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BIODIVERSITY OF INSECT SPECIES ON BERSEEM ECOSYSTEM

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ABSTRACT

A field study related to biodiversity of insect species on berseem ecosystem was conducted. In order to collect pests and natural enemies, methods like *In Situ* plant count, sweep net, and yellow sticky trap were used in the study. The experimental results indicated that in *In Situ* plant count method the population remained maximum (274.18) for aphid as compared to other insects including, thrips (27.00); whitefly (34.10); diamondback moth (12.05); cutworm (27.84); gram pod borer (16.2); tobacco caterpillar (13.2); lucerne caterpillar (21.5); lucerne weevil (25.2) and green stink bug (13.63) per 10 tillers. The total of individuals collected through *In Situ* plant count method was 465.35 and species was 10. The Sweep net method indicated that the population of aphid, thrip, whitefly, diamondback moth, cutworm, gram pod borer, tobacco caterpillar, lucerne caterpillar, lucerne weevil, and green stink bug was 217.97, 130.53, 158.10, 136.80, 47.49, 116.20, 50.28, 21.50, 101.20 and 113.36 per 10 sweeps, respectively. The total individuals collected through this sweep net method were 1093.43 and species were 10. The insect pests captured through yellow sticky method indicated that the population of aphid, thrip, whitefly and diamondback moth was 243.00, 175.18, 158.10 and 22.80 per 10 yellow sticky traps, respectively. The total individuals collected through yellow sticky trap method were 599.08 and species were 4. The predators collected through *In Situ* plant method indicated that the population of zigzag, 11-spotted, 7-spotted, brumus beetle, rove beetle hoverfly, damsel bug pirate, bug lacewing and wasp was 63.52, 27.32, 7.95, 7.50, 22.90, 26.05, 30.92, 43.56, 28.54 and 19.83 per 10 tillers, respectively. The total individuals collected through *In Situ* method were 278.09 and species were 10. In sweepnet method the population of zigzag, 11-spotted, 7-spotted, brumus beetle, rove beetle, hoverfly, damsel bug, pirate bug, lacewing, wasp was 87.84, 37.47, 10.33, 13.05, 21.37, 62.12, 50.66, 62.52, 39.75 and 40.49 per 10 sweeps. The total individuals (predators and parasitoid) collected through *In Situ* plant count and sweep net methods were 278.09 and 425.6, respectively and species were 10. It is concluded that berseem holds a high conservatory potential for control of soft bodied insect pests due to its harboring a large number of predators and parasitoids i.e., coccinellids, syrphid, chrysopid larvae, carabids, spiders, hymenopteran and parasitoids.

Keywords: Berseem**,** biodiversity, ecosystem, Insect.

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INTRODUCTION

Berseem is an important Rabi (winter) fodder crop, originated from ancient Egypt. It is grown as fodder crop in Egypt, India, Israel, Syria, Iran, Cyprus, Italy, South Africa, South America, Australia and Pakistan (Mari, 2006). It is cultivated in rotation with cotton crop. No fodder crop can compete with berseem in quality and quantity because it requires climate free of high temperatures and frost like that of Sindh. The agro-ecosystem of berseem is appropriate for the study of insect species that occur early and remain all over the season (Harper *et al.,* 1994). Attack by natural enemy can severely depress pests; they are either consumed or parasitised by a range of specialist and generalist coccinellids, syrphid, chrysopid larvae, carabids, spiders, hymenopteran parasitoids, and entomophagous fungi (Kidd and Jervis, 1995).

Host variety and preponderance of natural enemies vary with crop species, management regimes and seasons (French *et al*., 2001). Although abiotic factors, natural enemies and plant suitability have all been implicated as determinants of the seasonal population of pests, none has been shown definitively to be the sole factor responsible for rapid decline (Bernays and Chapman, 1994). The poor profitability of crop production and concerns about the impact of insecticides on beneficial organisms and the environment in general all presage the eventual adoption of biological control in pest management programs (Webster and Amosson, 1995). Through a field survey an attempt has been made to ascertain if berseem crop could help to increase the number of predatory insects and to determine the period of time during which predatory insects had an impact on pest population.

