ABIOTIC FACTORS EFFECT ON POPULATION FLUCTUATION OF ALATE APHIDS IN WHEAT

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ABSTRACT

These studies were conducted at Daphar (Mandi Baha-ud-Din) and Bahawalpur during 1997-2005 and at Ayub Agricultural Research Institute, Faisalabad, Pakistan during 1999-2005 to determine the role of temperature and relative humidity in fluctuating aphids density in wheat crop. Moericke yellow water traps were used for monitoring alate aphids. The results revealed that pest population varied in different years. The highest population (347.24/tray) was observed at 20.20ºC and 59.55 percent RH at Faisalabad during 2003-04. The lowest population (5.84/tiller) at 13.37ºC and 78.17 percent RH was noted at Daphar during 1997-98. Temperature at Daphar showed positive and significant correlation (0.394**) with alate aphids while RH at Faisalabad and Bahawalpur showed significant correlation with r-values of –0.642** and 0.369**, respectively. On cumulative basis, temperature and relative humidity contributed 12.1 and 4.8 percent role in population change, respectively. The study will provide guideline to extension workers for undertaking plant protection measures to avert higher pest losses in wheat yield with better socio-economic impact on farming community.

KEYWORDS: *Triticum aestivum;* aphids; population density; temperature; relative humidity; Pakistan.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is a major crop with the largest area under cultivation in Pakistan. It is a staple food of people of Pakistan, and plays a significant role in economic stability of the country. The aphids (Aphididae: Homoptera) are important sucking pests of various field crops, fruits and vegetables and are commonly called as plant lice. Their population has been increasing for last few years and had attained the status of a regular pest in Pakistan. Aphids caused substantial yield losses by feeding and as vector of several plant viruses. The pest can cause 100 percent loss to wheat crop in severe attack (3). Kuroli and Nemeth (9) reported that aphids reduced 50 to 70 percent grain weight per ear in winter and spring wheat, respectively. Aheer *et al.* (1) found that one aphid caused 2.20 percent loss in grain yield.

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Various workers (2, 4, 6, 8, 11, 12) showed that abiotic factors seriously affect the population build-up of wheat aphids. Change in number of flying aphids depends principally on climatic factors (7) and fluctuation in pest population varied in different years (1). Aheer *et al.* (2) found peak population of aphids during March. Temperature between 7.7 to 25.02ºC favoured the multiplication of aphids on wheat. Minimum temperature of 7.1 to 15.1ºC, maximum temperature of 24.9 to 29ºC with mean relative humidity ranging from 61 to 65 percent were congenial for proper development of aphid population (14). The optimum conditions for development of aphid population were 30.3ºC (maximum temperature), 13.7ºC (minimum temperature) and 45.3 percent RH (13). Maximum temperature showed significant and positive role in fluctuating aphids density, whereas relative humidity showed negative and significant impact (2).

The present studies were aimed at observing the influence of temperature and relative humidity on population fluctuation for wheat aphids in various districts of Punjab to forecast aphid population dynamics in future.

MATERIALS AND METHODS

These studies were conducted during 1997-2005 at Mandi Baha-ud-Din (latitude 32°-10'N, longitude 72°-47'E, altitude 218, mean temperature 24ºC and annual rainfall 360 mm), Bahawalpur (latitude 26°-25'N, longitude 71°-40'E, altitude 115, mean temperature 26.50ºC and annual rainfall 162 mm) and during 1991-2005 at Faisalabad. (latitude 31°-25'N, longitude 73°-06'E, altitude 214, mean temperature 24.50ºC and annual rainfall 350 mm). Catches of alate aphids were made through Moericke yellow water traps, each measuring 59 x 46 x 7.5 cm. These trays were half filled with water and placed on 0.75 meter high wooden stands. Daily population of aphids and meteorological data were recorded and correlated with aphids density for each year. Multiple linear regression analysis was performed to make inference of forecasting pest incidence and percent contribution of weather in fluctuating aphid density.

