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Population Dynamics of Aphid and its Bio-Control Agents in Wheat Crop

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Abstract: Aphid is a serious pest of wheat and other field crops. It is widely distributed in southern Punjab as well as other areas of the country. There are number of aphid species which are going to become pest of wheat crop. Experiment was conducted at farmer's field in southern Punjab for population dynamics, number of aphid and bio-control agents (predator) recorded on weekly using diagonal method by randomly selecting 30 plants from each fields. Aphid attack started in 1st week of January in all plots and increased with the vegetative growth of plant and reached at peak level in the 3rd week of March and after that its population started to decrease and population of bio-control agents was low at start but maximum during the March when aphid population was at its peak level.

Key words: Aphid, population dynamics and bio-control agents

INTRODUCTION

Wheat (*Triticum aestivum* L.) is a convenient, nutritious and economical source of food. It provides about 20% world food calories and food for nearly 40% of the world's population. The cereal is grown on 23% global cultivated area is for great importance in bread, diet, pharmaceutics and other industry but also important product of international trade for worldwide market (Istvan, 2006). Wheat a staple food contains 13% protein (Ahmad and Shaikh, 2003).

During 2010-11, 661.4 million metric tons of wheat was produced worldwide. The yield of wheat in Pakistan was 24.1 million metric tons, while the consumption is 21.9 million tons (FAO, 2010-11). Statistics suggests that Pakistan's per acre output of wheat is 920-960 Kg which is very low as compared to other wheat growing countries like Netherlands, England, New Zealand, Germany and France (3640, 3080, 2960, 2600 and 2480 Kg/Hac respectively) and even in India which has the same environment as of Pakistan, produce 1040 kg/acre (Anonymous, 2011).

In Pakistan, Wheat is a major food of Pakistan (Ahmad, 2009) and grown as cereal crop, but its plant, seed, straw and bran is used in industrial products as well as a feed of livestock. wheat is 2nd largest crop and contributes 12.5% value added in agriculture and 2.6% to the GDP. Nearly 62 percent of the country's population is indirectly or directly engaged with agriculture for their mean of living and live in rural areas. Major crops, keep account for 12.5 percent of agricultural value added. Production of wheat was 25,214 thousand tons in 2010-11 which decreased to 23,517 thousand tons in 2011-12 (Government of Pakistan, 2012). Due to large scale consumption in the country special attention for its production in large quantities is planned at government level to meet the needs of rapidly growing population. Pakistan is still facing problems to meet the food requirements of its population. The yield per hectare was decreased by 4.2% in 2011-12 as compared to 2010-11 (Government of Pakistan, 2012).

Various factors like late sowing, traditional method of seedbed preparation, poor quality seed, imbalance use of fertilizer, water shortage and especially poor insect control are responsible for the low production of wheat in Pakistan (El-Gizawy, 2009). Among these insect pest plays a key role in reducing the yield per hectare (Khattak *et al*., 2007). Wheat is attacked by number of diseases and insect pests like wheat aphid. Aphid also known as plant lice is an important sucking pest of various field crops, fruits and vegetables (Aheer *et al*., 2008). In Pakistan, English grain aphid (*Sitobion avenae* F.), Greenbug (*Schizaphis graminum* R.) and Bird cherry-oat aphid (*Rhopalosiphum padi* L.) are important wheat aphid species (Khan and Farmanullah 2005).

To prevent the losses by aphid numerous control methods have been evolved. These include, cultural, chemical biological and host plant resistance. The natural enemies maintain mostly the aphid population below the economic injury level. Biological control is major element of integrated pest management plan. The best control of aphid on wheat can be obtained through biological control agents like predator (Coccinellid beetle, Chrysoperla, Syrphid fly, Earwigs and hover flies grubs) and parasites (*Aphidius ervi* Haliday and

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Aphidius colemani (Iqbal *et al*., 2008b). Coccinellids are common biological agents for controlling the aphid on cotton and wheat (Khan and Suhail, 2001).

Cereal aphid could become a problem in future even though their numbers are presently kept low by using insecticide. In Pakistan, attack of aphid on wheat crop is increasing day by day. Generally its attack starts at milky grain stage when it is not suitable to spray non-selective pesticides on large scale for the controlling of aphids especially in cotton growing areas of Multan, Bahawalpur and Dera Ghazi Khan. Keeping in view the importance this study was arranged to know about population dynamics of the pest and as well as their biological agents.

