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Prevalence of Natural Enemies on different Cotton Varieties from Sindh

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Abstract: The field survey on population dynamics of natural enemies on different varieties of cotton were conducted during the year 2010 from June to September. The experiment was laid out in RCBD with four replications and four varieties of cotton i-e CIM-506, CIM-473, CRIS-134 and SHAHBAZ were studied for observing the incidence of seven predators i.e. pirate bug, big eyed bug, green lacewing, stethorus, spider, wasp and ant. The overall mean populations of predators were reported significantly highest on CRIS-134 followed by CIM-506. However, no significant difference was recorded on SHAHBAZ and CIM-473 respectively. Correlation of predator's population with temperature was positive and with rainfall was negative. Analysis of variance showed the significant differences in the population of predators on all the varieties tested during present study.

Keywords: Cotton, Natural Enemies, Green Lacewing, Pirate Bug

INTRODUCTION

Cotton (*Gossypium hirsutum* Linn.) is main fiber crop of Pakistan; it occupies the largest area after wheat, and earns highest export revenue. During the last one and half decades the production of cotton has been doubled in Pakistan but it is still low as compared to major cotton growing countries of the world (Agriculture Statistics 2004). The responsible factors for low yield are insect pests and diseases (Hashmi, 1994 and Lohar, 2001). All insect populations are affected to a greater or lesser extent by natural enemies, meaning the "balance of nature" and natural regulation. Natural enemies of *Helicoverpa zea* and *Heliothis virescens* played an important role in suppressing them. Based on predator data, hemipterans were more abundant than any other species (Vargas 1996). The characteristics of energy uptake use of the *Orius minutus, Geocoris pallidipennis* and some other natural enemies population in cotton fields are subjected varying sowing times, intercropping and tillage system examination (Ge-Feng *et al.*, 1996).

Due to regular cultivation of land, hundreds of insect pests appear that reduce the quality and quantity of crops. Development of the predator population depends on the availability of prey. A number of beneficial insects are found in fields, where their food habits are different. A high reproductive rate is important so that populations of natural enemy can rapidly increase when hosts are available (Solangi *et al.*, 2005).

Several authors have made causal reference to trace natural enemies on cotton varieties. (HanXu 2004) recorded eight species of natural enemies belonging to 8 genera and 5 families in cotton fields, and most of these species composition related to spiders, which are believed to be important natural enemies of cotton pests. Big eyed bug, *Geocoris puntipes* is compact, brightly coloured, most abundant and important predator of many insect species in cotton crop and on all life stages of whiteflies, thrips, aphid, jassid and eggs of the bollworms. The most distinguishing characteristics are their large, bilbing eyes. Bigeyed bug walk with a distinctive "waggle". Both the immature and adults feed by sucking juices from their prey through a "needle-like" beak. Adults and immature can consume dozens of eggs, larvae and adults of *H. zea* per day (Tillman and Mullinix, 2003).

(Wang *et al.*, 1996) reported 8 species of lady bugs, 4 of Green lacewings, 10 of spider mite, 4 of *Epistrophe* spp. and 3 of *Orius* spp from Israel in cotton field He further said that the peck predation period was from 25th June to 15th August, during this period large quantity of egg and larvae were present in field but these information was inadequate and no data is available from this region. Keeping in view, the economic importance of cotton in Pakistan, present study has been carried out from this region. The results of this study might be helpful to pest management agencies for effective control measures in coming future.

MATERIAL AND METHOD

The present study was conducted at Agriculture Research Institute Tandojam, from June to September, 2010. Four cotton varieties *viz.* CIM-506, CIM-473, CRIS-134 and SHAHBAZ were sown in Randomized Complete Block Design (RCBD) with four replications. Drilling method was followed for sowing of cotton seed at the spacing of 30cm (plant to plant) x 75cm (row to row). Ten plants were randomly selected from each replication for weekly observation of predators (*i.e.* Pirate bug *Orius insidiosus*, Green lacewing *Chrysoperla carnea*, Big eyed bug *Geocoris punctipes*, Stethorus *Stethorus punctis*, Wasp spp. Ant spp. and Spider spp.). The plant was observed from bottom to top, first upper and then lower sides of plant leaves were also observed.

The predator population was carefully counted with the help of naked eye. No pesticide was applied in or around the field. Abiotic factors (temperature and rain fall) data were obtained from Agro-metrological Department, Tandojam during cropping season **(Table 1)**. After compilation, the data were correlated with abiotic factors. The data on predators were recorded when the abundance of predator was observed and lasted at the end of Sept. Weekly observation was made on the predator population in the sampling unit separately in each replication and their efficiency was analyzed.

Statistical analysis

The data obtained was statistically analyzed using Mstat-C computer software, to determine superiority of treatment means.

