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Distribution Patterns and Abundance of the Dura Andat, *Agonoscelis pubescens* (Thunb.), and other Pentatomids Across Habitat Patches in the Central Clay Plain of Sudan*

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Abstract: Field surveys were carried out at three locations in the central clay plain of Sudan at Gedarif, Blue Nile and North Darfur States. The objective was to determine the most preferred resting sites of the dura andat, *Agonoscelis pubescens* , and other associated pentatomid species. These sites are where the chemical control campaigns of this pest are conducted every year. The results showed that *A. pubescens* preferred certain types of trees as resting sites and that different pentatomid species aggregated and stayed together with it at these sites. *A. pubescens* was the main species sheltering on trees, while *Carbula pedalis,* an unconfirmed pest of sorghum, was the main species sheltering in mountain caves. Each of these two species seemed to join with a set of specific group of pentatomids, which differed from those associated with the other. It is argued that control of *C. pedalis* may be unnecessary if it is proved that this insect is neither a pest of sorghum nor of any other main crop.

Key words: Sorghum shield bug; *Agonoscelis pubescens*; pentatomids; sheltering sites

INTRODUCTION

The sorghum shield bug or the Sudan millet bug, *Agonoscelis pubescens* (Thunb.), locally known as dura andat, is a serious pest of grain sorghum in many African countries south of the Sahara (Schmutterer 1969; Kranz *et al.* 1977). In Sudan, it is mainly found in the major sorghum producing

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areas within the central rain lands belt (isohytes 250-800 mm). The insect is also a pest of other important food crops such as sesame, sunflower and wheat. During the period from November to the end of June, populations of this bug usually cluster in well protected environments, located in areas within the isohytes 350-550 mm (Razig 1978). In recent years, the ecology of the central rain lands belt has slightly changed due to the increasing demand on forest products and on land for agricultural production. Apparently, these changes in habitat have also had an impact on the choice of the sorghum shield bugs for alternative resting sites (Mustafa 2004; Ibrahim 2005).

The sheltering sites are the main targets for the annual chemical control campaigns of the dura andat organized by the Plant Protection Directorate of the Ministry of Agriculture in Sudan (Mohamed 1977). Hence, the proper characterization and the accurate location of these sites should help improve the efficiency of both survey and control operations of this notorious pest.

The objectives of this study were to identify the main sheltering sites, assess the degree of preference of the bugs for each site and determine the composition of the pentatomid species complex at each site.

MATERIALS AND METHODS

Study sites

Three sites were chosen at different geographical locations; namely, Kabkabiya (13^0N and 24'E) North Darfur State, Khalil village ($13^012'$N and $33^030'$E) Sinnar State and Camp 39 ($14^07'$N and $34^050'$E) Gedarif State. The main criterion for the choice of a site was that it should contain trees heavily colonized by clusters of resting pentatomid bugs. The specific location of each site was determined by means of a geographic positioning system, using Trailblazer GPS 1994. Similarly, two mountain caves harbouring different resting pentatomid species were demarcated at Kolbus ($14^025'$N and $22^050'$E) near Kabkabiya, North Darfur State and at Jebel Kanga near Kadogli ($11^000'$N and $29^099'$E), South Kordofan State.

Sampling methods

The sampling sites, within the selected locations, for pentatomids sheltering on trees were arranged in a randomized complete block design. The sample size was an area of 5x10 m, within which five trees harbouring high population densities of resting pentatomid bugs were chosen. The bugs in an area of 30x20 cm of the trunk of every selected tree were collected in a plastic bag using a suitable painter`s brush. The total number of insects collected from each type of tree was counted with the help of a calibrated plastic cup which holds about 630 insects when full. The insects in each collection were sorted out, identified and counted. The same procedure was used for collection, identification and counting of insects dislodged from walls of colonized mountain caves.

Data were subjected to analysis of variance and the means were separated using the least significant difference (LSD) and Duncan's Multiple Range Test procedures.