MATERIALS AND METHODS

Study was conducted at five farmer fields located in Dera Ghazi Khan viz; Mouza Choratha Sindh North (plot 1), Mouza Kotla Shafi (plot 2), Mouza Kotla Sikhani (plot 3), Mouza Gadai North (plot 4) and Mouza Gadai West (plot 5).Wheat variety sehar-2006 was sown till 25th November by line sowing method in one acre of fields for each plot. Seed rate 40 kg per acre was used in each field and recommended doses of NPK 50:40:24: kg per acre in the form of Urea, DAP and Potassium Sulphate were used. After the germination of crop, regular observation was done to check the appearance of pest in the field. At the start of January aphid population started to appear in the field. Data was recorded from 1st January to 20th April. For the population dynamics, numbers of aphid and bio-control agents (predator) were recorded weekly using diagonal method by randomly selected 30 plants from each field. Counting of aphid and bio-control agents was done in fields by visual methods. Adults and young ones were counted on tiller at earlier stages of crop and later on its population was counted on spikes after the spike formation.

Data was analyzed by using average mean population of aphid and its bio-control agents in wheat crop on the basis of monthly recording data.

RESULTS

Mean Average population of Aphid per plant: In the month of January 2012 aphid population was observed on all five plots, so in this month there were five observations. According to Table 1 in 1st observation average population of aphid per plot regarding diversity and richness were 1.60 and 0.75 respectively. This goes to an increasing trend for second observation, here average population richness and diversity for all plots was 1.29 and 1.20, respectively. In case of 3rd observation, average population of aphid per plant regarding the diversity and richness were 1.00 and 1.53 respectively. While in 4th observation, average population of aphid per plant regarding diversity and richness were 1.00 and 1.59 respectively. In last observation of January average population of aphid per plant regarding the diversity and richness were 2.00 and 1.93, respectively.

In the month of February 2012, there were four observations. According to 1st observation average population of aphid per plant regarding diversity and richness were 2.0 and 2.39, respectively. This goes to an increasing trend for second observation, here average population richness and diversity for all plots was 2.0 and 2.50, respectively. In case of 3rd observation, average population of aphid per plot regarding the diversity and richness were 2.0 and 4.85 respectively. While in 4th observation, average population of aphid per plant regarding diversity and richness were 2.0 and 7.95, respectively.

In the month of March 2012, there were four observations and in 1st observation average population of aphid per plant regarding diversity and richness were 2.40 and 13.22, respectively. This goes to an increasing trend for second observation; here average population richness and diversity for all plots were 14.96 and 3.20, respectively. In case of 3rd observation, average population of aphid per plot regarding the diversity and richness were 4.00 and 29.10, respectively. While in 4th observation, average population of aphid per plant regarding diversity and richness were 3.40 and 17.56, respectively.

In the month of April 2012, there were three observations and in 1st observation average population of aphid per plot regarding diversity and richness were 2.40 and 9.57, respectively. This goes to a decrease trend for second observation; here average population richness and diversity for all plots were 8.68 and 2.40 respectively. In case of 3rd observation, average population of aphid per plot regarding the diversity and richness were 1.80 and 4.79, respectively.

Mean average population richness of green lace wing: In the month of March 2012 Green lacewing population was observed on all five plots. According to Table 2 in 1st observation average population of green lace wing per plot regarding richness was 1.70.This goes to an increasing trend for second observation, here average population richness for all plots was 2.05. In case of 3rd observation, average population of green lacewing per plant regarding richness was 2.75. While in 4th observation, average population of green lace wing per plant regarding richness was 3.37. In the month of April 2012, green lacewing population was observed on all five plots, so in this month there were three observations and on 1st observation green lace wing population richness was 1.79. This goes to an increasing trend for second observation; here average population richness for all plots was 3.89. In case of 3rd observation, average population of green lacewing per plot regarding richness was 1.41.