RESULTS

The maximum population of predators per ten plants was reported significantly highest on CRIS-134 (0.52±0.28) followed by CIM-506 with the ratio of 0.38±0.23, however, there was no significant difference (0.28±0.19 and 0.21±0.15) noted on SHAHBAZ and CIM-473 respectively **(Table II)**. However, the overall

Table-I. Average weekly meteorological record of experimental period

Months	Weeks	Temperature °C			Rainfall (mm)
		Maximum	Minimum	Mean	
June	1	41.00	24.78	32.89	0.1
	2	37.00	26.92	31.96	-
	3	40.21	25.14	32.68	0.05
	4	39.50	26.71	33.11	0.05
	5	38.57	28.00	33.29	-
July	6	38.14	27.07	32.61	-
	7	37.78	26.17	32.25	-
	8	36.78	26.57	31.68	-
	09	37.21	26.64	31.93	-
	10	35.42	25.64	30.53	4.31
August	11	34.21	24.50	29.36	-
	12	34.50	25.71	30.11	-
	13	35.64	25.35	29.99	-
	14	34.14	24.64	29.39	-
September	15	36.50	23.85	30.18	-
	16	35.14	25.85	30.50	-
	17	36.78	25.28	31.03	0.1
	18	35.78	24.50	30.14	-

Table-II. Mean population of natural enemies recorded on Cotton Crop during year 2010.

Predators	Cotton varieties			
	CRIS-134	SHAHBAZ	CIM-506	CIM-473
Pirate Bug	0.80	0.43	0.59	0.36
Bigeyed bug	0.95	0.63	0.76	0.48
Green lacewing	0.63	0.31	0.47	0.21
Stethorus	0.33	0.19	0.23	0.15
Spider	0.37	0.16	0.23	0.12
Wasp	0.11	0.07	0.08	0.03
Ant	0.49	0.21	0.33	0.13
Means ±SD	0.52±0.28	0.28±0.19	0.38±0.23	0.21±0.15

means population of natural enemies **(Table III)** revealed that maximum population of Pirate bug was noted on CRIS-134 (0.80), followed by Shahbaz (0.43), CIM-506 (0.59) and on CIM-473 (0.36). The population of Big eyed bug on CRIS-134 was recorded (0.95), followed by Shahbaz (0.63), CIM-506 (0.76) and on CIM-473(0.48), while the inhabitants of Green lacewing on CRIS-134 was (0.63), followed by Shahbaz (0.31), CIM-506 (0.47) and on CIM-473 (0.21) respectively. In case of Stethorus, the population was on CRIS-134 (0.33), followed by Shahbaz (0.19), CIM-506 (0.23) and on CIM-473 (0.15), the incidence of Wasp spp. on CRIS-134 was recorded (0.37), followed by Shahbaz (0.16), CIM-506 (0.23) and on CIM-473 (0.12). The maximum population of Spider spp. on CRIS-134 was 0.11, followed by Shahbaz (0.07), CIM-506 (0.08) and CIM-473 (0.03). While Ant population was recorded on CRIS-134 (0.49), followed by Shahbaz (0.21), CIM-506 (0.33) and on CIM-473 (0.13) respectively.

Table: III. Analysis of variance of mean population of predators in cotton crop.

(a) Pirate bug

Source of variance	DF	SS	MS	Observed F.	Remarks
Replications	3	0.089	0.030	2.20	NS
Intervals (I)	17	22.270	1.310	97.52	**
Varieties (V)	3	8.170	2.723	202.73	**
I X V	51	3.190	0.063	4.66	**
Error	213	2.861	0.013	-	-
Total	287	36.580	-	-	-

Coefficient of variation = 21.40%

Note:

** = Significant at P < 0.01

NS = Non significant

(b) Bigeyed bug

Source of variance	DF	SS	MS	Observed F.	Remarks
Replications	3	0.079	0.026	2.26	NS
Intervals (I)	17	70.687	4.158	358.02	**
Varieties(V)	3	8.700	2.900	249.69	**
I X V	51	2.865	0.056	4.84	**
Error	213	2.474	0.012	-	-
Total	287	84.804	-	-	-

Coefficient of variation = 25.30%

(c) Green lacewing

Source of variance	DF	SS	MS	Observed F.	Remarks
Replications	3	0.291	0.097	13.31	NS
Intervals (I)	17	30.715	1.807	248.04	**
Varieties(V)	3	7.169	2.390	328.04	**
I X V	51	3.902	0.077	10.50	**
Error	213	1.552	0.007	-	-
Total	287	43.628	-	-	-

Cefficient of variation = 23.21%

(d) Stethorus

Source of variance	DF	SS	MS	Observed F.	Remarks
Replications	3	0.023	0.008	0.63	NS
Intervals (I)	17	21.911	1.289	108.09	**
Varieties (V)	3	1.341	0.447	37.48	**
I X V	51	7.651	0.150	12.58	**
Error	213	2.540	0.012	-	-
Total	287	33.465	-	-	-

Coefficient of variation = 48.46%

(e) Wasp Spp.

