

THE MAJOR PREDATORS AND THEIR SEASONAL ABUNDANCE IN OKRA FIELDS AT EL-GORAIR SCHEME, NORTHERN SUDAN

ABSTRACT

Okra (*Abelmoschus esculentus*) is a popular vegetable crop in northern Sudan and many other parts of the country as well. The crop sustains different insect fauna which serve to attract numerous predators. Although, insecticides application is the sole measure of control practiced in many areas, it is not widely used in Northern Sudan. This seems to enrich the natural bio-agents in that area. Therefore, this research was aimed to survey the main predators associated with okra crop and to study their seasonal abundance at El-Gorair scheme in Northern State, as a step forward to evaluate the potential natural enemies in the area. The importance of this area emerged from the establishment of Merowe dam which expected to expand the irrigated land in the region.

A total of 14 predatory species, in seven families, including members of coccinellids, chrysopids, syrphids, mantids and spiders were detected at variable levels, attacking mainly *Bemisia tabaci* and *Aphis gossypii* besides other soft insects. Chrysopids and spiders were the dominant predators in autumn and summer seasons, whereas syrphids, chrysopids and coccinellids were the abundant groups during winter. However, *Chrysoperla carnea* was the most prevalent species in okra fields all the year round. These predators, particularly the latter species, should be stressed so as to encourage ecological means of pest control, and to minimize the need for chemical application on okra and other vegetable crops.

Keywords: Okra; predators; seasonal abundance; chrysopids; coccinellids; Northern Sudan.

INTRODUCTION

Considering the study area, El-Gorair scheme is located few kilometers downstream from the newly constructed Hamdab (Merowe) dam in Northern State. Such a State is found in the arid part of the country, where residents are settled in narrow strips along the two banks of the River Nile. The scheme is largely cultivated by horticultural fruits including; date palms, citrus and mangoes. Seasonal crops like vegetables, faba beans and wheat are sporadically grown in winter season. Alfalfa is the most important forage crop occurred.

However, among the main cultivated vegetable crops, okra [*Abelmoschus esculentus* (L.) Moench] (Malvaceae) is the most popular one. The crop is subjected to attack by several pests like *Bemisia tabaci* and *Aphis gossypii*, which suck plant nutrients and transmit serious viral diseases. Although, insecticidal application is the sole measure of control practiced in many areas, it is not widely practiced in the northern region. Accordingly, it was hypothesized that the northern Sudan might be rich in natural enemies, but it was uncertain how these enemies sustain themselves in such an area of harsh climatic conditions, especially during the long summer (very hot weather and limited cultivated land) period. Nevertheless, what has been raised is a neglected aspect from the research point of view, in spite of its vital importance in ecological stability and sustainable development.

A number of natural enemies (predators and parasites) were recorded to attack various pests on different vegetable crops in the Sudan. The important predators are members of coccinellids, chrysopids, syrphids, mantids and spiders. Most of these natural enemies were reported from central States including Gezira, Sennar, White Nile, Gedarif and Khartoum^{1,2,3}. However, very meagre research studies were conducted on natural enemies in northern Sudan. All what have been done in this region were merely restricted to diaspine scales bio-agents on date palms⁴. Therefore, this pioneer research was proposed to survey the important predators associated with okra pests, and to study their seasonal occurrence on the crop at El-Gorair scheme in Northern State, which aimed to shortlist potent species for biological control.

MATERIALS AND METHODS

Records of predators

Regular surveys were conducted every ten days in okra fields so as to record the prevailing predatory species, and to study their population levels throughout the year, during 2009/2010. The surveys were limited to the area of El-Gorair scheme, where extensive cropping system and numerous okra plots were found. Accordingly, the important predators detected on the crop were listed. Observations were also taken on insect pests attacking the okra leaves which serve as major preys. Although, most of the encountered predatory insects are well known species as reported from other parts of the country^{1,2,5}, more confirmation on the identity of some species were made at the Environment and Natural Resources Research Institute, National Centre for Research, Khartoum. However, based on the previous literature, the detected spiders were reported only by their family names, due to the lacking of indigenous detailed classification.

