005), or is a problem of lack of studies focused on species-level identification (e.g. MARQUES & LAMAS, 2006).

Anyway, the lack of taxonomists was directly related to the delay in the report of ***H. armigera*** in Brazil, which has affected high value crops such as cotton and soybean (CZEPAK et al., 2013; EMBRAPA 2013; SPECHT et al., 2013). This indicates the vulnerability of Brazil and other countries in South America concerning the change of the status of native arthropod species, due to climate change, the invasion risk of quarantine pests, management, and the introduction of new crops or cultivars.

Feeding behavior

Traditionally, the insects associated with major crops, such as soybean, are grouped according to their feeding behavior. This classification allows damage estimates, appropriate sampling methods, and even

Table 1 - Lepidoptera representatives of ***Tortricoidea*** and ***Pyraloidea*** associated with soybean and their respective feeding behavior.

Higher taxa / species	Habits	References
Tortricoidea*[A] – *Tortricidae*: *Tortricinae		
1. ***Argyrotaenia fletcheriella*** (Koehler, 1939)	Polyphagous - leafroller	3
2. ***Argyrotaenia loxonephes*** (Meyrich, 1937)	Polyphagous - leafroller	3
Tortricidae*: *Olethreutinae		
3. ***Cydia fabivora*** (Meyrich, 1928) [Sin. ***Laspeyresia leguminis*** (Heinrich, 1943)]	***Fabaceae**** - borer.	1
4. ***Crocidosema aporema*** (Walsingham, 1914)	***Fabaceae****- borer	1
5. ***Strepsicrates smithiana*** (Walsingham, 1891)	Polyphagous - borer.	2
Pyraloidea*[A]- *Pyralidae*: *Pyralinae		
6. ***Dolichomia olinalis*** (Guenée, 1854) [Sin. ***Herculia infimbrialis*** Dyar, 1910)]	Oligophagous - leafroller	2
7. ***Dolichomia resectalis*** (Lederer, 1863)	Oligophagous - leafroller	2
8. ***Hypsopygia costalis*** (Fabricius, 1775)	Oligophagous - leafroller	2
Pyralidae*: *Epipaschiinae		
9. ***Pococera vandella*** Dyar, 1914	***Fabaceae*** - leafroller	2
Pyralidae*: *Phycitinae		
10. ***Elasmopalpus lignosellus*** (Zeller, 1848)	Polyphagous - subterranean, stems	2
11. ***Etiella zinckenella*** (Treitschke, 1832)	Oligophagous - borer	1
Crambidae*: *Glaphyriinae		
12. ***Helulla phidilealis*** (Walker, 1859)	Oligophagous - borer	3
Crambidae*: *Pyraustinae		
13. ***Achyra bifidalis*** (Fabricius, 1794)	Polyphagous -leafroller	3
14. ***Achyra similalis*** (Gueneé, 1854)	Polyphagous - leafroller	3
15. ***Maruca vitrata*** (Fabricius, 1787) [Sin.: ***Maruca testulalis*** (Geyer, 1832)]	Oligophagous – borer	2
16. ***Omiodes indicata*** (Fabricius, 1775)	***Fabaceae**** - leafroller	1
17. ***Salbia haemorrhoidalis*** Guenée 1854	Oligophagous - leafroller	2
18. ***Samea ecclesialis*** Gueneé, 1854	Polyphagous - leafroller	3

Current systematic: A - HEPPNER (1995); References: 1- SILVA et al. (1968); 2- BIEZANKO et al. (1974); 3- PASTRANA (2004); *Principally.

preliminary identification (HOFFMANN-CAMPO et al., 2012). Records of Lepidoptera, whose larvae were collected in soybean in South America, indicated that more than half of the species can be considered polyphagous (52.2%); more than a quarter feed mainly on ***Fabaceae*** (27.5%), one quarter mainly feed on ***Gramineae*** (5.8%), and the other species feed on plants belonging to a few families, including ***Fabaceae*** or specifically soybean (14.5%) (Tables 1 to 3).

Regarding feeding behavior, the larvae of most species (83.8%) feed on foliage (including leaf eater, leafrollers, and pod eaters). Nearly half of these species (48.5%) prefer to eat the leaves directly; a quarter (25.0%) feed on foliage, but their larvae are also “leafrollers”, joining the edges of the leaves with silk threads to build a shelter; 10.3% of the species that injury the foliage also consume the pods; six species are essentially borers (8.8%); while only five (7.4%) act as cutworms (Tables 1 to 3).

Different methods are demanded to efficiently sample caterpillars that act as leaf eater, leafrollers, borers, pod eater and cutworms. Because of this, it is convenient to consider the specific abundance of species with different feeding habits. This information directly affects the method of the sampling and the validation of the results (CORREA-FERREIRA, 2012).

