

Qualitative and quantitative faunal complex of cotton and their natural enemies in semi arid eastern plain of Rajasthan

■ S.R. DHAKA

ABSTRACT : Investigation on qualitative and quantitative faunal complex of cotton and their natural enemies in semi arid eastern plain of Rajasthan was carried out. Fourteen insect pests were recorded on cotton in the zone. Of which, jassid, whitefly, spotted bollworms, pink bollworm, and American bollworm were found as important one. The survey revealed 11 natural enemies of insect pests of cotton. Of which, spider, chrysopa and coccinellids were found important. The incidence of both jassid and whitefly started from second and third week of June, population increased gradually and reached to its peak in the month of August and first week of October, respectively. Low population of thrips, aphid and mite was recorded for short duration. The infestation of spotted bollworms started in the second fortnight of June, increased gradually and reached to its peak in first week of August and first week of October. The infestation of pink bollworm started in second fortnight of July, increased gradually and reached to its maximum in the last week of September and first week of October. The incidence of American bollworm was recorded from middle of August. The larval population and infestation gradually increased and reached to its peak in the middle of October.

Key Words : Agriculture, Cotton, Insect pests, Natural enemies

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AUTHOR FOR
 CORRESPONDENCE :

S.R. DHAKA
 Agricultural Research Sub Station,
 Diggi, TONK (RAJASTHAN) INDIA

Cotton, the White Gold is the most important commercial fibre crop in India as well as in many countries of the world influencing their economic development. In India, it is grown in 9.25 million hectare and ranks first in world in area and third in production with 16.88 million bales. About five per cent of the gross cropped area of our country is under cotton cultivation, of which 30 and 70 per cent is irrigated and rainfed, respectively. It is grown in Maharastra, Punjab, Andhra Pradesh, Karnataka, Haryana, Rajasthan, Madhya Pradesh and Tamil Nadu. Nevertheless, the productivity and average yield is only 310 kg and 170 kg ha⁻¹, respectively, whereas, the average world productivity of cotton is 583 kg ha⁻¹ (Anonymous, 1999a). In Rajasthan, cotton is grown in 0.44 million hectare with 175 kg ha⁻¹ production (Anonymous, 2004).

One of the several factors responsible for low productivity and quality deterioration of cotton, is the attack of various insect pests right from the time of planting till harvesting of the crop. Hargreaves (1984) listed 1326 insect pests on cotton throughout the world, but in India, the crop is attacked by 162 insects, of which nine are considered as key

pests in different zones causing 50-60 per cent losses of seed cotton yield (Dhawan, 2004). The sucking insect pests viz., jassid, *Amrasca biguttula biguttula* Ishida, whitefly, *Bemisia tabaci* Gennadius and the bollworm complex viz., spotted bollworm, *Earias* spp., pink bollworm, *Pectinophora gossypiella* Saunders and American bollworm, *Helicoverpa armigera* Hubner are the major pests posing a serious threat to cotton production in our country.

Most cotton agro-ecosystems besides predators and parasites have a rich complex of naturally occurring entomophagous arthropods and entomopathogenic micro-organisms. The conservation of native natural enemies may be a promising factor in combating cotton insect pests problem in India. *Chelonus blackburni* Cameron, *Trichogramma achaeae* Nagraja, *T. brasiliensis* Ashmead, *Bracon* spp., *Chrysoperla carnea* Stephens, *Coccinella septempunctata* Linnaeus, *Menochilus sexmaculatus* Fabricius and spiders have been observed as potential parasitoids of key pests of cotton and play an important role in the cotton ecosystem.

A thorough knowledge of seasonal activity of different

insect pests determines the predisposing climatic factors affecting their population dynamics. Survey on insect pests in a particular agro-climatic zone provides the information about type of insects and their status, which helps in developing efficient pest management strategies. The present study is expected to generate know how about qualitative and quantitative faunal complex of cotton and their natural enemies in semi arid eastern plain of Rajasthan.