MATERIALS AND METHODS

The present field and laboratory studies “Biodiversity of insect species on berseem ecosystem” were conducted at Department of Plant Protection, Sindh Agriculture University, Tandojam, for three years. The work included insect diversity and insect population fluctuation. The meteorological data were obtained from Drainage and Reclamation Institute of Pakistan, (DRIP), Tandojam.

Insect diversity in berseem ecosystem

Different sampling techniques were employed to collect various insect specimen and classified taxonomically. The placement of the insects was carried out on the trophic level vis-a-vis the berseem crop. The insect diversity connoted the identification of insects either as pests and predators. Four berseem fields at different sites at University Campus were selected and each site was surveyed during winter. Berseem was sown in the second half of November. All common agronomic practices were followed. No pesticide was used either for pest or weed control throughout the growing period. Observations on insect population were made at weekly intervals that started from 3rd week of December to 3rd week of

March. In order to collect pests and natural enemies, methods such as *In Situ* plant count, Sweep net and the Yellow sticky trap methods were used.

Observations on mature 50 tillers taken as representative samples for *In Situ* plant counts were used. Five sampling units (replications) were selected at random from each field at each observation and counting of all harmful and harmless insects was made. Four spots were selected randomly for sweep net method, in each field. A California type ground sweepnet (dia of 38 cm) was used for collection. Each sampling unit comprised of five sweeps and each sweep was taken from 5 square meter area selected at random in the field. Insects thus collected were put in a plastic bag, and kept in the freezer for 15 minutes to immobilize. They were sorted out and counted for each species. Five yellow sticky trap (453 cm^2) sizes were installed randomly in each experimental field. The insects were identified from the Insect Museum, Entomology Department, Sindh Agriculture University Tandojam. Confirmation was obtained from the Institute of Biological Control, Islamabad, Pakistan.

RESULTS

Insect diversity in berseem ecosystem

Insect pests are so diverse that in order to control them through biological control program, it is necessary to identify them. The effectiveness of both proactive and reactive management measures depends on correct identification.

Insect identification

Insect pests and predators were recorded in berseem ecosystem from 3rd week of December to 3rd week of March (Tables 1 and 2). Ten insect pests and the same number of predator species were collected from the selected plots which were: alfalfa aphid, *Therioaphis trifolii* (M.); thrip, *Thrips tabaci* (L.); whitefly, *Bemisia tabaci* (G.); cutworm, *Agrotis ipsilon* (H.); gram pod borer, *Heliothis armigera* (H.); tobacco caterpillar, *Spodoptera litura,* (F.); lucerne caterpillar, *Spodoptera exigua* (H.); diamondback moth, *Plutella xylostella* (L.); lucerne weevil, *Hypera posticae* (F.) and green stink bug, *Nezara viridula* (L.).

Species richness indices

The data on the quantitative aspects of insect pest diversity obtained through *In Situ* plant count, sweepnet, and yellow sticky trap methods in berseem ecosystem are produced in Tables 3 and 4.The experimental results indicated that in *In Situ* plant count method the population of aphid was maximum (274.18) as compared to other insetces including thrips (27.00), whitefly (34.10), diamondback moth (12.50), cutworm (27.84), gram pod borer (16.2), tobacco caterpillar (13.2), lucerne caterpillar (21.5), Lucerne (25.2) and green weevil bug (13.63). The total individuals collected through *In Situ* plant count method were 465.35 and species were 10 (Table 3). Sweepnet method indicated that the population of aphid, thrip, whitefly, diamondback moth, cutworm, gram pod borer,

tobacco caterpillar, lucerne caterpillar, lucerne weevil and green stink bug was 217.97; 130.53; 158.10; 136.80; 47.49; 116.20; 50.28; 21.50; 101.20 and 113.36 per 10 sweeps, respectively. The total individuals collected through sweep net method were 1093.43 and species were 10.