RESULTS AND DISCUSSION

A limited number of tree species harboured large numbers of the resting stage of the sorghum shield bug, but these trees were not evenly distributed. At each geographical location, conditions favoured the abundance of certain tree species, which offer the optimum choice as resting sites. Table 1 shows the most attractive tree species to adult pentatomids seeking shelter at the three study sites (Kabkabyia, Sinnar and Gedarif), and the degree of preference for each type of tree at each location. At Kabkabyia, the most preferred tree species was *Acacia albida* and the least was *Capparis decidua*, while at Sinnar, both *Balanites aegyptiaca* and *Acacia nilotica* were more attractive than *Acacia mellifera.* At Gedarif, the population of the resting bugs was evenly distributed among the three common tree species; namely, *Acacia nilotica*, *Zizyphus spinachristi* and *Balanites aegyptiaca.*

The population of some of these trees appears to be rapidly decreasing due to the selective felling in response to the rising demand for timber, fire wood and other forest products. Besides, the increased activities in the mechanized rainfed farming sector and the development of irrigated

agricultural production schemes in the area have added to the scarcity of trees suitable for harbouring aestivating sorghum shield bugs and other pentatomids. Accordingly, these insects seem to be gradually shifting to alternative resting habitats such as fruit orchards, sugarcane plantations, ornamental shrubs and hedges around residential areas (Ibrahim 2005). This shift in behaviour is likely to have serious future environmental costs, especially when these alternative sites become targets for treatment with insecticides during the routine annual dura andat chemical control campaigns.

To avoid such negative future developments, it may be worth considering the establishment of sanctuaries at carefully selected sites, in which the most preferred trees for aestivation at each location are protected. Such foci of preferred sheltering sites are expected to divert pentatomid aggregations away from the alternative ecologically sensitive spots which include fruit orchards and sugarcane plantations. This should also enable field scouts and plant protection officers targeting the dura andat during the chemical control campaigns to focus on specific areas and trees, thus saving time and reducing costs of control operations.

The data displayed in Table 2 show that *A. pubescens* was the dominant species sheltering on trees at the three locations, and that it was associated with two other pentatomids whose population densities differed at each location. On the other hand, *C. pedalis*, which was the dominant species aestivating in mountain caves, was accompanied by seven other pentatomid species, excluding *A. pubescens* (Table 3).

An interesting finding of this study is the communal aestivation behaviour, where different pentatomid species were found clustering together at sheltering sites (Tables 2 and 3). This is unusual because, according to Prokpy and Roitberg (2001), adults of the same species of nonsocial insects have often been observed to avoid joining even con-specifics. However, in this case it may be argued that because the aestivating pentatomid species complex are exposed to very low levels of atmospheric relative humidity, ranging between 5.6% and 33% (Mustafa 2004), they are forced to aggregate in order to protect themselves against

desiccation (Lockwood and Story 1986). Furthermore, aggregation of the different species was probably also a defense strategy against the ravages of natural enemies (Sillen-Tullberg and Leimar 1988). This may explain the tendency among the different pentatomid species for joining rather than avoidance or competitive displacement behaviour (Reitz and Trumble 2002).

Both *A. pubescens* and *C. pedalis* have so far been considered as dura andat, although there is no evidence that the latter is a pest of sorghum or any other major crop in Sudan. Azeez (1972) reported *C. pedalis* to cause nuisance to Nigerian villagers at their residential premises during aestivation, but not a crop pest. On the other hand, *A. pubescens* is a serious pest of grain sorghum and other food crops in Sudan and elsewhere. It is the dominant species sheltering specifically on trees (Table 2), while *C. pedalis* is the dominant species sheltering only in mountain caves (Table 3). The two species were never found together at any location although they mix freely with a number of other pentatomids. Large quantities of insecticides are sprayed annually to control *C. pedalis* and associates in mountain caves. These chemicals could be spared if it is proved that *C. pedalis* is not a pest of any of the major crops in Sudan, especially sorghum, and that it is not a dura andat.

