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Insects feeding on *Sesbania* species in natural stands and agroforestry systems in southern Malawi

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Abstract. Pest and disease interactions in agroforestry systems is a little studied area. Surveys were conducted in the Mangochi and Zomba districts of southern Malawi between December 1997 and February 1998 to identify insects feeding on *Sesbania* species in natural stands and in agroforestry systems at the research station and on farms, and the host range of the insects. Out of a total of 30 insect species recorded in natural stands, *Brachyplatys testudonigro*, *Mesoplatys ochropter*a, *Exosoma* sp. and *Ootheca* sp. were the most commonly found insects feeding on *S. sesban*. *Afrius figuratus*, *Glypsus conspicuus*, *Macrorhaphis acuta*, *Mecosoma mensor*, *Rhinocoris segmentarius* and *Cyaneodinodes faciger* were recorded for the first time as natural enemies of *Mesoplatys ochroptera* in Malawi. The defoliating beetles, *M. ochroptera*, *Exosoma* sp. and *Ootheca* sp., were the most frequently found insects infesting *S. sesban* on farms. *M. ochroptera* attacked only *Sesbania* species, and usually higher populations of this beetle were recorded on annual *Sesbania* species (*S. tetraptera*, *S. bispinosa*, *S. leptocarpa* and *S. sericea*) than on perennial types. Although the sap-sucking bug, *B. testudonigro*, was relatively less common on sesbania on farms, it has been found to infest a number of other legumes of the genera *Aeschynomene*, *Crotalaria*, *Desmodium*, *Indigofera*, *Mucuna*, *Phaseolus*, *Tephrosia* and *Vigna*. Given the wide variety of plant species it attacks, *B. testudonigro* may become a potential pest of many agroforestry tree species. The insects *Anoplocnemis curvipes*, *Aphis fabae*, *Hilda patruelis*, *Megaleurothrips sjostedti*, *Mylabris dicincta*, *Nezara viridula* and *Ootheca* sp. also have the potential to become pests of agroforestry systems, as they can damage many agroforestry trees, including *Sesbania*, and crops. There is a need to study the biology and ecology of potential insect pests of *S. sesban* to plan for their integrated management in agroforestry.

Introduction

Sesbania sesban (L.) Merril (Leguminosae) is distributed widely in northern, eastern, southern and central Africa (Gillett, 1963) and it has been receiving considerable attention in recent years for its use in agroforestry systems (Kwesiga and Ngugi, 1996; Onim et al., 1990). In southern Africa, it grows naturally along riverbanks, lakeshores and in seasonally flooded areas locally known as *dambos* (Kwesiga and Beniest, 1998). *S. sesban* is easy to propagate, it nodulates well with local rhizobium strains, grows fast after the seedling stage and produces a large quantity of biomass, including high quality foliage (Kwesiga and Beniest, 1998). Among the various leguminous trees and shrubs screened, *S. sesban* was found to be outstanding in replenishing soil fertility in nitrogen-depleted soils, either as short-rotation planted fallows (Kwesiga and Coe, 1994) or in relay intercropping with other food crops (ICRAF, 1995). One- or two-year sesbania fallows have been found to supply adequate N for moderate maize yields (3 to 4 t ha^{-1}) in western Kenya (Niang et al., 1996) and many countries in southern Africa (Kwesiga and Ngugi, 1996). Similarly, relay intercropping of sesbania with food crops (maize or groundnut with/without pigeonpea) has shown promising results in some parts of southern Malawi (Snapp et al., 1998). In addition to improving soil fertility, *S. sesban* has been found to yield 10 to 20 t ha^{-1} of fuelwood when planted as pure fallows, and up to 2 t ha^{-1} in relay intercropping. *S. sesban* is also used as fodder for ruminants, as green manure, for shade in coffee, as a windbreak and for fencing (Evans and Rotar, 1987).