Seasonal abundance

Regarding the seasonal trends of the recorded predators, regular counts were conducted per ten days intervals on okra crop as mentioned above. Each count was performed early in the morning to record the number of predators (all species and stages encountered) per 50 leaves/10 plants/plot, replicated three times in different plots. Hence, the monthly and seasonal population levels of each predatory species were presented. The overall annual population means were statistically analyzed and compared based on the Randomized Complete Block design and Duncan's Multiple Range test.

RESULTS AND DISCUSSION

The detected predators

The predators recorded on okra were presented in Table (1). They included a total of 14 predator species; four coccinellids, one chrysopid species, two hoverflies, two mantids and five spiders. Although, *Cydonia vicina* is one of the dominant coccinellid species in the country, it was not encountered on this crop. This species seems to be more abundant as we go southwards in semi-arid and semi-humid regions, since it was reported from such zones by some investigators^{2,5}. All the present listed predators are well acquainted by the authors, and were already recorded on different crops in other parts of the country^{1,2,5,6}.

The important insect pests observed to attack the foliage parts of okra during the study period, and found to be preyed upon by such general predators in the field, were the cotton whitefly (*Bemisia tabaci*) and the cotton aphid (*Aphis gossypii*). Other pests such as spider mites were also found in some periods. Coccinellids were found to be more associated with aphids. Eggs of *Chrysoperla carnea* and syrphids were generally found laid among the immature stages of whitefly and the aphid colonies, respectively. So, the larvae of the former predator were noticed to feed largely on pupae of the *B. tabaci*, and those of syrphid flies to prey on *A. gossypii* (Pl. 1). Moreover, adults of whiteflies were noticed entangled by the networks of spiders as the major preys attacked on the plant leaves (Pl. 1). These observations agreed with several previous studies conducted in Khartoum State and elsewhere, demonstrating the preference of syrphid and coccinellid predators to different aphid pests, and chrysopid species to whiteflies^{5,7,8,9,10,11,12}. Studies in other countries also showed the occurrence of *B. tabaci* and *A. gossypii* among the major okra pests, with some coccinellids, chrysopids and spiders as the dominant predators^{12,13,14}. HaAbd-Rabou (1999), also reported the highest occurrence of *C. carnea* in connection with *B. tabaci* on eggplant¹⁵. In the same context, okra volatiles were recorded to attract the adults of *B. tabaci* in an olfactometer¹⁶. Since the whiteflies and aphids were recognized among the main okra pests in this research, the detected predators may represent an important biocontrol factor in their management. These natural enemies should be emphasized in comprehensive bio-ecological studies to encourage the natural control of vegetable pests and to minimize the need for chemical control.

Seasonal abundance

The monthly population means of the recorded predators are shown in Table (2). It is clear that *Chrysoperla carnea* and spiders were the most abundant predators throughout the year, showing appreciable numbers in all months. *Scymnus* spp. and *Ischiodon* spp. came next in ranking, respectively. Accordingly, the *Scymnus* species were recorded the highest appearance among coccinellids, in a period extended through winter and summer months (Nov.-July), followed by *Hippodamia variegata* almost during the same period, while the *Coccinella undecimpunctata* showed the lowest sporadic numbers in few months. The appearance of *Ischiodon* spp. were mainly

confined to the winter months (December- March), as seemed to be coincided with the appearance of *Aphis gossypii* as a preferred prey.

The seasonal comparisons of these predators revealed high significant differences among the various species within each season (Table 3). *Chrysoperla carnea* and spiders were the top significant predators during the summer-autumn period, whereas the *Ischiodon* spp., *C. carnea* and *Scymnus* spp. were the highest enemies in winter, in descending orders. Comparing the overall annual means of predators, highly significant differences were appeared among the different groups (Table 3). The *C. carnea* and spiders showed significantly the highest population levels, followed by *Scymnus* spp. and *Ischiodon* spp., while the rest of predators revealed significantly the lowest densities.

The recorded predators were found to attack different insects on the crop including mainly the *B. tabaci* and *A. gossypii*, as mentioned above. The whitefly was occurred all the year round, but the aphids were only found in winter season. Therefore, the thriving chrysopids and spiders all the year round were found to be highly connected with the occurrence of whitefly in all months, as opposite to winter abundances of syrphids and coccinellids in relation to aphids. These predator-prey relationships were thought to be among the main factors governing the seasonality and population abundance of most predators in the field. More investigations are needed on this aspect.