Source of variance	DF	SS	MS	Observed F.	Remarks
Replications	3	0.299	0.100	11.12	**
Intervals (I)	17	11.116	0.654	73.06	**
Varieties (V)	3	2.574	0.858	95.85	**
I X V	51	2.225	0.044	04.87	**
Error	213	1.906	0.009	-	-
Total	287	18.120	-	-	-

Coefficient of variation = 43.66%

(f) Spider Spp.

Source of variance	DF	SS	MS	Observed F.	Remarks
Replications	3	0.013	0.004	0.67	NS
Intervals (I)	17	0.996	0.059	9.47	**
Varieties (V)	3	0.201	0.067	10.82	**
I X V	51	0.308	0.006	0.98	NS
Error	213	1.318	0.006	-	-
Total	287	2.835	-	-	-

Coefficient of variation = 22.76%

(g) Ant spp.

Source of variance	DF	SS	MS	Observed F.	Remarks
Replications	3	0.019	0.006	0.50	NS
Intervals (I)	17	15.354	0.903	72.76	**
Varieties (V)	3	5.208	1.736	139.86	**
I X V	51	2.653	0.052	4.19	**
Error	213	2.644	0.012	-	-
Total	287	25.877	-	-	-

Coefficient of variation = 28.52%

Average weekly population dynamics of natural enemies were studied on cotton crop at weekly intervals revealed that, the pirate bug, Green lacewing, Big eyed bug and Ant population appeared 25 days after sowing; whereas Stethorus and Wasp after 40 days, Spider after 45 days in field.

Correlation of Insect Predators with Abiotic factors

(a)Correlation with Temperature (^oC)

The correlation coefficient showed significant relationship with Pirate bug, highly significant with Bigeyed bug, non significant with Green lacewing, significant with Stehorus, highly significant with Wasp, non significant with Spider and Ant (Table-IV).

(b) Correlation with Rainfall (mm)

The correlation coefficient showed highly significant relationship with Pirate bug, with Bigeyed bug, highly significant with Green lacewing, highly significant with Stehorus, non significant with Wasp, highly significant with Spider and with Ant **(Table-IV)**.

Table-IV. Coefficient of correlation (r), coefficient of determination (r2) and Regression coefficient between some metrological factors and predators in cotton ecosystem

(a) Temperature (^oC) V/S

Characters correlated	Coefficient of correlation (r)	Coefficient of determination (r^2)	Regression coefficient (byx)
Pirate bug	-0.226*	0.051	-0.050
Bigeyed bug	-0.699**	0.489	-0.276
Green lacewing	0.134 NS	0.018	0.035
Stethorus	0.361*	0.130	0.079
Wasp	0.483**	0.233	-0.075
Spider	0.105NS	0.011	0.005
Ant	0.110 NS	0.012	-0.020

(b) Rainfall (mm) V/S

Characters correlated	Coefficient of correlation (r)	Coefficient of determination (r^2)	Regression coefficient (byx)
Pirate bug	0.348**	0.121	0.098
Bigeyed bug	-0.027 NS	0.001	-0.014
Greenlacewing	0.591**	0.349	0.196
Stethorus	0.455**	0.207	0.127
Wasp	0.178 NS	0.032	0.036
Spider	0.562**	0.316	0.034
Ant	0.459**	0.211	0.108

* = Significant at P <0.05
** = Significant at P <0.01
NS = Non Significant

DESCUSION

Natural enemies like Pirate bug, Bigeyed bug, Green lacewing and Ant were present throughout the season while Spider and Stethorus were mostly found in middle of the crop season and Wasp population was observed from middle of the season up to last picking of crop.

Population of predators was heavily affected by the rain during August. Elkassabany *et al.,* (1996) reported the over-wintering and seasonal habitats of

Orius insidiosus during 1992 and 1993 at southwestern and central Arkansas, during late spring and summer, population of *O. insidiosus* increased in association with increasing thrips population. Ge-Feng *et al.,* (1996) reported that the population dynamics of *S. punctillum*, *O. minutus*, *G. pallidipennis* and other some predators were examined in cotton field in China. The characteristics of natural enemies and population were examined.