S. sesban has been reported to be affected by a number of insects in Africa and Asia. For example, based on a literature search, Singh Rathore (1995) compiled a total of 26 records of insect species reported to have infested sesbania. He also reported five other insect species feeding on sesbania in Kenya and Rwanda, based on field observations. Besides the insects in the native plant range, a number of insects of exotic plant range were found associated with sesbania (Murphy, 1990). These reports did not identify the most important pests of sesbania in Africa. However, recent reports have indicated the leaf eating beetle, *Mesoplatys ochroptera* Stål (Chrysomelidae: Coleoptera), as one of the most serious insect pests of sesbania in Ethiopia and Malawi (Mchowa and Ngugi, 1994; Wale et al., 1996). The beetle has been reported to damage sesbania in the seedling stage to cause failure of stand establishment, and to defoliate trees at later stages to deprive the foliage of its economic value (Steinmüller, 1995; Wale et al., 1996). Other insects, such as *Anoplocnemis curvipes*, *Exosoma* sp., *Formicomus* sp., *Hilda patruelis* and *Medythia quaterna*, have also been reported to attack *S. sesban* in agroforestry systems in southern Africa (Mchowa and Ngugi, 1994). There is limited knowledge about insect fauna that attack *S. sesban* in sub-Saharan Africa although the species is being tested widely and promoted in agroforestry systems in eastern and southern African countries. Information is also scanty on the biology and ecology of insects feeding on *Sesbania* spp. and the threshold levels of damage for *S. sesban* grown in different systems for different purposes. This information is essential to determine the pest status of insects and to plan for appropriate management strategies.

Huxley and Greenland (1989) emphasised the need for undertaking surveys to identify pests of trees and crops and studying the influence of tree–crop interactions on pests in agroforestry systems. A series of surveys was undertaken to monitor insect fauna associated with *S. sesban* in the natural stands widely prevalent in Mangochi District (Ndungu and Boland, 1994) and to monitor insects on *S. sesban* in agroforestry systems at the research station and on farms in Zomba District. The objectives of the surveys were to (1) identify the range of harmful and beneficial arthropods associated with *Sesbania* species, particularly *S. sesban* and (2) identify the insects that may potentially become pests of *S. sesban* and other species in agroforestry. As the use of *Sesbania* in agricultural systems is relatively new in southern Malawi, monitoring *Sesbania* on farms alone would not give a complete picture of the insect's status.

Materials and methods

The study area (Mangochi and Zomba districts) in southern Malawi lies between 14°3′ S and 15°5′ S latitudes and 34°8′ and 35°5′ E longitudes, with altitudes ranging from about 400 m near the lakeshore (L. Nyasa) to about 1050 m in the Zomba plateau. The area receives rainfall varying from 750 to 1050 mm in one rainy season, from November to April. The vegetation consists of lakeshore savannah grassland and thickets. The major crops grown in the area include maize (*Zea mays* L.), groundnut (*Arachis hypogaea* L.), bean (*Phaseolus vulgaris* L.), cowpea (*Vigna unguiculata*), pigeonpea (*Cajanus cajan* (L.) Millsp), cotton (*Gossypium hirsutum* L.), tobacco (*Nicotiana tabacum* L.) and cassava (*Manihot esculenta* Crantz). Except for tobacco, all other crops are interplanted with maize. The potential use of *Sesbania* is being examined in two agroforestry systems in southern Malawi, short-rotation fallows and relay intercropping (ICRAF, 1995; Snapp et al., 1998).

Natural stands of *S. sesban* were studied at four sites outside farms (Nkope, Kadawere, Palm Forest and Palm Beach) and three sites on farms in Mangochi District. Three separate surveys were undertaken around the lakeshore, one in December 1997 and two in February 1998. These surveys were conducted during the rainy period when insect populations were expected to be abundant. Trees and seedlings were visually examined for insects. The adult insects were collected by hand or using a sweep net or a pooter, depending on the size and agility of the insects. Insects in immature stages (such as caterpillars) were also collected by hand for rearing to the adult stage. Some of the larvae failed to develop into adults. The adults collected from the field and reared in the laboratory were killed in a bottle containing cotton wool soaked in ethyl acetate. Insect specimens were identified by specialists of the Natural History Museum (London) and CABI Bioscience, and by being compared with specimen collections available at the Forestry Research Institute of Malawi and the Makoka Agricultural Research Station. In order to catalogue alternative hosts of the insects, specimens of host plants were collected and identified with the help of taxonomists at the National Herbarium and Botanical Gardens (NHBG) of Malawi.