RESEARCH PROCEDURE

Periodical surveys on qualitative and quantitative composition of insect pests of cotton crop were conducted in Zone III A, Semi arid eastern plain, of Rajasthan. A total of four locations *i.e.* farmers field of four villages *viz.*, Lamba Hari Singh, Deval, Arain and Haripura were selected from the cotton growing belt of this zone.

Observations were made on quality and intensity of sucking pests on whole plant initially and later on three leaves per plant, one each from top, middle and bottom of ten randomly selected plants. The infestation of bollworm complex on plants was recorded by counting larval population on shed and retained reproductives. The occurrence of natural enemies was recorded simultaneously with the pest population. The crop was surveyed at weekly interval right from one week after germination to harvesting of the crop.

RESEARCH ANALYSIS AND REASONING

The experimental findings obtained from the present study have been discussed in following heads:

Qualitative faunal complexes of cotton and their natural enemies :

The insect pests infesting cotton alongwith their natural enemies recorded during the study have been presented in Table 1 and 2.

The quantitative investigation on the season of incidence of jassids, whiteflies, thrips, aphids and mites; bollworms *viz.*, spotted, pink and American bollworm in cotton and their important predators *viz.*, spider, chrysopa and coccinellids was also conducted.

The fourteen insect pests *viz.*, one Isopteran, one Thysanopteran, one Coleopteran, one Acarinan, five Hemipterans and five Lepidopterans were recorded on cotton in the zone. The present study corroborates with those of Borah (1995) and Dhawan (2000) who have reported 12 and 162 species of insect pests, respectively, infesting cotton in India.

Out of 14 insect pests recorded during survey, jassid, whitefly, spotted bollworm, pink bollworm, and American bollworm emerged as important ones. The present finding gets support from the observations of Bhatnagar and Davies (1978), Agarwal and Katiyar (1979) and Mathur (2001).

The survey revealed 11 natural enemies of different insect pests of cotton *viz.*, five insects, one spider and five birds. Out of these, spider, chrysopa and coccinellids emerged as important one. The present findings are in agreement with those of Kapadia and Puri (1989) who reported 17 natural enemies of *Bemisia tabaci*, out of which chrysopa was important one. Murlidharan and Chari (1992) reported 17 species of spiders associated with insect pests of cotton and Patel *et al.* (2000) reported chrysopa and coccinellids as predators of sucking pests, corroborates the findings.

Table 1 : Insect pests faunal complex of cotton recorded in semi arid eastern plain of Rajasthan

Sr. No.	Common name	Scientific name	Family	Order
Sucking Pests				
1.	Termite	<i>Microtermes obesi</i> Holmgren	Termitidae	Isoptera
2.	Cutworm	<i>Agrotis ipsilon</i> Hufnagel	Noctuidae	Lepidoptera
3.	Thrip	<i>Thrips tabaci</i> Lindeman	Thripidae	Thysanoptera
4.	Jassid	<i>Amrasca biguttula biguttula</i> Ishida	Cicadellidae	Hemiptera
5.	Whitefly	<i>Bemisia tabaci</i> Gennadius	Aleurodidae	Hemiptera
6.	Aphid	<i>Aphis gossypii</i> Glover	Aphididae	Hemiptera
7.	Leaf-roller	<i>Sylepta derogate</i> Fabricius	Pyraustidae	Lepidoptera
8.	Red cotton bug	<i>Dyesdercus koenigii</i> Fabricius	Pyrrhocoridae	Hemiptera
9.	Dusky cotton bug	<i>Oxycarenus laetus</i> Kirby	Lygaeidae	Hemiptera
10.	Mite	<i>Tetranychus macfarlanei</i> Baker and Prichard	Tetranychidae	Acarina
11.	Grey weevil	Desbrocher	Curculionidae	Coleoptera
Bollworms				
1.	Spotted bollworm	<i>Earias insulana</i> Boisduval <i>E. vitella</i> Fabricius	Noctuidae	Lepidoptera
2.	Pink bollworm	<i>Pectinophora gossypiella</i> Saunders	Gelechiidae	Lepidoptera
3.	American bollworm	<i>Helicoverpa armigera</i> Hubner	Noctuidae	Lepidoptera