Table 1: Mean Average population of Aphid per plan

	Observation (1)		Observation (2)		Observation (3)		Observation (4)		Observation (5)	
	Diversity	Richness	Diversity	Richness	Diversity	Richness	Diversity	Richness	Diversity	Richness
January	1.60	0.75	1.20	1.29	1.00	1.53	1.00	1.59	2.00	1.93
February	2.00	2.39	2.00	2.50	2.00	4.85	2.00	7.95	--	--
March	2.40	13.22	3.20	14.96	4.00	29.10	3.40	17.56	--	--
April	2.40	9.57	2.40	8.68	1.80	4.79	--	--	--	--

Table 2: Mean average population richness of green lace wing

	Obser. (1)	Obser. (2)	Obser. (3)	Obser. (4)
January	--	--	--	--
February	--	--	--	--
March	1.70	2.05	2.75	3.37
April	3.85	3.89	1.41	--

Obser: Observation

Table 3: Mean average population richness of coccinellids

	Obser. (1)	Obser. (2)	Obser. (3)	Obser. (4)
January	--	--	--	--
February	--	--	0.19	1.52
March	1.77	1.79	1.26	0.47
April	0.39	0.16	0.11	--

Obser: Observation

Table 4: Mean average population richness of spider

	Obser. (1)	Obser. (2)	Obser. (3)	Obser. (4)	Obser. (5)
January	0.31	0.67	0.88	0.97	1.23
February	1.35	1.48	1.80	2.37	--
March	6.00	5.17	2.77	1.13	--
April	0.29	0.19	0.26	--	--

Obser: Observation

Mean average population richness of coccinellids: In the month of February, there were four observations. According to Table 3 in 1st and 2nd observation no coccinellids was found in all plots. In case of 3rd observation, average population of coccinellids per plot regarding richness was 0.19. While in 4th observation, average population of coccinellids per plant regarding richness was 1.52. In the month of March 2012, in 1st observation average population of coccinellids per plant regarding richness was 1.70. This goes to an increasing trend for second observation; here average population richness for all plots was 1.79. In case of 3rd observation, average population of coccinellids per plot regarding richness was 1.26. While in 4th observation, average population of coccinellids per plant regarding richness was 0.47. In the month of April 2012, in this month there were three observations and 1st observation average population of Coccinellids per plot regarding richness was 0.39. This goes to a decreasing trend for second observation, here average population richness for all plots remained 0.16. In case of 3rd observation, average population of Coccinellids per plot regarding richness was 0.11.

Mean average population richness of spider: In the month of January 2012 spider population was observed on all five plots, so in this month there were five observations. According to Table 4 in 1st observation average population of spider per plot regarding richness was 0.31.This goes to an increasing trend for second observation, here average population richness for all plots 0.67. In case of 3rd observation, average population of spider per plot regarding richness was 0.88. While in 4th observation, average population of spider per plant regarding richness was 0.97. In last observation of January average population of spider per plant regarding the richness was 1.23. In the month of February 2012, in this month there were four observations. In 1st observation average population of spider per plot regarding richness was 1.35.This goes to an increasing trend for second observation, here average population richness for all plots was 1.48. In case of 3rd observation, average population of spider per plot regarding richness was 1.80. While in 4th observation, average population of spider per plant regarding richness was 3.37.

In the month of March 2012, in this month there were four observations and in 1st observation average population of spider per plot regarding richness was 6.00. This goes to a decreasing trend for second observation, here average population richness for all plots remained 5.17. In case of 3rd observation, average population of spider per plot regarding richness was 2.77. While in 4th observation, average population of spider per plant regarding richness was 1.13. In the month of April 2012, in this month there were three observations and in 1st observation average population of spider per plot regarding richness was 0.29.This goes to a decreasing trend for second observation, here average population richness for all plots was 0.19. In case of 3rd observation, average population of spider per plot regarding richness was 0.26.

Table 5: Mean average population richness of syrphid fly

	Obser. (1)	Obser. (2)	Obser. (3)	Obser. (4)	Obser. (5)
January	--	--	--	--	--
February	--	--	--	--	--
March	1.51	2.23	3.81	2.01	--
April	0.89	0.28	0.29	--	--

Obser: Observation

Mean average population richness of syrphid fly: In the month of March 2012 syrphid fly population was observed on all five plots, there were four observations and in 1st observation average population of syrphid fly per plot regarding richness was 1.51. This goes to an

increasing trend for second observation, here average population richness for all plots was 2.23. In case of 3rd observation, average population of syrphid fly per plot regarding richness was 3.81. While in 4th observation, average population of syrphid fly per plant regarding richness was 2.01. In the month of April 2012, there were three observations and in 1st observation average population of syrphid fly per plot regarding richness was 0.89.This goes to a decreasing trend for second observation, here average population richness for all plots was 0.28. In case of 3rd observation, average population of syrphid fly per plot regarding richness was 0.29.