The present research was the first one to be conducted in the study area. Therefore, no literature is available concerning the situation of natural enemies on vegetable crops. Nevertheless, the results were in consistency with previous findings obtained on *Cucumis melo* in Khartoum area (semi-arid), which showed the dominant occurrence of *Chrysoperla carnea* all the year round, and that of syrphid flies peaked in winter. The latter study also reflected the dominance of *Scymnus* spp. over the other coccinellids⁵. The current results also agreed with Bashir (1986), who showed the peak population of *C. carnea* in central Sudan to be found during October-November, late in the rainy season¹⁷. On the other hand, the abrupt buildup of syrphids in winter confirmed what have been stated by Bashir (1968) and Satti et al., (1998)^{1,5}.

CONCLUSION

The study revealed the presence of diversified predatory species associated with okra crop at El-Gorair scheme in northern Sudan. These predators manifested variable seasonality trends which seem to be connected with their preferable preys' abundance on the crop, a relationship that needs to be clarified. The dominant occurrence of *Chrysoperla carnea* all the year round may suggests its potential role in combating the okra pests such as *Bemisia tabaci*, and invites additional studies on this species to be exploited in proper way.

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Common names	Scientific names	(Order: Family)
Ladybirds	Hippodamia variegata	(Coleoptera: Coccinellidae)
	Scymnus spp. (two species)	
	Coccinella undecimpunctata	
Green lacewing	Chrysoperla carnea	(Neuroptera: Chrysopidae)
Hoverfly	Ischiodon aegyptium	(Diptera: Syrphidae)
	Ischiodon sp.	
Mantids	Mantis spp. (two species)	(Dictyoptera: Mantidae)
Spiders	5 unidentified species	(Araneida: Salticidae, Thomisidae and other cob-web weavers)

Table 1. The major predators recorded on okra (*Abelmoschus esculentus*) crop at El-Gorair scheme in Northern State, during 2009/10.



Plate 1. Left). A syrphid larva feeding on *Aphis gossypii*, Right). Adults of *Bemisia tabaci* trapped in spider's nets.

Table 2. The monthly population means of major predators on okra (*Abelmoschus esculentus*) crop at El-Gorair scheme in Northern State, during the period Aug. 2009-July 2010.

Predators	Monthly population means											
	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.
<i>Hippodamia variegata</i>	0.0	0.0	0.0	0.0	1.0	1.6	0.2	0.0	3.2	5.9	0.6	0.4
<i>C. undecimpunctata</i>	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	1.5	0.9	0.0	0.0
<i>Scymnus</i> sp.	0.0	0.0	0.0	4.1	10.9	7.1	3.6	1.9	3.1	4.3	5.5	0.0
<i>Chrysoperla carnea</i>	6.1	2.5	10.6	13.8	10.5	5.9	9.9	3.6	5.4	6.1	3.3	0.8
<i>Ischiodon</i> spp.	0.0	0.0	0.0	0.0	14.7	10.7	5.1	2.5	0.0	0.5	0.7	0.0
Mantids	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.1	0.0	0.0	0.2
Spiders	1.7	1.4	11.4	12.4	8.1	4.6	4.1	2.4	5.0	6.1	7.7	4.4

C.= *Coccinella*

Table (3). Comparisons of seasonal population densities of the different predators recorded on okra crop at El-Gorair scheme in Northern State, during 2009/2010.

Predators	Summer	Autumn	Winter	Overall mean
Hippodamia variegata	2.5bc	0.0 b	0.7 c	1.1 b
Coccinella undecimpunctata	0.6cd	0.2 b	0.0 c	0.3 b
Scymnus sp.	3.2 b	1.0 b	5.9ab	3.4ab
Chrysoperla carnea	3.9ab	8.3 a	7.5ab	6.6 a
Ischiodon spp.	0.3cd	0.0 b	8.3 a	2.9ab
Mantids	0.1 d	0.0 b	0.1 c	0.1 b
Spiders	5.8 a	6.7 a	4.8 b	5.8 a
C.V.%	61.5	115.1	61.2	84.6

Means followed by the same letter (s), in each column, are not significantly different ($p=0.05$), according to Duncan's Multiples Range test.

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