Table 2: Natural enemies of insect pests of cotton recorded during surveys

Sr. No.	Common name	Scientific name	Family	Host	Stage attacked
A. Insects					
1.	Chrysopa	<i>Chrysoperla carnea</i> Stephens	Chrysopidae	Almost all cotton pests	Egg, nymph, smaller and adult
2.	Coccinellids	<i>Coccinella septempunctata</i> Linnaeus <i>Menochilus sexmaculatus</i> Fabricius <i>Brunoides suturalis</i> Fabricius <i>Hippodamia variegata</i> Goeze	Coccinellidae	Aphid, jassid, mites, whitefly, thrips	Nymph and adult
3.	Syrphid fly	<i>Syrphus serarius</i> Wiedmann	Syrphidae	Aphid	Nymphs and adult
4.	Wasp	<i>Vespa orientalis</i> Linnaeus	Vespidae	Leaf roller, American and spotted bollworm	Larva
5.	Preying mantid	<i>Mantis religiosa</i>	Mantidae	Whitefly, thrips	Nymph and adult
B. Spider					
6.	Spider	<i>Distina albida</i> Linnaeus	Araneae	Bollworms, Jassid, Leaf roller	Nymph, larva and adult
C. Birds					
7.	House sparrow	<i>Passer domesticus</i> Linnaeus	Passeridae	Bollworms	Larva and adult
8.	House crow	<i>Corvus splendens</i> Vieillot	Corvidae	Bollworms	Larva and adult
9.	King crow	<i>Dicrurus adsimilis</i> Bech.	Dicruridae	Bollworms	Larva and adult
10.	Indian mynah	<i>Acridotheres tristis</i> Linnaeus	Sturnidae	Bollworms	Larva and adult
11.	Partridges	<i>Francolinus pondicerianus</i> Gmelin	Turnicidae	Bollworms	Larva and adult

Table 3 : Population dynamics of insect pests of cotton

Month	Std. week	Sucking insect pests (Population/30 leaves*)					Bollworms (Larval population/10 plant *)		
		Jassid	Whitefly	Thrips	Aphid	Mite	Spotted	Pink	American
May	21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
June	22	0.00	0.00	8.00	0.00	0.00	0.00	0.00	0.00
	23	8.00	9.50	14.75	0.00	0.00	0.00	0.00	0.00
	24	14.25	8.25	29.25	0.00	0.00	0.00	0.00	0.00
	25	16.75	9.75	41.00	0.00	0.00	0.00	0.00	0.00
July	26	20.50	10.25	32.25	0.00	0.00	2.75	0.00	0.00
	27	32.75	15.50	24.25	0.00	0.00	2.00	0.00	0.00
	28	36.25	83.25	17.00	0.00	0.00	1.75	1.25	0.00
	29	49.75	87.75	8.75	0.00	0.00	2.75	2.50	0.00
	30	57.75	87.00	3.25	0.00	0.00	3.25	2.75	0.00
Aug.	31	68.25	113.75	1.00	0.00	0.00	3.75	3.25	0.00
	32	72.75	137.25	0.00	0.00	0.00	3.75	3.25	1.50
	33	90.25	149.25	0.00	0.00	0.00	3.25	5.75	2.50
	34	63.50	149.00	0.00	0.00	0.00	3.00	3.25	1.75
Sept.	35	59.00	158.75	0.00	0.00	0.00	3.25	3.00	3.25
	36	57.75	164.50	4.25	0.00	0.00	4.75	5.00	4.75
	37	49.25	247.25	7.25	0.00	0.00	6.25	5.75	3.00
	38	37.00	278.00	11.00	0.00	0.00	9.75	8.50	5.75
	39	63.50	489.75	22.00	9.50	8.25	12.25	11.25	6.75
Oct.	40	73.75	538.25	43.25	26.25	20.75	8.25	9.50	5.00
	41	58.50	473.25	21.75	54.25	36.25	7.50	8.25	6.75
	42	29.75	367.50	13.00	83.00	28.75	7.25	7.75	6.50
	43	23.50	249.75	4.25	50.00	19.50	6.25	6.00	7.75
Nov.	44	27.25	261.25	3.50	28.50	11.75	6.00	5.50	6.25
	45	18.75	92.00	1.00	12.25	6.00	3.50	4.00	4.75
	46	17.50	61.50	0.00	0.00	0.00	3.75	3.25	3.25
	47	17.25	32.25	0.00	0.00	0.00	2.75	3.00	4.00
Dec.	48	9.50	27.25	0.00	0.00	0.00	2.50	3.00	0.00