The aphid population was appeared in the fields in 1st week of January and its increases with plants growth. A sudden increase was observed in the month of February and aphid population was high in the month of March. The peak population of aphid was observed in 3rd week of March and after this its population was started to decrease and was minimum in the in the month of April. The aphid population was totally disappeared from the fields till 15th April.

The population of bio-control agents was also observed in the wheat fields at different dates of observations. Firstly spider was appeared in the fields with peak population in at the end of February and remains in the fields till last date of observations. The coccinellids was examined in the fields in 2nd week of February and its peak population was observed on 2nd week of March and after this its population start to decrease and low at the time of last observations in April. The population of green lace wing was appeared in the in the 1st week of March and its population was increased gradually and showed variation with the passage of time. The peak population of green lace wing was observed in 2nd week of April and population remained in the fields at last date of recording data.

The population of syrphid fly was firstly observed in the fields in 1st week of March and a sudden increased was observed in syrphid fly population and was peak at 3rd week of March when aphid population was maximum. After that its population was declined but still presents at last date of observation.

DISCUSSION

The main objective of the present research work was to know about the population dynamics of aphid and its bio-control agents in wheat crop. The research was conducted during the growing season 2011-12, in five different location of Dera Ghazi Khan viz; Maoza Choratha Sindh north (plot 1), Maoza KotlaShafi (plot 2), Maoza Kotlasikhani (plot 3), Maoza Gadai North (plot 4) and maoza Gadai west (plot 5) were selected and wheat variety Seher-2006 was sown till 25th November 2011.

For the population dynamics of aphid and bio-control agents (predators), number of aphid and its bio-control agents were counted on weekly basis by randomly selecting 30 plants from each field of one acre. From month of January aphid population was appeared and observation was started. The total average population was 7.09 per plant and diversity was 6.80 per plant with average temperature maximum and minimum was 20.70 and 4.70°C, respectively with average R.H 85.64%. While in case of bio-control agents only spider was observed with total average richness 4.06 per plant. Aphid appeared in plots in the month of January as said by Riazuddin *et al*. (2004) and Khan and Farman Ullah (2005) that aphid was appeared first time in January with minimum number.

In the month of February total aphid average population was 17.69 a sudden increase was done in this month as earlier reported by Ashfaq *et al*. (2007) that in aphid population sudden increase was examined. The total diversity average was 8.00 in the month of February with average temperature maximum and minimum was 21.51 and 5.51°C respectively with average R.H 72.58%. In case of bio-control agent spider population start to increased and total average population was 7.01 per plant. Coccinellids was 1stly observed in 3rd week of February in all plots as reported by Saleem *et al*. (2009) with total average population richness 1.71 per plant.

Aphid population started to increase and was peak in 3rd week of march as reported by Ashfaq *et al*. (2007), Zeb *et al*. (2011) has said that 3rd week of march is favorable for aphid growth and its population was maximum in this month and after that its population start to decrease and total average population was 74.84 per plant in march with average temperature maximum and minimum was 28.80 and 13.30°C, respectively with average R.H 67.03%, while in case of bio-control green lacewing (*Chrysoperla carnea S.)* firstly appeared in the field in 1st week of march with average total richness 9.87 per plant.

The Coccinellids (*Coccinella septempunctata*) Population started to increase in March and peak population was observed in 2nd week of March when aphid population was increasing. After this its population decreased as compared to other bio-control agents as earlier reported by Saleem *et al*. (2009) and its total average richness was 5.29 per plant in March.

The spider population was highest in 1st week of march with total average richness was 15.07 per plant in all plots and syrphid fly (*Scaeva pyrastri* L.) also was observed in the 2nd week of march same as result of Saleem *et al*. (2009) that syrphid fly (*Scaeva pyrastri* L.) population appeared in wheat field in 1st week of march and its total average population was 9.55 per plant in march.

In April, aphid population was started to decrease (total average richness was 23.04 per plant) with average temperature maximum and minimum was 35.27 and 20.10°C, respectively with average R.H 64.80% and

totally disappeared from the field in the month of April (Aslam *et al.* (2004), Khan and Farman Ullah (2005), Khan *et al.* (2007) and Zeb *et al.* (2011) reported that aphid population start to decrease and totally disappeared from the field.

In April peak richness of green lace wing was observed in 2nd week which is confirmed by Saleem *et al.* (2009) who resulted that from 2nd week of April the environment is favorable for green lace wing. Coccinallids were low as earlier described by Saleem *et al.* (2009).

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