In each area visited, populations of the most prevalent insect species (*M. ochroptera* and *Brachyplatys testudonigro* F.) were counted on the *Sesbania* species encountered. Ten plants of approximately similar size (less than 1 m tall) were selected for each *Sesbania* species and the numbers of individuals per plant recorded. For all insects observed on *S. sesbania*, the potential for each to damage crops was judged qualitatively, based on our visual observations of frequency of occurrence and host range. Literature was consulted wherever possible (Bohlen, 1973; Hill, 1975).

A seed orchard of *S. sesban* etsablished by ICRAF at Palm Forest was visited during the first and last surveys. The orchard was two years old, and half of the plot (about 10 m × 10 m) was weeded one month before our survey. The rest was left unweeded. While the trees in the weeded area were free from *Mesoplatys* beetles and *Brachyplatys* bugs, those in the unweeded area were severely infested by both these insects. Following this observation, adults of *M. ochroptera* and *B. testudonigro* were counted on two shoots (branch tips with 10 fully expanded leaves) of 10 randomly selected trees from each of the sub-plots. The data were transformed into $\log_{10}(x + 1)$ values and the difference between the two was tested by *t*-test.

Research plots on farms around Govala (altitude 600 m), Thondwe (950 m) and Makoka (1029 m), seed orchards, and nurseries and research plots at the Makoka Research Station in Zomba District were visited two or more times during the rainy season (November 1997 to February 1998). In all these visits no attempt was made to quantify the populations of different insect species observed on their respective host plants, but only qualitative observations were made on the abundance of insects relative to those in natural stands.

Results

A total of 30 species belonging to seven orders of insects, and one mite have been observed to attack *S. sesban* in natural stands (Table 1). Of all these species, *M. ochroptera* and *B. testudonigro* were the commonest. Among other species, *Sycophila* sp., *Euproctis rubricosta* Fawc., *Plusia orichalcea* F., *Tetranychus* sp. and an unidentified moth (Tortricidae) were found frequently on naturally growing *S. sesban*. A number of insects that attacked *S. sesban* were found to damage many agroforestry tree species, crops and weeds (Table 2). However, *M. ochroptera* attacked only plants of the genus *Sesbania* (*S. bispinosa*, *S. leptocarpa*, *S. macrantha*, *S. rostrata*, *S. sericea*, *S. sesban* and *S. tetraptera*). In contrast, *B. testudonigro* was found to feed on a number of legume genera (Table 2).

As the range of *Sesbania* species in the natural stands at Palm Beach and on farm sites was limited (only *S. sesban*, *S. sericea* and *S. bispinosa*) and insect populations were low, quantitative results are reported only from three sites (Table 3). *Sesbania* species indicated substantial differences in the degree of infestation by *M. ochroptera* and *B. testudonigro*. The fast-growing annual *Sesbania* species were usually more heavily infested by these insects than

Table 1. Insects feeding on natural stands of *S. sesban* in Mangochi District, southern Malawi.

Insect species	Family: Order	Potential for crop damage[a]	Occurrence on *S. sesban*[b]
Sucks sap from leaves, stems or pods			
Agonoscelis pubescens Thunb.	Pentatomidae: Heteroptera	1	+
Anoplocnemis curvipes (F.)	Coreidae: Heteroptera	1	+++
Aphis fabae Scopoli	Aphididae: Homoptera	1	+++
Brachyplatys testudonigro F.	Plataspidae: Heteroptera	1	+++
Coptosoma sp.	Plataspidae: Heteroptera	0	+
Ferrisia sp.	Pseudococcidae: Homoptera	0	+
Graptostethus sp.	Lygaeidae: Heteroptera	1	+
Hilda patruelis Stål	Tettigometridae: Heteroptera	1	++
Icerya purchasi Mask	Margarodidae: Homoptera	1	+
Leptocoris amicta Germ	Phyrrhocoridae: Heteroptera	1	+
Lipaleyrodes sp.	Aleyrodidae: Homoptera	0	++
Nezara viridula L.	Pentatomidae: Heteroptera	1	+
Spilostethus sp.	Lygaeidae: Heteroptera	1	+
Oxyrachis tarandus F.	Membracidae: Heteroptera	1	+
Causes defoliation			
Chrysolagria sp.	Lagriidae: Coleoptera	0	+
Euproctis rubricosta Fawc	Lymantriidae: Lepidoptera	1	+++
Exosoma sp.	Halticidae: Coleoptera	0	+++
Lagria villosa F.	Lagriidae: Coleoptera	1	+
Medythia quaterna Fairmaire	Chrysomelidae: Coleoptera	0	+
Mesoplatys ochroptera Stål	Chrysomelidae: Coleoptera	2	+++
Ootheca sp.	Chrysomelidae: Coleoptera	1	+++
Plusia orichalcea F.	Noctuidae: Lepidoptera	1	+
Tetranychus sp.	Tetranychidae: Acari	0	+
Zonocerus variegatus L.	Acrididae: Orthoptera	1	+
Unidentified Tortricid	Tortricidae: Lepidoptera	0	++
Damages flowers			
Alcidodes erythropterus (Chevr.)	Curculionidae: Coleoptera	0	+
Megalurothrips sjostedti Trybom	Thripidae: Thysanoptera	1	+
Mylabris dicincta Gerst.	Meloidae: Coleoptera	1	+++
Damages seeds			
Acanthoscelides obtectus (Say)	Bruchidae: Coleoptera	1	+
Sycophila sp.	Eurytomidae: Hymenoptera	0	++