Leaf eater caterpillars are the largest number of species and are often more abundant, but it has been registered the host plant compensation for their injuries, especially in the vegetative stage (CORREA-FERREIRA, 2012). However, it is important to take in consideration the importance of the identification of the caterpillar due the different capacity for leaf consumption of different species (BEACH & TODD, 1988; NAVA & PARRA, 2002; FRANCO et al., 2014), their reproductive potential (MONTEZANO et al., 2013), and the spatial distribution of the different species in the host plant (PANSERA DE ARAÚJO et al., 1999).

The leafroller caterpillars, in early development, scrape the leaf parenchyma, making a net in the leaflets, which dry out. In other developmental stages, especially in the end of larval stage, the

Table 2 - Lepidoptera representatives of ***Bombycoidea*** and ***Hesperioidea*** associated with soybean and their respective feeding behavior.

Higher taxa / species	Habits	References
Bombycoidea[A] **– Saturniidae**: **Hemileucinae**		
1. ***Automeris illustris*** (Walker, 1855)	Polyphagous - leaf eater	4
2. ***Hyperchiria incisa*** Walker, 1855	Polyphagous - leaf eater	2
3. ***Leucanella memusae*** (Walker, 1855)	Polyphagous - leaf eater	4
Hesperioidea[B]**– Pieridae**: **Coliadinae**		
4. ***Colias lesbia*** (Fabricius, 1775)	***Fabaceae*** - leaf eater	1
5. ***Eurema albula*** (Cramer, 1775)	***Fabaceae*** - leaf eater	2
6. ***Eurema deva*** (Doublday, 1847)	***Fabaceae*** - leaf eater	1
7. ***Eurema elathea elathea*** (Cramer, 1777)	***Fabaceae*** - leaf eater	2
8. ***Eurema elathea plataea*** (Felder, 1862)	***Fabaceae*** - leaf eater	1
9. ***Eurema elathea flavescens*** (Chavannes, 1850)	***Fabaceae*** - leaf eater	8
Hesperioidea[C]**– Hesperiidae**: **Pyrginae**		
10. ***Chioides catillus catillus*** (Cramer, 1779)	Oligophagous - leaf eater	1
11. ***Epargyreus exadeus exadeus*** (Cramer, 1779)	***Fabaceae*** - leaf eater	2
12. ***Urbanus proteus proteus*** (Linnaeus, 1758)	***Fabaceae*** - leaf eater	1
13. ***Urbanus simplicius*** (Stoll, 1790)	Oligophagous - leaf eater	2
14. ***Urbanus teleus*** (Hübner, 1821)	***Fabaceae*** - leaf eater	2
15. ***Urbanus zagorus*** (Plötz, 1880)	***Fabaceae*** - leaf eater	3
Geometroidea[D] **– Geometridae**: **Ennominae**		
16. ***Macaria abydata*** Guenée, [1858]	***Fabaceae*** - leaf eater	6
17. ***Macaria regulata*** (Fabricius, 1775)	Oligophagous - leaf eater	5
18. ***Oxydia nimbata*** Guenée, [1857]	Polyphagous - leaf eater	5
19. ***Physocleora dimidiaria*** (Guenée; 1852)	Polyphagous - leaf eater	9
20. ***Stenalcidia vacillaria*** (Guenée, [1858])	Polyphagous - leaf eater	7

Current systematic: A- HEPPNER (1996), LEMAIRE (2002); B- LAMAS (2004), BRABY et al. (2006); C- MIELKE (2005); D- SCOBLE (1999). References: 1- SILVA et al. (1968); 2- BIEZANKO et al. (1974); 3- LINK & TARRAGÓ (1974); 4- BERTELS (1975); 5- CORRÊA & SMITH (1976); 6- LOURENÇÃO et al. (1980); 7- PANIZZI & FERREIRA (1980); 8- PASTRANA (2004); 9- FORMENTINI (2009).

caterpillars interweave multiple leaves, forming a mass, which is partially consumed. In addition to reducing the photosynthetic tissue by depriving the leaves of sunlight, intense leaf feeding can consume the entire vegetal tissue, leaving only the veins. In addition, due to the behavior of rolling and joining multiple leaves, the caterpillars keep protected from insecticide sprays, making chemical control less effective (MOSCARDI et al., 2012).

The phyllophagous caterpillars of several species may also feed on pods. However, species such as representatives of ***Helicoverpa***, ***Heliothis***, and ***Spodoptera*** frequently consume soybean pods (PANIZZI et al. 2012). Although they represent only just over 10% of the species, these caterpillars have an economic impact on the crop. They directly affect productivity, and the plant cannot replace the lost pods. In addition, by staying at the bottom of the plant, they are less noticeable and sheltered, and thus again, less vulnerable to insecticide sprays.