The insect pests captured through yellow sticky method indicated that the population of aphid, thrip, whitefly and diamondback moth was 243.00, 175.18, 158.10 and 10 22.80 per 10 yellow sticky traps respectively. The total individuals collected through yellow sticky trap method were 599.08 and species were 4. The population of coccinellid predators collected through *In Situ* method indicated that the population of zigzag, 11-spotted, brumus beetle, 7-spotted, rove beetle, hoverfly, damsel bug, pirate bug, lacewing and wasp was 63.52, 27.32, 7.95, 7.50, 22.90, 26.05, 30.92, 43.56, 28.54 and 19.83 per 10 tillers respectively. The total individuals collected through *In Situ* method were 278.09 and species were 10. In sweepnet the population of zigzag was 87.84; 11-spotted was 37.47; 7-spotted was 10.33; brumus beetle was 13.05; rove beetle was 21.37; hoverfly was 62.12; damsel bug was 50.66; pirate bug was 62.52; lacewing was 39.75 and wasp was 40.49 per 10 sweeps. The number of predators and parasitoid recorded through this method were 425.6 as individuals and 10 as species (Table 4).

DISCUSSION

All insect pests and their predators are diverse in their characteristics, feeding behavior and choice of food. The sucking insect pests (alfalfa aphid, thrip, whitefly and stink bug) appeared in crop in a large number (Table 3). The aphid was abundant as compared to other sucking insect pests. Our results are in agreement with those of Mari *et al* (2007), who reported that sucking pests appeared on leaves and were present till the crop reached to the maturity. Besides, the cutworm, gram pod borer, tobacco lucerne caterpillar and weevil were also found. Gillespie and Kemp (1995) collected species of the gram pod borer in wheat and berseem crops. They observed that the pest was highly damaging to the crops. Similarly, Dubey *et al.* (1995) encountered cutworm and the gram pod borer in berseem. Elawad *et al.* (1996) reported that leaf worm was a major pest in berseem. Wright (1995) and DeGooyer *et al.* (1996) observed strong phenological relation between growth of lucerne and weevil population.

At the same time there was a sizeable number of zigzag, 7-spotted, brumus and rove beetle (Table 4). Pugalenthi and Livingstone (1997) reported that population fluctuation of the aphid and zigzag beetle depended on each other and a significant positive correlation existed between them. Devi *et al*. (1999) observed that *M. sexmatulatus*, *C. septempunctata* and *C. transversalis* were abundant in aphid colonies. Their population synchronized with that of aphids. Agarwala and Bardhanroy (1999) reported that *M. sexmatulatus* and *C. transversalis* occurred abundantly in berseem, which infested with *Aphis craccivora* Koch; the population of adult coccinellids increased in response to the aphid. In present study zigzag, 11-spotted, 7-spotted, brumus, rove beetles, hoverfly, damsel bug, pirate bug, lacewing and wasp were observed in berseem crop (Table 4).

Similarly, Zhang *et al*. (2000) found a large number of natural enemies in alfalfa crop. The same was observed by Gutierrez *et al*. (1995).

Table 1. Taxonomic status of herbivorous insects associated with berseem crop.

Common name	Technical name	Family	Order	Pictures
Alfalfa aphid	*Therioaphis trifolii* (M.)	Aphidae	Homoptera	
Tobacco thrip	*Thrips tabaci* (L.)	Thripidae	Thysanoptera	
Whitefly	*Bemisia tabaci* (G.)	Aleyrodidae	Homoptera	
Cutworm	*Agrotisi psilon* (H.)	Noctuidae	Lepidoptera	
Gram pod borer	*Heliothis rmigera* (H.)	Noctuidae	Lepidoptera	
Tobacco caterpillar	*Spodoptera litura,* (F.)	Noctuidae	Lepidoptera	

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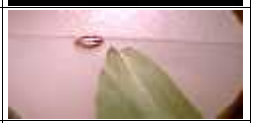
Lucerne caterpillar	*Spodoptera exigua* (H.)	Noctuidae	Lepidoptera	
Diamondback moth	*Plutella xylostella* (L.)	Plutelidae	Lepidoptera	
Lucerne weevil	*Hypera posticae* (F.)	Curculionidae	Coleoptera	
Green stink bug	*Nezara viridula* (L.)	Pentatomidae	Hemiptera	

Table 2. Taxonomic status of carnivorous insects associated with berseem crop.