[a] 0 = unknown, 1 = exists, 2 = does not exist.
[b] + = rare; ++ = sporadic; +++ = frequent.

the slow-growing perennial species. *Sesbania* species ranked for the relative density of *M. ochroptera* and *B. testudonigro* populations as follows: *S. tetraptera* = *S. bispinosa* = *S. leptocarpa* > *S. sericea* > *S. sesban* > *S. rostrata*. The trend was similar at all the four sites visited (Table 3). In sesbania/maize relay intercropping systems at Makoka, the biennial *S. macrantha* was attacked

Table 2. Host range of some insects recorded on *Sesbania sesban* in Mangochi District, southern Malawi.

Insect species	Host plants recorded during the survey		
	Crops	Agroforestry trees	Weeds
A. curvipes	*Phaseolus vulgaris, Vigna unguiculata*	*Sesbania sesban*	*Sesbania* spp., *Aeschynomene indica*
A. fabae	*Arachis hypogeae*	*Cajanus cajan Gliricidia sepium, S. sesban*	*Aeschynomene afraspera, A. cristat, Sesbania rostrata*
B. testudonigro	*P. vulgaris, V. unguiculata*	*Sesbania macrantha S. sesban*	*Aeschynomene afraspera, A. cristat, A. indica, Chamaesyce parva, Crotalaria barkae, C. ochroleuca, C. polysperma, C. senegalensis, C. virgulata, Desmodium demissa, Indigofera antunesiana, I. Astragalina, Indigofera dyeri* var. *congesta, Mucuna poggei, Senna absus, Sesbania leptocarpa, S. tetraptera, Tephrosia elata* subsp. *heckmanniana, T. purpurea* var. *elagonsis, T. richardsiana*
Coptosoma sp.	unknown	*S. sesban,*	*D. demissa, Sesbania sericea*
Exosoma sp.	unknown	*S. sesban, S. macrantha*	Unknown
E. rubricosta	unknown	*S. sesban*	*Sesbania* spp.
H. patruelis	*A. hypogeae*	*S. sesban*	*Sesbania* spp.
M. ochroptera	none	*S. sesban S. macrantha*	*Sesbania bispinosa, S. leptocarpa, S. sericea, S. tetraptera, Sesbania rostrata*
M. sjostedti	many legumes	*C. cajan, S. sesban*	many *Sesbania* species
M. dicincta	*P. vulgaris*	*C. cajan, S. sesban*	many *Sesbania* species
Ootheca sp.	*P. vulgaris, V. unguiculata*	*S. sesban, S. macrantha*	unknown
N. viridula	*P. vulgaris, V. unguiculata*	*S. sesban*	many *Sesbania* species

Table 3. Adult populations of *Mesoplatys ochroptera* and *Bracyplatys testudonigro* on different *Sesbania* species in natural stands in Mangochi District, southern Malawi.