Although the borer species represent only 9.1% (Tables 1-3), their injury to the stems, flower buds, and pods cause economic impact since compromise the plant growth, This leads to the abortion of flowers and also favors plant pathogen colonization. In addition, they consume or damage the grains (PANIZZI et al., 2012).

Caterpillars of Noctuini Tribu, represented especially by ***Agrotis*** and ***Peridroma*** with cryptic species, have polyphagous habits and are cutting species. (BAUDINO & VILLARREAL, 2007). Probably more species of cutworms than those reported in table 3 are responsible for damaging the early crops by reducing the plant stand.

Different temporal and spatial changes in species composition.

As previously described, most studies devoted to identify the entomofauna associated with soybean crops were done before 1980. That is when most soybean was cultivated in southern Brazil and Argentina, in a cropping system which was rotated with winter wheat and summer soybean crops. Since

Table 3 - Lepidoptera representatives of ***Noctuoidea*** associated with soybean and their respective feeding behavior.

Higher taxa / species	Habits	References
------***Noctuoidea***[F] – ***Erebidae***: ***Arctiinae***------		
1. ***Paracles cajetani*** (Rothschild, 1910)	Polyphagous - leaf eater	4
2. ***Paracles vulpina*** (Hübner, [1825])	Polyphagous - leaf eater	6
3. ***Spilosoma virginica*** (Fabricius, 1798)	Polyphagous - leaf eater	6
------***Erebidae***: ***Eulepidotinae***------		
4. ***Anticarsia irrorata*** Fabricius, 1781	***Fabaceae*** - leaf eater	6
5. ***Anticarsia gemmatalis*** Hübner, 1818	***Fabaceae*** - leaf eater	1
------***Erebidae***: ***Erebinae***------		
6. ***Mocis latipes*** Guenée, 1852	***Gramineae**** - leaf eater	1
------***Erebidae***: ***Herminiinae***------		
7. ***Phalaenophana eudorealis*** (Guenée, 1854)	Oligophagous - leaf eater	4
8. ***Rejectaria pharusalis*** (Walker, [1859]	Polyphagous - leaf eater	4
------***Noctuidae***: ***Condicinae***------		
9. ***Condica mobilis*** (Walker, [1857]) [Sic.: ***Condica sutor*** (Guenée, 1852)]	Polyphagous - leaf eater	8
------***Noctuidae***: ***Plusiinae***------		
10. ***Autoplusia egena*** (Guenée, 1852)	Polyphagous - leaf eater	2
11. ***Ctenoplusia oxygramma*** (Geyer, 1832)	Polyphagous - leaf eater	2
12. ***Enigmogramma admonens*** (Walker, [1858])	Soybean - leaf eater	3
13. ***Chrysodeixis includens*** (Walker, [1858]) [Sin. ***Plusia oo*** (Stoll, 1782)]	Polyphagous - leaf eater	2
14. ***Trichoplusia ni*** Hübner, [1803]	Polyphagous - leaf eater	4
15. ***Rachiplusia nu*** Guenee, 1852	Polyphagous - leaf eater	1
------***Noctuidade***: ***Heliothinae***------		
16. ***Helicoverpa armigera*** (Hübner, 1809)	Polyphagous - leaf eater, pod eater	9
17. ***Helicoverpa gelotopoeon*** (Dyar, 1921)	Polyphagous - leaf eater, pod eater	6
18 ***Helicoverpa zea*** (Boddie, 1850)	Polyphagous - leaf eater, pod eater	2
19. ***Heliothis virescens*** (Fabricius, 1777)	Polyphagous - leaf eater, pod eater	6
------***Noctuidae***: ***Noctuinae***------		
20. ***Agrotis gypaetina*** Guenée, 1852	Polyphagous - cutworm	7
21. ***Agrotis ipsilon*** (Hufnagel, 1766)	Polyphagous - cutworm	4
22. ***Agrotis malefida*** Guenée, 1852	Polyphagous - cutworm	6
23. ***Dargida meridionalis*** (Hampson, 1905)	***Gramineae**** - leaf eater	4
24. ***Elaphria agrotina*** (Gueneé, 1852)	Polyphagous - leaf eater	2
25. ***Mythimna adultera*** (Schaus, 1894)	***Gramineae**** - leaf eater	2
26. ***Mythimna sequax*** (Franclemont, 1951)	***Gramineae**** - leaf eater	1
27. ***Peridroma saucia*** (Hübner, 1808)	Polyphagous - cutworm	8
28. ***Spodoptera albula*** (Walker, 1857b)	Polyphagous - leaf eater	5
29. ***Spodoptera cosmioides*** (Walker, 1858) [Sic.: ***Spodoptera latifascia*** (Walker, 1856)	Polyphagous - leaf eater, pod eater	4
30. ***Spodoptera eridania*** (Stoll, 1782)	Polyphagous - leaf eater, pod eater	3
31. ***Spodoptera frugiperda*** (J.E. Smith, 1797)	Polyphagous - leaf eater, pod eater	1

