VARIETAL VARIATION AND INTERACTION BETWEEN POPULATION OF APHIDS AND THEIR PREDATORS IN WHEAT

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ABSTRACT

Eleven genotypes of wheat viz. V-05066, V-5BT-006, V-04178, V-04022, V-05003, V-05082, Seher-06, Inqalab-91, Chakwal-5C-011, V-033010 and V-032862 were sown in the field area of Entomological Research Institute, AARI, Faisalabad, Pakistan during 2009 following RCBD with three repeats. The objective was to study varietal variation and interaction between aphids and predators. The genotype V-05066 was found comparatively more susceptible with maximum aphids population (18.69/tiller) while V-04178 proved as more resistant with minimum population (5.73/tiller). The peak population of the pest was observed on February 24 (46.07/tiller). The population of lady bird beetles (*Coccinellids* spp.) larvae and adults, green lacewing (*Chrysoperla carnea)* larvae and hover fly (syrphid fly) larvae reached to peak levels on March 21 (0.66/tiller) on March 28 (0.54/tiller), April 1 (0.09/tiller) and April 4 (0.47/tiller), respectively. The correlation between aphid population and Coccinellid larvae was significant ($P \leq 0.05$) and positive with r-value of 0.680. Coccinellid larvae played maximum role (8.4%) in fluctuation of aphid population followed by *C.carnea* larvae (4.8%).

KEYWORDS: ***Triticum aestivum;*** **genotypes; aphids;** ***Chrysoperla carnea;*** **Coccinellids; Pakistan.**

INTRODUCTION

Wheat, *Triticum aestivum* (L.), is severely attacked by wheat aphids (11) causing considerable loss in grain yield (18). Tradan and Milevol (18) reported that aphid reduced 10 to 50 percent crop yield directly and 20 to 80 percent indirectly. Mahmood (12) and Kindler *et al.* (10) reported that 7.19

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aphids per tiller reduced 16.38 percent yield. Major reliance has been on biological agents to reduce these losses. Several groups of natural enemies may limit aphid population: adults and larvae of lady bird beetles (Coleoptera:Coccinellidae), larvae of green lacewing (Neuroptera: Chrysopidae) and hover flies (Diptera: Syrphidae) living in upper vegetation of cereal fields and feed predominantly on aphids (19). Messina and Sorenson (14) reported that lacewings reduced the aphid population on some plants and proved to be 84 percent effective. In another study (3) positive and significant correlation of predators viz. Coccinellids*, Chrysoperla carnea* and syrphid fly was found with aphid population under Bahawalpur ecological conditions.

Sharma and Joshi (17) reported that *C. septumpuntata* consumed more aphids (78.00/day) under un-starved and laboratory conditions as compared to *C. carnea* (67.19/day) (13). Syrphid fly consumed 309.72 aphids per day as reported by Roshmi and Dutta (15). Sattar *et al*. (16) reported that a single larva of *C. carnea* consumed 1604 nymphs of 1^{st} instar, 689 of 2^{nd} instar and 144.7 nymphs of 3^{rd} instar of cotton mealy bug in its entire period.

Ali *et al*. (2) recorded maximum mean population of aphids (6.08), Coccinellid adults (2.21) and *Chrysoperla carnea* adults (0.88) per tiller on March 6, 2004, whereas mean population of *C. carnea* (0.24) and Coccinellids (1.30 larvae/ tiller) was noted on February 28 and March 13,2004, respectively. They further reported that effect of Coccinellids adults (r = 0.029) and *Chrysoperla* adults (r =0.059) and larvae (0.140) was highly significant ($p \leq 0.01$) on aphids population and role of predators on cumulative basis in aphid fluctuation was 28.3 percent. Hassan *et al*. (9) observed significantly maximum mean population of aphids per tiller (1.17) on February 28, Coccinellids larvae per tiller (1.33) on February 21, and syrphid fly per sweep (0.27) on March 13, 2004. They also reported that aphids population showed significant correlation ($p \leq 0.05$) with population of Coccinellid adults (r = 0.145) and highly significant ($p \leq 0.01$) with *Chrysoperla* adults (0.214). The coefficient of determination value between aphids and all these predators was 0.082. Ali *et al.* (1) found that ten genotypes of wheat viz. Inqalab 91, V-2400, V-2278, V-4012, V-2000, V-2333, V-2210, Uqab-2000, Punjnad and V-2237) differed significantly regarding population of aphids, Coccinellids, *C. carnea* and syrphus fly. The genotype V-2237 showed maximum population of aphids (73.43 /tiller) followed by Punjnad (72.97/tiller), while Inqalab-91 was comparatively resistant with minimum aphids (42.60/tiller). They further observed highly significant and positive correlation among the population of all predators and aphids.