Locality	*Sesbania* species	Mean number per plant	
		M. ochroptera	*B. testudonigro*
Nkope	*S. tetraptera*	12.6 ± 4.6[a]	446.0 ± 63.9[a]
	S. bispinosa	8.1 ± 1.8	151.4 ± 57.4
	S. leptocarpa	5.9 ± 2.3	138.0 ± 54.3
	S. sesban	1.6 ± 0.2	15.1 ± 2.8
Palm forest	*S. tetraptera*	8.3 ± 2.3	4.2 ± 2.2
	S. bispinosa	7.4 ± 2.4	5.5 ± 2.5
	S. leptocarpa	3.4 ± 1.1	16.4 ± 10.3
	S. sesban	2.2 ± 1.0	25.5 ± 24.9
	S. sericea	2.3 ± 0.8	16.4 ± 11.8
Kadawere	*S. tetraptera*	34.7 ± 5.3	1.0 ± 0.1
	S. bispinosa	18.2 ± 2.8	1.0 ± 0.1
	S. sesban	5.1 ± 1.2	2.5 ± 1.4
	S. rostrata	1.8 ± 0.1	1.0 ± 0.2

[a] Standard error of mean.

more severely than the perennial *S. sesban*. In another field experiment at Makoka where *S. macrantha*, *S. tetraptera* and *S. sesban* were planted side by side, *S. sesban* was the least affected.

Natural stands of *Sesbania* hosting *M. ochroptera* and *B. testudonigro* occurred in two distinct habitats: the well-drained plains and the seasonally flooded areas, including the lakeshores. In the well-drained plains, *S. bispinosa, S. tetraptera* and *S. leptocarpa* were common and *S. sesban* was rare. These species were found growing mixed with a number of legume shrubs such as *Aeschynomene indica*, *Crotalaria*, *Indigofera*, *Chamaesyce*, *Senna* and *Tephrosia* species and grasses such as *Dactyloctenium*, *Digitaria*, *Panicum* and *Setaria* species. *M. ochroptera* and *B. testudonigro* occurred in large numbers in such areas. Along the lakeshores and in seasonally flooded areas, *S. sesban*, *S. sericea* and *S. rostrata* were found growing in association with the shrubs *Aeschynomene afraspera, A. cristata* and *A. elaphroxylon* and the grasses *Eriochloa borumensis*, *Panicum repens*, *Phragmatis mauritianus* and *Vossia cuspidata*. Infestations by *M. ochroptera* and *B. testudonigro* in these areas were light and sporadic compared with those in the well-drained plains. *S. rostrata* was relatively free from infestation of both these insects.

Ootheca sp. and *Exosoma* sp. were more common in *Sesbania*/maize relay intercropping on farms and at the Makoka Research Station than in the natural stands. In both Mangochi and Zomba districts, *Ootheca* sp. was found mainly in gardens (locally called *dimbas*) located in *dambos* where leguminous crops such as cowpea and bean were grown with *S. sesbania*. *Exosoma* sp. occurred in large numbers only in the *S. sesban* seed orchard at Palm Forest and in farms in Zomba district. The frequency of occurrence of other insects such as *Anoplocnemis curvipes*, *Aphis fabae*, *Hilda patruelis*, *Megaleurothrips sjostedti*, *Mylabris dicincta* and *Nezara viridula* was similar in natural stands and farmers' fields. These insects also attacked other agroforestry trees and crops in addition to damaging *S. sesban* (Table 2).

In the seed orchard at Palm Forest, *S. sesban* trees in the unweeded plot contained three times more populations of *M. ochroptera* and eight times more of *B. testudonigro* per shoot than the trees in the weed-free plot (Table 4). The predominant weeds in the unweeded plot included *Crotalaria virgulata, Desmodium demissa, Indigofera astragalina* and *Tephrosia purpurea* (Leguminosae), *Abutilon angustifolia* (Malvaceae), *Ceratotheca sesamoides* (Pedalaceae), *Boerhavia erecta* (Nytaginaceae), *Corchorus olitorius* (Tiliaceae), and *Dactylactenium aegyptiaca* and *Setaria* sp. (Graminae). The leguminous weeds *C. virgulata*, *D. demissa*, *I. astragalina* and *T. purpurea* were severely infested by *B. testudonigro*.

