



ENTOMOLOGICAL OBSERVATIONS ON COVER CROPS IN COTTON CROPPING SYSTEMS IN MATO GROSSO STATE: FIRST RESULTS (*)

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ABSTRACT - Using the cropping system experimental set-up laid out at Fazenda Mourão (Campo Verde-Mato Grosso), from 2003 onwards we made observations of the various cover plants in order to gain knowledge of the entomofauna present. The qualitative data collected using the visual observations and sweep net methods are presented here. The risks run have sometimes been described when cover was left after the normal drying period. All the Poaceae allowed the development of *Spodoptera frugiperda*. It seems important to measure the impact of this polyphagous pest on various plant species. The technique using a 1 m square in wood is recommended in trials on sowing dates or plant combinations. When *Cajanus cajan* is left in the field until fruiting, it forms an excellent food for *Heliothis virescens*. *Spodoptera cosmioides* can feed on *Crotalaria* and *Amaranthus*, as was observed in 2005. An advantage of the use of *Eleusine coracana* is the development of very large populations of parasites of aphids, probably *Lysiphebus testaceipes*, that also parasitise *Aphis gossypii*. In the case of millet, a parasite of *Spodoptera frugiperda* developed on the heads left in the field. Mycosis of insects (*Lagria villosa*, caterpillars) were only observed in live cover consisting of *Arachis pintoi*.

Key words: cropping systems, cover crops, entomofauna

AValiação Entomológica das Plantas de Cobertura nos Sistemas de Cultivo Algodoeiro no Estado de Mato Grosso: Primeiros Resultados

RESUMO - No dispositivo experimental da Fazenda Mourão (Campo Verde-MT), observou-se na safra de 2003/2004, as diferentes coberturas, a fim de conhecer a entomofauna presente. Os dados qualitativos obtidos com as metodologias das observações visuais e rede estão sendo apresentados neste resumo. Às vezes, os riscos fitossanitários foram caracterizados quando as coberturas foram deixadas após o período normal da dessecação. Todas as Gramíneas permitiram o desenvolvimento de *Spodoptera frugiperda*. Para esta praga polífaga, é importante medir o impacto das diversas espécies de plantas. A técnica do quadro de madeira 1 m x 1m esta sendo preconizada em ensaios de datas de plantio, ou de consórcios de plantas. Quando *Cajanus cajan* foi deixado no campo até a frutificação, este foi um excelente suporte alimentar para o *Heliothis virescens*. *Spodoptera cosmioides*, pode se alimentar das folhas de *Crotalaria* e *Amaranthus* como observado em 2005. Uma vantagem ligada ao uso da *Eleusine coracana* é o desenvolvimento de populações muito elevadas dos parasitoides de pulgões, provavelmente *Lysiphebus testaceipes*, também parasitoides de *Aphis gossypii*. No caso do milheto, um parasitóide de *Spodoptera frugiperda* se desenvolveu nas espigas deixadas no campo. Somente a cobertura viva de *Arachis pintoi* permitiu observar micoses frequentes nos insetos presentes (*Lagria villosa*, lagartas).

Palavras-chave: sistemas de cultivo, coberturas, entomofauna.



INTRODUCTION

The impact of cover crops, in particular on cotton pests or their natural enemies, has been the subject of several studies around the world (REEVES, 1994; MCCUTCHEON *et al.*, 1995; TILLMAN *et al.*, 2004). The information available in Brazil is from studies generally conducted in agrosystems that do not include cotton, with observation of crop pests or soil fauna. Several comparisons have been made between conventional and direct sowing methods (CIVIDANES and BARBOSA, 2001; CIVIDANES, 2002; CIVIDANES and YAMAMOTO, 2002; BASTOS *et al.*, 2003; PICANÇO *et al.*, 2004).

Entomological observations were started in 2003 at Fazenda Mourão, 30 km from Campo Verde (Mato Grosso State) in order to perform a qualitative analysis of the phytosanitary risks related to the cover crops used in the rotations. They were aimed at describing the entomofauna in cover crops, the insects present, pests and natural enemies such as entomopathogenic fungi and at appraising their advantage from the entomological point of view.