The results showed that the lacewing occurred in the field together with White fly and their larvae feed on nymphs but other factor that the White fly is not its first choice. Application of the insecticide monocrotophos often results in an increase in lacewing egg populations. El-Naggar *et al.,* (2000) reported that the true spiders play an important role in reducing the infestation ratio of field crop pests. The study identified 10 families, 15 genera and 16 species associated with four different field crops. The relationship between temperature and the number of true spider were also studied. Dias *et al.,* (2004) reported on the red imported fire ant and other predators on cotton field during 2001 and 2002 on central and northern Texas, suggested that, ant is an important predator of bollworm and armyworm eggs. Xu Wen Hua *et al., (*2004) reported the significant variation in population dynamics of spider among six species in cotton fields in China, during 2002.

Mori *et al.,* (2005) reported that *S. japonicus* Kamiya is an indigenous ladybird beetle in Japan, which feeds on many spider mite species. Survival rate of egg to adult were more than 71% at temperatures between 17.5 and 30ºC. The highest immature mortality was 100% at 35ºC followed by 76% at 15ºC and 52% at 32.5ºC. The lower threshold temperature for development from egg to egg-laying adult was 13.0ºC and the thermal constant was calculated as 238.7 days. Thereafter, the predator population decreased due to rainfall in first week of August but other than this population was constant. It showed that the temperature was favorable until rainfall, after rainfall it decreased and grew again because of the increased pest population. The population of predators clearly justifies that there is not necessary to use of any pesticide at any phonological stage of the cotton crop.

CONCLUSION

The maximum population of Pirate bug, Green lacewing, Stethorus, Spider and Ant were observed significantly higher in the last week of July; while, Bigeyed bug appear in the last week of September and Wasp in the first week of September on cotton crop. The major focus on the cotton crop was to reduce the insecticide applications. Predators population also fluctuated based on availability or non-availability of cotton pests. The correlation of predators' population with temperature was positive and negative with rainfall.

REFERENCES

Diaz R., A. Knutson and J. S. Bernal (2004) Effect of the red imported fire ant on cotton aphid population density and predation of bollworm and beet armyworm eggs. J. Econ. Entomol. 97 (**2**): 222-229.

Elkassabany, N., J. R. Ruberson and T. J. Kring (1996) Seasonal distribution and overwintering of *Orius insidiosus* (Say), in Arkansas. J. Entomolog. Sci. 31 (**1**): 76-88.

El-Naggar, M. E., G. M. Sallam and M. A. Abd-El-Halim (2000) Survey of true spiders associated with some field crops in Egypt. Proc. Beltwide Cotton Conf. San Antonio, USA, 4-8 (**2**): 1021-1022.

Ge-Feng., Ding-yang Qin, F. Ge and Y.Q. Ding (1996) The population energy dynamics of predacious natural enemies and their pest control activity in different cotton agro-ecosystem. Acta Entomologica Sinica. 39 (**3**): 266-273.

Govt. of Pakistan (2004) Agri. Statistics of Pakistan, Ministry of Food and Livestock, Islamabad, Govt. of Pak. 39-40.

Han, Xu. (2004) Spiders in cotton fields of Hebei Province in early winter. Acta Arachnologica Sinica. 13 (**1**): 52-54.

Hashmi, R. A. (1994) Insect Pest Management, cereal and cash crops. Pak. Agric. Res. Council, Islamabad. 317Pp.

Lohar, M.K. (2001) Text Book of Applied Entomology. 2nd Ed. Pub. Kashif Publ. Hyderabad. 242 Pp.

Mori, K., M. Nozawa, K. Arai and T. Gotoh (2005) Life-history traits of the acarophagous lady beetle, *Stethorus japonicus* at 3 constant temperatures. Biocontrol. 50(**1**):35-51.

Solangi, B. K., M. A. Talpur and I. A. Nizamani. (2005) Population of Spotted Bollworm Earias spp. and Its Predators (Natural Enemies) on Cotton. J. App. Sci. 5 (**8**): 1402-1404.

Tillman, P. G., and B. G. Mullinix (2003) Effect of prey species on plant feeding behavior by the big-eyed bug, *Geocoris punctipes* (Say) (Heteroptera: Geocoridae), on cotton. Envi. Entomol. 32 (**6**): 1399-1403.

Vargas-Camplis-J., (1996) Natural enemies of bollworm complex and other foliage feeding worms in northern Tamaulipas and their role in cotton production. Proc. Beltwide Cotton Conf. , Nashvile, TN, USA, Jan. 9-12 (**2**): 710-711.

Wang-AnYuan., Wang-liping, Wang-AY and Wang-LP. (1996) An explory study on cotton insect control by natural enemies. Agric. Technique Ext. Station, Bachu, Xingiang Uygur Autonomous Region, China, 23 (**8**): 31Pp.

Xu WenHua., Wu Chun, Wang RuiMing, Shan XiaoLing and Wu. JinLong (2004) Dynamic distribution of spider predominant species on Bt transgenic cotton in Jiangsu coastal cotton area. Jiangsu J. Agric. Sci. 20 (**1**): 23-27.