Table 1. Mean number of *Agonoscelis pubescens* resting on different trees, at three locations

Location	Tree species	Mean number of insects in a sample
Kabkabiya	*Balanites aegyptiaca*	822.1b
	Acacia albida	1654.8a
	Capparis decidua	348.0c
Sennar	*Balanites aegyptiaca*	1474a
	Acacia nilotica	1491a
	Acacia mellifera	192c
Gedarif	*Balanites aegyptiaca*	1517a
	Acacia nilotica	1522a
	Ziziphus spinachristi	1501a

Means followed by the same letter are not significantly different at P=0.05.

Table 2. Pentatomid species complex sheltering on trees at three locations

Location	Pentatomid species	Mean number of insects in a sample	% of the total population
Kabkabiya	*Agonoscelis pubescens*	980	76.9
	Sphaerocoris annulus	200	15.7
	Nezara viridula	95	7.5
Sennar	*Agonoscelis pubescens*	1110	67.3
	Sphaerocoris annulus	150	9.1
	Nezara viridula	400	24.2
Gedarif	*Agonoscelis pubescens*	1019	70.8
	Sphaerocoris annulus	120	8.3
	Nezara viridula	300	20.9

Table 3. Pentatomid species complex sheltering in mountain caves at two locations

Location	Pentatomid spp.	Mean number of insects in a sample	Total population (%)
Kabkabiya	*Carbula pedalis*	2307	93.1
	Amoxosana punctata	98	4.0
	Sphaerocoris annulus	40	1.6
	Aethemenes chloris	14	0.56
	Aethemenes punctata	12	0.48
	Delegorguelea laula	5	0.20
	Aspongopus viduatus	2	0.10
Kadogli	*Carbula pedalis*	2331	91.6
	Amoxosana punctata	145	5.7
	Aethemenes punctata	70	2.7

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أنماط إنتشار وكثافة عنتد الذرة الرفيعة (*Agonoscelis pubescens*) وحشرات من فصيلته في بيئات متفرقة من السهول الطينية الوسطى بالسودان*

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المستخلص: أجري مسح حقلي في ثلاثة مواقع في السهول الطينية الوسطى بالسودان وتحديداً في ولايات القضارف والنيل الأزرق وشمال دارفور بهدف تحديد الأماكن المفضلة للبيات الصيفي لعنتد الذرة الرفيعة *Agonoscelis pubescens* وحشرات أخرى مرتبطة بها من نفس الفصيله (Pentatomidae) في كل موقع جغرافي. أماكن البيات الصيفي هي المواقع التي تجرى فيها حملات المكافحة الكيماوية السنوية لهذه الآفة. أظهرت النتائج أن حشرات عنتد الذرة الرفيعة تفضل فصائل معينة من الأشجار كأماكن للبيات الصيفي وأن أنواعاً مختلفة من نفس فصيلة عنتد الذرة الرفيعة تتجمع وتبقى معها في ذات الأماكن. أظهرت النتائج أيضاً أن عنتد الذرة الرفيعة هو النوع الرئيسي الذي يحتمي بالأشجار بينما النوع *Carbula pedalis*، والذي لم يؤكد بعد أنه من آفات الذرة الرفيعة، هو النوع الرئيسي الذي يحتمي في كهوف الجبال أثناء فترة البيات الصيفي. يبدو أن كِلا هذين النوعين مرتبط بمجموعة معينة من فصيلة Pentatomidae تختلف تماماً عن المجموعة الأخرى. يعتقد أن مكافحة *C. pedalis* ربما تكون غير ذات جدوى إذا تأكد بأن هذه الحشرة ليست آفة على الذرة الرفيعة أو أي من المحاصيل الرئيسية الأخرى.

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