Current systematic: A- LAFONTAINE & SCHMIDT (2010). References: 1- SILVA et al. (1968); 2- BIEZANKO et al. (1974); 3- LINK & TARRAGÓ (1974); 4- BERTELS (1975); 5- POGUE (2002); 6- PASTRANA (2004); 7- BENTANCOURT & SCATONI (2006); 8- FORMENTINI (2009); 9- EMBRAPA (2013). *Principally.

1980, soybean has spread to the warmer regions of both countries and also Paraguay, increasing significantly the production areas, in a cropping system with rotation with other crops, such as cotton and corn. This expansion and intensification of soybean production, rotated with other major annual crops, certainly influenced the specific composition of associated species (EMBRAPA, 2004). Another aspect that may influence the potential of different species to establish is the architecture of the plant and plant spacing, which has led to a reduction in branching and concentration of the pods on the main stem (MAUAD et al., 2010).

In addition, different events demand the modification of established management systems for crops in large areas in Brazil due to the changing species composition of the entomofauna and the dynamics of the main noctuids associated with these crops. The introduction of Asian soybean rust caused by the fungus ***Phakopsora pachyrhizi*** Syd. & P. Syd., in the 2001/02 harvest (YORINORI et al., 2005), required preventive and intensive use of fungicides in the crop. This reduced the natural occurrence of the entomopathogenic fungus ***Metarhizium rileyi*** (Farlow) Kepler, Rehner & Humber, which consequently affect the natural biological control and changed the noctuids species composition (MOSCARDI et al., 2012).

The latest generation of pest control employs genes expressing proteins in plant species from the bacterium ***Bacillus thuringiensis*** (Berliner) [Bt]. For caterpillar control, this technology has been widely adopted in Brazil in corn and cotton, with recent adoption (2013/14 crop) in soybean. The reduction in insecticide applications, which consequently could favor natural biological pest control, has been listed as one of the benefits of plants expressing the Bt toxin (HELLMICH et al., 2008). In the US, it has been documented the reduction of the pest ***Ostrinia nubilalis*** (Hübner) in corn and consequently the economic benefits of introducing Bt plants (HUTCHISON et al., 2010). On the other hand, the change in the status of secondary pests may represent a problem. The survival of secondary pest species may increase, due to decreasing and even elimination of chemical control in the agroecossystem, which can be aggravated by eliminating competition existed prior to the control of key pests by Bt. This considerations highlight the importance of the knowledge of all species present in the soybean agroecosystem in a new scenario of Bt technology. Another factor to be considered in the adoption of Bt technology is the risk of the development of resistance in populations of target pests (e.g. TABASHNIK, 2013; FARIAS et al., 2014). The Bt toxin is expressed in high dose in the plant, with high exposure and high persistence during the whole crop cycle. These aspects are considered advantages of the technology. However, they also represent a selection pressure for some target caterpillars to survive to the Bt technology. As a result, there is a risk of establishing resistance in future generations of populations of some species, in which the toxin can lose the desired control. Insect resistance management (IRM) measures are required in order to deal with this risk of resistance.

The recent detection of ***H. armigera*** (CZEPAK et al., 2013; EMBRAPA 2013; SPECHT et al., 2013), previously not reported in the American continent become another important aspect for agriculture in Brazil. ***H. armigera*** is reported to feed in more than 300 native and cultivated host plants (LIU et al., 2004). Many of these plants are used to produce food, fiber, and oils in Brazil. In addition, the caterpillars prefer the reproductive parts of the plants, but also injury the vegetative structures with a high capacity of economic impact (ZALUCKI et al., 1986).

CONCLUSION

There are at least 69 representatives of Lepidoptera, whose larvae have already been reported, that feed on soybean in Argentina, Brazil, Chile, and Uruguay. Most species belong to Noctuoidea and are leaf eaters and polyphagous caterpillars.

Most studies on soybean do not present a species-level identification, due to the lack of publications on morphology and taxonomy of Lepidoptera, especially related to immature morphology description.

In addition to the species-level identification, it is necessary to preserve vouchers specimens which document researches and can also indicate temporal and spatial variations of the species composition. This is particularly relevant in cases of the introduction of exotic species or other changes in the agroecosystem.

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