MATERIAL AND METHODS

The matrix layout serving as the basis for observations was set out in 2001. It covers an area of some 10 ha along BR Campo Verde-Primavera do Leste, opposite the entry to Fazenda Mourão I. It consists of plots 20 to 40 m wide depending on the position and 100 m long to allow mechanised farming representative of that practised in the region. The long sides of the plots are parallel with each other and run north-south. Further plots referenced from A to D were defined within this layout in order to use the irregularities in the land initially observed. They were cultivated using mulch-based direct sowing only and therefore planted with cover crops that were also observed.

The layout consists of two groups of 14 plots. Each group received different fertilisation; the 'model' fertilisation (western part) used on the fazenda and half of this on the group in the lower (eastern) part.

Six (6) cropping systems were compared, with 2 control systems (T1: a 'conventional' system with disc cultivation and T2, a 'semi-direct' system with cover consisting of millet, *Pennisetum glaucum*) and 4 systems with 'true' direct sowing (S1 to S4, see Table 1). The control plots T1 and T2 were sited at the extremities of each part but also in the inner part of the layout. Two neighbouring plots were defined for the systems, with a two-year rotation to be able to have plots of cotton each year. The sequence is as follows from west to east for the strongly fertilised part: A, B, T1, T2, S1 (two plots), C, S2 (two plots), T1, T2, S3 (two plots) and S4 (two plots), D, T1, T2. The set of plots to which a half dose of fertiliser is applied laid out in the same order, without the supplementary plots. One extra plot, noted E, was installed at the end of the layout for study of the effect of cover crops on nematodes from 2004 onwards. It was used for strips of the main crops in 2003 and not sprayed in the last 20 metres in order to observe the pests present. In the same year, plot E was separated from the rest of the layout by a strip of *Crotalaria juncea*, a species with a tall habit.

The rotations conducted and the cover crops used—alone or in combinations—in the cropping systems compared (S1 to S4) are shown in detail in Table 1. The millet (*Pennisetum glaucum*) used in system T2 and the plants in the 4 other systems were observed regularly according to the state of vegetative growth.

The visual observations were completed by sampling and the rearing of the larval stages of Lepidoptera. Noyes' triangular sweep net was used with 2 x 50 sweeps per plot when permitted by the vegetative development of the plants. The entomofauna was also observed during the 2003 inter-



season and then in 2004 by systematic sweeping. The use of a 1-m square wooden frame was started at the end of 2004 to measure the number of *Spodoptera frugiperda* larvae and chrysalides in cover consisting of *Brachiaria ruziziensis*, *Pennisetum* and other Poaceae, but the operation had to be stopped in November 2004.

The insects were killed with ethyl acetate and then preserved dry on small pharmaceutical cotton pads in flat boxes or on a layer of cotton wool; the most delicate were preserved in alcohol 70°. Insects that had died as a result of mycosis were preserved dry in small Petri dishes placed in a refrigerator.

The taxonomic study of the numerous specimens collected required work by a long list of specialists on the various insect or spider families. We are grateful for their contribution.

RESULTS AND DISCUSSION

Rice growth problems were observed in the first two seasons and the crop was replaced by maize in 2005. Unforeseen nematode problems affected the soybean and cotton crops.

Table 1. Rotations applied in the various cropping systems

Year 1	Year 2
S1: <i>Eleusine coracana</i> + cotton /	/ Soybean + <i>E. coracana</i> /...
S2: Short cycle soybean + “safrinha” (late sown) cotton /	/ Short cycle rice + <i>E. coracana</i> /...
S3: <i>Brachiaria ruziziensis</i> + cotton /	/Soybean + <i>B. ruziziensis</i> /...
S4: <i>B. ruziziensis</i> + “safrinha” cotton /	/ Short cycle soybean + (sorghum + <i>B. ruziziensis</i>)/...

The entomofauna of the upper part of the soil was captured during the second quarter of 2003 using pitfalls traps with water. The taxonomic study is in progress and only the results for the aerial parts of plants are presented below.

The entomological advantages and disadvantages of each cover plant (or plant combination) are summarised in Table 2. Each year has different features and it is always necessary to remember the limits of each observation method used.