The present study was undertaken to (i) determine the role of predators in fluctuation of aphids population, (ii) determine the period of abundance of predators and aphids and (iii) observe the resistant and susceptible genotypes of wheat against aphids.

MATERIALS AND METHODS

This study was conducted at Entomological Research Institute, AARI, Faisalabad, Pakistan during the year 2009. Genotypes of wheat viz. V-05066, V-5BT-066, V-04178, V-04022, V-05003, V-05082, Seher-06, Inqalab-91, Chakwal-5C-011, V-033010 and V-032862 were sown on November 5, 2009 following RCBD replicated thrice. The plot size was maintained as 6 × 27m. The data regarding population of aphids, Coccinellids larvae and adults, *Chrysoperla carnea* and syrphid fly larvae were recorded from tillers of ten plants selected randomly from each plot at 4 ± 1 days interval from February 14 to April 4, 2009. The data were subjected to analysis of variance using M-Stat package. The means were compared by DMR test (p =0.05).

The simple correlation (r) between aphid density and predator's population was determined. The impact of predators on aphid population was also calculated by processing the data through multiple linear regression analysis. The data were transformed into square root before processing for analysis. Effect of weather factors on the population of predators was also observed by computing the data into simple correlation.

RESULTS AND DISCUSSION

Aphids population

Significant difference was found among genotypes regarding aphids population (Table 1, Column A). Genotype V-05066 possessed maximum population (18.69/tiller) followed by V-05003 (17.73) and Inqalab-91 (15.45). Minimum population was observed on V-04178. (5.73/ litter). These results do not agree to those of Ali *et al*. (1) who observed Inqalab-91 with resistant response, having minimum aphids population (42.07/tiller) as compared to susceptible V-2237 (73.43/tiller). Similarly, significant difference in varieties was also reported by Hassan *et al.* (9) with different set of materials. In present study, peak population was recorded on February 24, 2009 (46.07/tller) and this population decreased thereafter on subsequent dates of observation (Table 2, Column A). However, these findings cannot be

compared with those of Ashfaq *et al.* (4) who reported peak density of aphids during 3rd week of March 2003 and 1st week of April, 2004.

Table 1. Population of aphids and predators on various genotypes of wheat.

Wheat genotypes	Aphids/tiller	Coccinellids/tiller		C.carnea/ tiller (larvae)	Sprphid fly/ tiller (larvae)
		Larvae	Adults		
	(A)	(B)	(C)	(D)	(E)
V-05066	18.694 a	0.240	0.280 ab	0.051	0.149
V-5BT-006	8.868 c	0.189	0.158 c	0.062	0.176
V-04178	5.730 c	0.180	0.202 bc	0.042	0.146
V-04022	10.74 bc	0.202	0.158 c	0.062	0.216
V-05003	17.73 a	0.307	0.207 bc	0.033	0.184
V-05082	6.99 c	0.218	0.162 c	0.038	0.156
Seher-06	7.27 c	0.109	0.207 bc	0.040	0.187
Inqalab-91	15.45 ab	0.200	0.224 bc	0.051	0.182
Chakwal-5C-011	11.54 bc	0.196	0.244 bc	0.056	0.171
V-033010	7.32 c	0.180	0.336 a	0.049	0.169
V-032862	11.467 bc	0.167	0.284 ab	0.071	0.224
LSD at P=0.05	5.70	NS	0.07	NS	NS

Means sharing similar letter (s) are not significantly different by DMR test.