In addition to insects, natural enemies were also recorded in the study area. Predatory insects on *M. ochroptera* included *Afrius figuratus, Glypsus conspicuus*, *Macrorhaphis acuta* and *Mecosoma mensor* (Pentatomidae: Heteroptera), *Rhinocoris segmentarius* (Reduvidae: Heteroptera), *Cyaneodinodes faciger* (Carabidae: Coleoptera), and two unidentified spider species (Araenae). Adults and nymphs of the Pentatomidae have occurred in large numbers and attacked eggs, larvae and adults of *M. ochroptera*. All the predatory species were more abundant in the well-drained plains, where *S. bispinosa*, *S. tetraptera* and *S. leptocarpa* grew together with *Panicum maximum* grass, than in the other habitats. An unidentified hymenopteran egg parasite was observed on *B. testudonigro* in the natural stands and farms.

Discussion

The survey of *S. sesban* natural stands has indicated the potential for a number of insects to assume pest status on *S. sesban* if the use of this species inten-

Table 4. Mesoplatys ochroptera and *Brachyplatys testudonigro* populations in weedy and weed-free plots in the seed orchard at Palm Forest in Mangochi District, southern Malawi.

Plots	Mean number per shoot	
	M. ochroptera	*B. testudonigro*
Weedy	3.47a	8.51a
Weed-free	1.32b	1.05b
t-test (probability)	<0.05	<0.05

Treatment means followed by different letters within a column differed significantly at 5% probabilty. *t*-test was conducted on log transformed data.

sifies in agroforestry. The most important among them were the leaf beetles, *M. ochroptera, Exosoma* sp. and *Ootheca* sp. Severe defoliation of *Sesbania* species by *M. ochroptera* has been periodically recorded in Malawi (Smee, 1935; Mchowa and Ngugi, 1994), eastern Zambia (F.R. Kwesiga, pers. comm., 1998), western Kenya (Onim et al., 1990; A. Niang, pers. comm., 1998) and Ethiopia (Wale et al., 1996). Sometimes there was total defoliation, depriving the benefits of sesbania to farmers. This beetle appears to be an endemic pest of *Sesbania* species, and at present is probably the key 'pest' of *S. sesban* in agroforestry systems in Malawi and other countries in southern and eastern Africa.

Although *Sesbania* species appear to be the only hosts of *M. ochroptera*, the beetle may be found resting or laying eggs on non-host plants growing near *Sesbania*. For instance, females were seen laying eggs on maize and pigeonpea in the *Sesbania*/maize/pigeonpea relay intercropping systems, but the larvae usually died after hatching. Cotton (Harris, 1936), *Aeschynomene* and *Erythrina* species (Mchowa and Ngugi, 1994) and legumes (Harris, 1937) have been cited as hosts of the beetle. However, we did not notice any damage by *M. ochroptera* to five different *Aeschynomene* species growing in close association with *Sesbania* species. Undoubtedly, the genus *Aeschynomene* is not a host to the beetle, and earlier references to its host status probably referred to *S. sesban*'s old name, *Aeschynomene sesban* L. We have not found this insect to attack other crops such as cotton, pigeonpea, bean, cowpea and groundnut. Larvae hatched from eggs on non-hosts have been found to migrate in search of host plants. Therefore, plants on which these beetles are found laying eggs should not automatically be assumed as hosts. Considering its limited host range, it is unlikely that *M. ochroptera* will pose any threat to crops or other trees in agroforestry systems.

Many *Sesbania* species, in addition to *S. sesban*, have been reported in eastern Africa to host *M. ochroptera* (Onim et al., 1990; Singh Rathore, 1995; Steinmüller, 1995). The beetle may probably breed on *S. goetzii*, *S. grandiflora*, *S. mossambicensis*, *S. rogersii* and *S. speciosa*, which are known to occur widely in different parts of Malawi (Drummond, 1972; NHBG, unpublished checklist). These and other naturally growing *Sesbania* species could become a source for the multiplication and spread of *M. ochroptera* to *S. sesban* in agroforestry systems.

Since *S. sesban* is apparently a less preferred host of the beetle than other *Sesbania* species and given the wide genetic diversity in this species (Gillett, 1963), there are possibilities for identifying provenances, populations and/or individual trees that are tolerant to beetle attack. Such germplasm could be found in areas where the beetle has exerted sufficient selection pressure leading to the development of tolerance. Therefore, the search for new germplasm should focus on areas of high beetle endemicity, such as southern Malawi.