The observation of pathogens in one year does not mean that they will be present in the following year. When the cover crop goes beyond the normal stage at which it should have withered, certain phenomena are observed such as the presence of *Heliothis virescens* caterpillars on *Cajanus cajan* pods or parasites of caterpillars (probably of *S. frugiperda*) on ears of millet. The Hemiptera Cicadomorpha group (Cercopidae and Cicadellidae families) is strongly represented on Poaceae with a low habit. However, in this group only the species *Agallia albidula* is reported to be a cotton pest. *Eleusine coracana* harbours aphids strongly parasitised by a member of the Braconidae family (Hymenoptera) and identified as a *Lysiphlebus*, that may be the parasite species of *Aphis gossypii*. The latter aphid is indeed strongly parasitised in May and June, especially on *safrinha* (late sown) cotton. But this strong presence does not prevent attacks of young cotton plants by aphids at the beginning of the next season.

The absence of insects feeding on dried mulch logically results in the absence of pathogens. We did not observe markedly more caterpillars killed by mycosis in the direct sowing plots. This is in agreement with the observations by Sosa-Gomez *et al.* (2001) who observed greater presence of fungi



at the soil level in soybean grown with mulch-based direct sowing but no difference in the entomopathogens observed in the aerial parts of the plants. The only plant that appears to be interesting is *Arachis pintoi*, that in 2004 harboured several insects affected by fungi and especially the caterpillars, larvae and adults of the beetle *Lagria villosa* (DE OLIVEIRA *et al.*, 2004).

Table 2. The entomological (and sometimes agronomic) advantages and disadvantages observed for cotton growing related to the cover crops used.

Type of cover	Advantages	Disadvantages
<i>Eleusine coracana</i>	Harbours aphids parasitised by <i>Lysiphlebus</i> .	Presence of <i>S. frugiperda</i> and bugs (<i>Creontiades purgatus</i>)
<i>Cajanus cajan</i>	The fauna generally differs from that of cotton	Allows the development of <i>Heliothis virescens</i> on pods
<i>Arachis pintoi</i>	Presence of entomopathogenic fungi	Observation of caterpillars of the genus <i>Spodoptera</i>
<i>Cynodon dactylon</i> (tifton, Bermuda grass)	Entomofauna differs from that of cotton (Cicadellidae, Cercopidae)	Agronomic management
<i>Brachiaria ruziziensis</i>	Substantial biomass	Allows the development of <i>S. frugiperda</i>
<i>Pennisetum glaucum</i>	Parasitoids of caterpillars on the ears	Allows the development of <i>S. frugiperda</i>
<i>Crotalaria spectabilis</i> , <i>C. juncea</i>	The fauna generally differs from that of cotton	Strong attacks by <i>Megascelis</i> sp. (Chrysomelidae of soybean) Allows <i>Spodoptera cosmioides</i> to feed
<i>Sorghum</i> sp.	The fauna generally differs from that of cotton	Allows the development of <i>S. frugiperda</i> and <i>Nezara viridula</i> in some years

The polyphagous caterpillar *Spodoptera frugiperda* has been observed on all the Poaceae used although the population levels are variable. Entomopathogenic fungi and parasites are often found on isolated caterpillars on young sorghum. Still partial observations of density using the 1-m square wooden frame below strongly developed sole-cropped *B. ruziziensis* plants with clearly visible leaf damage gave counts of up to 55 caterpillars per square metre. Such values were not observed for younger plants. Comparisons must be made with other Poaceae such as millet. The plant is currently used in 'semi-direct' sowing and several chemical sprays are now applied to control *S. frugiperda* (M. Cecconi, E. Takizawa, per. comm.).



CONCLUSIONS

1. The use of *Cajanus cajan*, a potential intermediate host plant for *H. virescens* in some years, carries the risk of the multiplication of this cotton pest on pods if drying is not complete at the right time. Like *Amaranthus* in 2005, this species enables the development of *Spodoptera cosmioides* caterpillars. In the present situation and according to the results obtained, the development of cover crops of the Poaceae family, as a combination as in the case of sorghum-*Brachiaria*, can be a risk with regard to *S. frugiperda* that would seem to be the main pest to monitor in the future. Observation of this pest should be continued and intensified;
2. The presence of aphids other than *Aphis gossypii* on *Eleusine coracana* and the serious parasite attacks observed on the latter form a positive feature. However, the potential reduction of cotton aphids through the use of this cover plant remains to be demonstrated;
3. Finally, the other agronomic aspects related to the growing and management of such cover crops—especially the quality (purity) of seed, drying procedures and the equipment to be used at sowing to avoid cotton emergence problems, especially for live cover crops with *Cynodon* or *Arachis* should not be neglected.

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