Common name	Technical name	Family name	Order	Pictures
Zigzag beetle	*Menochilus sexmaculatus* (F.)	Coccinellidae	Coleoptera	
11-spotted Beetle	*Coccinella undecimpunctata* (L.)	Coccinellidae	Coleoptera	
7-spotted Beetle	*Coccinella semtempunctata* (L.)	Coccinellidae	Coleoptera	
Brumus Beetle	*Brumus suturalis* (F.)	Coccinellidae	Coleoptera	
Rove beetle	*Paederus fuscipes*(PF.)	Staphylinidae	Coleoptera	

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pageHoverfly	*Syrphid* sp.	Syrphidae	Diptera	
Damsel bug	*Nabis* sp.	Nabidae	Hemiptera	
Pirate bug	*Orius laevigatus* (F.)	Anthocoridae	Hemiptera	
Lace wing,	*Chrysoperla carnea*(S.)	*Chrysopidae*	Neuroptera	
Wasp	*Aphidius ervi* (H.)	Braconidae	Hymenoptera	

Table 3. Total number of insect pests collected in berseem ecosystem.

Species	*In Situ* plant count	Sweepnet	Yellow sticky traps
Aphid	274.18	217.97	243.00
Thrip	27.00	130.53	175.18
Whitefly	34.10	158.10	158.10
Diamond back moth	12.50	136.80	22.80
Cutworm	27.84	47.49	0.00
Gram pod borer	16.20	116.20	0.00
Tobacco caterpillar	13.20	50.28	0.00
Lucerne caterpillar	21.50	21.50	0.00
Lucerne weevil	25.20	101.20	0.00
Green stink bug	13.63	113.36	0.00
Total No. individuals	N= 465.35	1093.43	599.08
Total No. Species	S= 10	10	4

Khuhro *et al.* (2002) reported that predators were more abundant in alfalfa crop than in cotton. It could be due to frequent irrigations given to alfalfa crop that favored pest population as food for natural enemies. Refer to our study the Lucerne weevil was in huge number in the crop. Desneux *et al*. (2006) reported

that weevil was major pest of alfalfa but controlled by a wasp *Aphidius ervi.* Table 4 indicates that the number of predator species in *In Situ* plant count and sweep net was 10 in each. Its value was the highest for *In Situ* plant count. This value is an indication of decrease in diversity. It is clear that 58.92% of total observed individuals were aphids. The remaining 9 (41%) were other species. The species diversity in the sampling by traps is less than in sweep net and plant count. There were only 4 species of which 40.56% were aphids, 29.24% thrips, 26.39% whitefly and 3.8% hoppers. As such the sweepnet was more effective for species diversity and relative frequency. It is in agreement with those of Khuhro *et al*. (2002). They reported that sweepnet was better than direct plant count method. Leathwick and Penman (1999) used sweep and D-vac net and recommended sweepnet for collecting the coccinellids.

Table 4. Total number of predators and parasites collected in berseem ecosystem.

Species	*In Situ* plant count	Sweep net
Zigzag beetle	63.52	87.84
11-spotted beetle	27.32	37.47
7-spotted beetle	7.95	10.33
Brumus beetle	7.50	13.05
Rove beetle	22.90	21.37
Hoverfly	26.05	62.12
Damsel bug	30.92	50.66
Pirate bug	43.56	62.52
Lace wing	28.54	39.75
Wasp	19.83	40.49
Total No. Individuals N=	278.09	425.6
Total No. Species S=	10	10

CONCLUSION

Bereem holds a high conservatory potential for control of soft bodied insect pests due to its harboring a large number of predators and parasitoids i.e., coccinellids, syrphid, chrysopid larvae, carabids, spiders, hymenopteran and parasitoids. Of all the predators coccinellids are more important because of their biology, ecology, abundance, high aphid consumption rates, good searching capacity and predation activity. They are celebrated as effective and efficient biological control agents worldwide. The adults and young stages of both are predacious of soft-bodied insect pests. Based on the field data of predators in the present study, it is advisable that berseem crop should be grown in strips near cash crops. This practice would certainly be a step toward exploitation of natural enemies against many insect pests.

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