It appears that *Aeschynomene, Crotalaria, Indigofera* and *Tephrosia* species are the primary hosts of the bug *B. testudonigro*, as it attacked these legumes in large numbers even in the absence of *Sesbania* species. Although *B. testudonigro* can be considered unimportant on *S. sesban* in Malawi, this should not be neglected as we have noted outbreaks of the bug in the tree nursery in Chipata (Zambia). Given the wide variety of crops and weeds that it attacks, there is a real danger that it may become a pest to many other agroforestry trees and shrubs such as *Crotalaria, Desmodium, Sesbania* and *Tephrosia* and crops such as bean and cowpea. The bug was reported to attack many shrubs in Chikangawa in northern Malawi (Lee, 1971). The frequency of occurrence of this bug must be noted whenever explorations for new germplasm of agroforestry trees are conducted.

According to Huxley and Greenland (1989), 'primary interactions' (where the tree species and the associated crop share pests and their natural enemies) are not common. In contrast, our observations showed that a number of insect herbivores are common to *S. sesban* and crops, indicating the complexity of tree/crop associations. Although the relative host status of a tree and a crop may differ for a shared insect pest, the agroforestry system combining both the hosts will assume considerable significance to the pest (Huxley and Greenland, 1989). Polyphagous insects such as *A. curvipes, A. fabae, A. obtectus, H. patruelis, M. dicincta, M. sjostedti, N. viridula* and *Ootheca* sp., which feed on a number of crops (Bohlen, 1973; Hill, 1975; Wightman and Wightman, 1994), could pose a serious problem to agroforestry systems involving *S. sesban* and the insects' crop hosts.

Increased populations of *M. ochroptera, B. testudonigro* and predators of *M. ochroptera* on *S. sesban* in *Sesbania*–weed association were probably related to favourable niches the mixed vegetation offers to both the pestiferous and beneficial insects. We have also observed significantly higher numbers of pre-pupal and pupal stages of the above insects in unweeded *S. sesban* fallows, particularly under broad-leaved weeds such as *Tridax procumbens* (Asteraceae) and *Clerodendrum uncinatum* (Verbenaceae), than in clean-weeded fallows. Similar observations were reported from Ethiopia (Wale et al., 1996). Larvae prefer moist and shady areas (such as under broad-leaved weeds) for building the pupal cell. Populations of *B. testudonigro* tended to be higher in weedy areas, probably because most of the weeds were hosts to the bug and they provided an unlimited food supply for its multiplication. Weeding sesbania plots is apparently beneficial as it reduces the populations of beetles and bugs, but it may be disadvantageous if it reduces the natural enemy populations of these and other insect pests. Therefore, knowledge on how weedy vegetation influences other insect pests and natural enemies is essential to determine the trade-offs for weed control at different stages of sesbania growth.

S. sesban and *S. macrantha* seedlings from direct-seeding or natural regeneration grow slowly and experience weed competition in their first two months (ICRAF, 1995). *Sesbania* fallows established with nursery-raised seedlings may suffer less from weeds. At the Makoka Research Station, voluntary seedlings from previous *Sesbania* plantings (*S. sesban* and *S. macrantha*) and weedy *Sesbania* species (*S. bispinosa* and *S. leptocarpa*) have been observed to build populations of *M. ochroptera* at the commencement of the rainy season. In such situations, prompt weeding early in the season is necessary to reduce both weed competition and the build-up of the pest on voluntary seedlings, no matter what method was used for establishing the *Sesbania*.

Only two insect species were common in the reports of Singh Rathore (1995) and our observations, indicating that most previous recorded insects on sesbania were probably from outside Malawi or Africa. We did not find two of the species [*Coccus hesperidium* L. and *Hemiberlesia rapax* (comst.)] previously recorded by Lee (1971) in the same study area and *Formicomus* sp. and some natural enemies of sesbania insects reported by Mchowa and Ngugi (1994). As this study was conducted over a relatively short period, it probably failed to observe the complete insect fauna associated with sesbania. Considering this and the obvious limitations of rearing and identifying immature stages of the insects, the list of insects given here should not be considered complete. Obviously, periodic and repeated surveys covering a wider geographic area are required to get a full picture of the insects that affect *S. sesban*, their host range and natural enemies. Furthermore, the biology and ecology of the insects identified to have potential to become pests of *S. sesban*, such as *M. ochroptera*, *B. testudonigro*, *Exosoma* sp. and *Ootheca* sp., have to be studied and thresholds of damage levels determined so that appropriate pest management strategies are planned, where necessary.

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