Lady bird beetle

Larvae: The wheat genotypes did not show significant difference regarding Coccinellid larvae. The population ranged from 0.167 to 0.307 per tiller (Table 1, Column B). These findings cannot be compared with those of Hassan *et al*. (9), who reported significant difference among genotypes while studying different material. In present study, peak population was observed (0.664/tiller) on March 21, 2009 (Table 2, Column B). However, Hassan *et al*. (9) reported a peak Coccinellids larvae on February 21, 2004.

Adult: The data showed that Coccinellid (adult) differed significantly among genotypes. V-033010 possessed maximum population (0.336/tiller) against minimum on V-04022 and V-5BT-006 (0.158 each) (Table 1, Column C). The peak population of this predator was recorded on March 28, 2009 (0.539/tiller) (Table 2, Column C). The present findings cannot be compared with those of Ali *et al*. (1) due to variation in materials and methods as well as ecological conditions.

Chrysoperla carnea (larvae)

The difference among genotypes was non-significant regarding *C. carnea*. population which ranged from 0.033 to 0.071 per tiller (Table 1, Column D). The peak population of this predator was observed on April 1, 2009 (0.094

larvae/tiller) (Table 2, Column D). However, these findings do not agree to those of earlier workers (1, 14) who tested different wheat varieties.

Table 2. Population of aphids and predators at various dates of observation.

Dates	Aphid population/ tiller	Coccinellid/tiller		C. carnea/ tiller (larvae)	Syrphid fly/ tiller (larvae)
		Larvae	Adults		
	(A)	(B)	(C)	(D)	(E)
14-02-09	6.13 e	-	-	-	-
17-02-09	19.60 d	-	-	-	-
21-02-09	26.86 c	-	0.091def	-	-
24-02-09	46.07 a	0.073 de	0.106 de	-	-
28-02-09	39.04 b	0.142 cde	0.127 de	-	0.073 f
04-03-09	19.87 d	0.206 bcd	0.161 cd	0.039 ef	0.155 e
07-03-09	4.76 e	0.285 bc	0.179 cd	0.058 de	0.197 de
10-03-09	2.52 e	0.664 a	0.239 bc	0.079 cd	0.236 d
14-03-09	0.43 e	0.576 a	0.512 a	0.094 cd	0.261 cd
17-03-09	0.37 e	0.312 b	0.503 a	0.0342	0.321 bc
21-03-09	0.26 e	0.300 b	0.539 a		0.473 a
24-03-09	0.12 e	0.215 bcd	0.494 a		0.6019
28-03-09	0.036 e	0.141	0.279 b		
01-04-09	0.006 e		0.0879		
04-04-09	6.66				
LSD at P=0.05					

Means sharing similar letters are not significantly different by DMR test

Syrphid fly (larvae)

The genotypes did not show significant difference regarding Syrphid fly larvae. The population ranged from 0.146 to 0.224 per tiller (Table 1, Column E). The present results do not confirm the findings of Ali *et al*. (1) who reported significant variations among genotypes due to different material and ecological conditions. The peak population of predator (0.473/tiller) was observed on April 4, 2009 (Table 2, Column E). These do not agree to those of Hassan *et al*. (9) who reported peak population of syrphid fly on March 13, 2004.

Correlation of aphids and predators

The results (Table 3) show that Coccinellid larvae had significant and positive correlation with aphid's density, while all other predators showed non-significant correlation. These results can partially be compared with earlier findings (4) where positive and significant correlation between predators and aphids population was observed in wheat. However, Ali *et al*. (1) also reported highly significant and positive correlation between predators and aphid's density in wheat. In this study, Coccinellid larvae were found to be the most voracious predator with maximum impact (8.4%) on population

Table 3. Correlation coefficients (r) between aphid density on wheat and its predators during 2009.