*Mean of four locations

Quantitative faunal complexes of cotton and their natural enemies sucking pests :

Jassid (Amrasca biguttula biguttula Ishida) :

The data presented in Table 3 indicated that the population of jassid ranged from 8.00 to 90.25 jassids/30 leaves. The incidence of jassid was recorded from 3rd week of June, reached to its peak in August in both the years. Butani (1970) and Sidhu and Dhawan (1980) reported the maximum activity of jassid from August to October and July-August corroborates the present investigation. The slight variation in the activity of the insect may probably be due to the difference in agro-climatic conditions of the place.

Whitefly (Bemisia tabaci Gennadius)

It is evident from Table 3 that the population of whitefly

was initiated from 24th June and continued till harvesting of the crop. The population ranged 8.25 to 538.25 whiteflies/30 leaves. The peak period of infestation was recorded in the first week of October. These results corroborate with the findings of Singh and Butter (1985), Khodke and Dagaonkar (1992), Gather (1994) and Dhawan *et al.* (2002) who reported that build up of the population of whitefly started in August and reached to its peak in September.

Thrips (Thrips tabaci Lindeman) :

The incidence of thrips started in the 1st week of June and reached to its peak (41.00 thrips/ 30 leaves) in the 4th week of June. The population declined thereafter and again increased in the 1st week of October (43.25 thrips/ 30 leaves) showing two peaks (Table 3). Patel and Rote (1995) reported low population

Table 4 : Population dynamics of natural enemies of insect pests of cotton

Month	Std. week	Population/10 plants *		
		Spider	Chrysopa	Coccinellid
May	21	7.50	0.00	0.00
June	22	6.25	0.00	0.00
	23	13.50	0.00	0.00
	24	9.50	0.00	0.00
	25	7.50	2.25	0.00
July	26	9.75	5.00	0.00
	27	8.75	5.75	0.00
	28	17.25	5.75	0.00
	29	19.00	7.00	0.00
Aug.	30	17.25	5.25	0.00
	31	13.50	9.50	0.00
	32	7.50	4.25	0.00
	33	6.25	6.50	0.00
Sept.	34	7.75	7.50	0.00
	35	4.25	3.75	0.00
	36	4.25	7.50	2.50
	37	5.50	9.25	4.50
	38	7.50	7.75	5.25
Oct.	39	11.75	5.00	5.75
	40	9.00	6.25	7.25
	41	7.25	3.50	11.50
	42	5.50	6.00	17.50
Nov.	43	4.75	9.50	18.75
	44	5.00	11.25	19.00
	45	3.75	13.50	13.25
	46	3.50	13.50	14.50
Dec.	47	6.25	9.25	12.00
	48	3.00	7.50	11.75

* Mean of four locations

of thrips ranging from 0.61 to 4.64 per plant from 1st week of August to 2nd week of October partially corroborates the present investigation. These results are in agreement with that of Sharma *et al.* (2004) who reported thrips (1.00-1.40 thrips/leaf) in cotton throughout the crop season.