Aphid density	Coccinellid adult	Coccinellid larvae	*C.carnea* larvae	Syrphid fly larvae
	0.205	0.680*	0.029	0.099

* Significant (P ≤ 0.05)

fluctuation of aphids followed by *Chrysoperla carnea* (4.8%) (Table 4). Overall total impact of all predators on aphids population was calculated to be 16.5 percent. The present results are not in conformity with those of Hassan *et al*. (9) who reported 28.3 percent role of predators in population fluctuation of aphids on wheat. Some earlier results (13, 15, 17) showed that syrphid fly (*Episyrphus balteatus*) consumed maximum aphids (309.72/day) followed by *C. septumpunctata* (78.00/day) and *C. carnea* (67.14/day) under un-starved and laboratory conditions. Predatory potential of *C. carnea* against cotton mealy bug was studied by Sattar *et al*. (16) who reported that a single larva consumed 1604 nymphs of 1st instar, 689 of 2nd instar and 144.7 nymphs of 3rd instar in its entire period (no choice feeding) and these findings cannot be compared with the present findings due to difference in host and host plant as well as variation in methodology.

Table 4. Multiple linear regression models alongwith coefficients of determination among aphid density and predators.

Regression equation	R^2	100 R^2	Impact (%)
Y=14.737-72.822 X1	0.048	4.8	4.8
Y=12.3982-81.366 X1 +12.373 X2	0.065	6.5	1.7
Y=6.5214-69.698 X1 +16.799 X2 +21.634 X3	0.149	14.9	8.4
Y=1.7218-76.939 X1 +19.965 X2 +23.509 X3 +22.819 X4	0.165	16.5	1.6
		Total	16.5

X1 = *Chrysoperla carnea* (larvae) X2 = *Coccinellid* (adults) X3 = *Coccinellid* (larvae)
X4 = Syrphid fly (larvae)

Weather effect on predators

The results (Table 5) revealed that maximum, minimum and average temperatures exerted positive and significant correlation (P≤0.01) in case syrphid fly population with r-values of 0.516, 0.833 and 0.768, respectively. Minimum temperature showed significant and positive effect on the population of Coccinellid adults (P≤0.01) and *C. carnea* larvae (P≤0.05). Average temperature exerted significant and negative effect on coccinellid adults. Rainfall and relative humidity had non-significant correlation with population of all predators.

Table 5. Effect of weather factors on the population of predators in wheat crop during 2009.

Population of predators	Temperature (°C)			Relative humidity	Rainfall
	Maximum	Minimum	Average		
Aphids	-0.512**	-0.605**	-0.656**	0.203	-0.202
Coccinellid larvae	0.51	0.716**	0.693**	-0.237	0.101
Coccinellid adults	0.050	0.161	0.179	-0.060	0.240
Chrysoperla carnea larvae	0.046	0.553*	0.410	0.103	0.292
Syrpid fly larval	0.516*	0.833**	0.768**	-0.235	0.072

*Significant at P < 0.05, **Significant at P < 0.01.

CONCLUSION AND RECOMMENDATIONS

The genotype V-04178 was comparatively more resistant and V-05066 susceptible to aphids. Coccinellid larvae played maximum role in population fluctuation of aphids followed by *C.carnea* grubs. Temperature had negative significant correlation with aphids populations and positively significant with syrphid fly population. Coccinellid larvae was found to be voracious showing 8.4 percent role in per unit change in aphids population. Conservation of natural enemies would help develop sound environment for crop management. Therefore, the application of chemical insecticides should be avoided for the control of aphids on wheat crop. The predators should be conserved by sowing few lines of brassica in wheat crop for providing early host to predators and parasites of aphids which will control aphids on wheat crop later on.

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