Aphid (Aphis gossypii Glover) :

The incidence of aphid remained for a short duration *i.e.* from 39th standard week (sw) to 45th sw ending 30th September to 11th November. The population of aphid ranged between 9.50-83.00 aphids/30 leaves which reached to its peak of 83.0 aphids/30 leaves, in 42nd sw ending 21st October (Table 3).

Mite (Tetranychus macfarlanei Baker and Prichard) :

The mite infestation in cotton was recorded for a short period *i.e.* 39th sw to 45th sw (ending 30th September to 11th November). The mites ranged between 8.25 to 36.25 mites/30 leaves. The maximum population was recorded (32 mites/30 leaves in 2001 and 36.25 mites/30 leaves in 2002) in 41st sw (Table 3). The present results are in conformity with that of Patel and Rote (1995) who reported the incidence of mite from 1st week of October to 2nd week of November. Contrary to this, Bhat *et al.* (1984) reported mite as a major pest of cotton.

Bollworm complex :

Data regarding the quantitative observations of infestation of bollworm complex (Spotted bollworms, Pink bollworm and American bollworm) are presented in Table 3 and discussed below.

Spotted bollworm (Earias insulana Boisduval, E. vitella Fabricius) :

The infestation of spotted bollworm started from 4th week of June. Peak (12.25 larvae/ 10 plants) was found in last week of September. The population persisted throughout the cropping period. The present findings are in agreement with those of Srivastava and Bhatnagar (1960) and Sharma *et al.* (2004) who reported the activity of spotted bollworm throughout the crop season.

Pink bollworm (Pectinophora gossypiella Saunders) :

The larval population and infestation of pink bollworm was observed from 22nd July. The larval population ranged between 1.25 to 11.25 larvae/ 10 plants. The maximum activity of the pest was observed in the last week of September. The activity of pink bollworm was reported from mid August to

September (Anonymous, 1999b), from 3rd week of November (Mohapatra *et al.*, 2004) and from 2nd week of August (Sharma *et al.*, 2004), corroborate the present finding. Sharma *et al.* (2004) reported the peak period of infestation of pink bollworm in the 2nd week of October, support the present findings.

American bollworm (Helicoverpa armigera Hubner) :

The incidence of American bollworm was initiated from 2nd week of August which persisted throughout the crop season. The maximum population was recorded in 3rd week of October. The incidence of American bollworm was reported during 2nd fortnight of August till harvesting of the crop (Sharma *et al.*, 2004), from mid August (Anonymous, 1999), last week of August to 1st week of January (Jawalkar *et al.*, 2004) and from 2nd fortnight of July (Saini *et al.*, 2004) support the present finding. The present findings are in agreement with those of Jawalkar *et al.* (2004) and Saini *et al.* (2004) who reported the peak period of incidence of American bollworm from end of September to early October.

Natural enemies :

Spider (Distina albida Linnaeus) :

The population of spider was observed from the last week of May and persisted throughout the crop period. The population ranged from 3.00 to 19.00 spiders/10 plants, being maximum in the month of July (Table 4). The present findings are in agreement with that of Sharma *et al.* (2004) who reported 0.2 - 0.3 spider/ plant in the month of June-July.

Chrysopa (Chrysoperla carnea Stephens) :

The population of chrysopa was observed 4th week of June which ranged between 2.25 to 13.50 chrysopa/10 plants. The population was present throughout the crop period being maximum in November. The finding is supported by earlier work carried out by Patel *et al.* (2000) (0.67/plant), Sharma *et al.* (2004) (0.52-2.0 eggs/leaf) and Godhani *et al.* (2005) (31.40/ 25 plants), supports the present findings.

Coccinellids (Coccinella septempunctata Linnaeus) :

The activity of coccinellids started from 2nd week of September (Table 4). The population ranged between 2.50 to 19.00 per 10 plants, being maximum in the month of November. The present investigations are in agreement with that of Patel *et al.* (2000), Sharma *et al.* (2004) and Godhani *et al.* (2005) who reported 0.64/plant, 0.4-0.5/plant and 39.89 coccinellids / 25 plants, respectively, support the present findings.

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