RESULTS AND DISCUSSION

The data (Table 1) revealed that aphid population reached maximum level at Faisalabad (347.24/tray) at 20.20ºC and 59.55 percent RH during year 2003-04, at Bahawalpur (214.22/tray) at 19.46ºC and 64.61 percent RH during 2000-2001 and at Daphar (114.20/tray) at 14.40 ºC and 85.07 percent RH during 2001-2002. Great variation was observed in population of aphids during different years as well as localities. The present findings are in

Table 1. Abiotic factors and population of alate aphids on wheat during different years.

Year	Aphids/tray	Temperature ºC	Relative humidity (%)
Daphar			
1997-1998	5.84	13.37	78.17
1998-1999	14.36	15.63	80.92
1999-2000	24.38	16.24	65.31
2000-2001	47.44	15.92	85.13
2001-2002	114.20	14.40	85.07
2002-2003	36.78	15.16	84.52
2003-2004	36.78	16.27	84.29
2004-2005	99.04	14.98	84.74
Average	47.26	13.22	81.02
Faisalabad			
1999-2000	49.56	16.82	65.66
2001-2002	143.61	18.23	74.99
2002-2003	141.23	16.89	67.62
2003-2004	347.24	20.20	59.55
2004-2005	153.45	16.41	65.86
Average	167.02	17.71	66.73
Bahawalpur			
1997-1998	77.72	19.09	74.58
1998-1999	98.15	19.78	60.24
2000-2001	214.22	19.46	64.61
2004-2005	48.15	18.37	74.75
Average	109.56	19.17	68.54

conformity with those of different researchers (2, 4, 6, 7, 8, 9, 11, 12) who reported that change in number of flying aphids depends principally on climatic factors and fluctuation in pest population varied in different years (1). However, present findings did not agree to those of Aheer *et al.* (2) who reported that temperature ranging from 7.7 to 25.02ºC favoured multiplication of aphids on wheat. In present study maximum alate aphids were recorded at 14.40 to 20.20ºC. Contradictory results were also reported by Subhash and Chander (13) and Panda *et al.* (12).

The results (Table 2) further revealed that RH did not show significant correlation with aphids population at Daphar during all study years, whereas this factor showed significant and negative correlation at Faisalabad during 1999-2000 (-0.642**) and at Bahawalpur during 1998-1999 (-0.648**). On cumulative basis, temperature at Daphar showed positive correlation (0.394**) whereas RH at Faisalabad and Bahawalpur exerted negative (-0.642**) and positive (0.369**) correlation with the aphid, respectively. The present findings partially agree to those of Aheer *et al.* (2) who observed positive and negative correlation of temperature and RH with aphids on wheat, respectively.

Table 2. Effect (r-values) of temperature and relative humidity (R.H) on the population of alate aphids at various localities during different years.

Year	Daphar		Faisalabad		Bahawalpur	
	Temperature (ºC)	RH (%)	Temperature (ºC)	RH (%)	Temperature (ºC)	RH
1997-1998	0.673**	-0.285ns	-	-	0.521ns	-0.208ns
1998-1999	0.506*	0.006ns	-	-	0.287ns	-0.648**
1999-2000	-0.315ns	-0.460ns	0.457ns	-0.642**	-	-
2000-2001	0.542*	0.037ns	-	-	0.88ns	-0.138ns
2001-2002	0.635**	0.083ns	0.046ns	+0.135ns	-	-
2002-2003	0.689**	-0.223ns	0.595*	-0.514ns	-	-
2003-2004	0.256ns	0.243ns	0.474ns	-0.514ns	0535*	0.046ns
2004-2005	0.410ns	0.375ns	0.368	0.094ns	-	-
Cumulative	0.394**	0.065ns	0.457ns	-0.642**	0.325	0.369**

*Significant at P < 0.05, **Significant at P < 0.01, ns = Non-significant

The results (Table 3) further revealed that temperature at all places played maximum role in fluctuation of aphid population as compared to RH. On cumulative basis, temperature played 12.1 percent and RH 4.8 percent role in population fluctuation of pest.

Table 3. Multivariate linear regression analysis alongwith coefficients of determination regarding aphids density and weather factors at various localities.

Locality	Regression equations	R^2	100 R^2	Role of individual factor (%)
Daphar	$Y = -3.4236+2.2094^{**}X_1$	0.156	15.6	15.6
	$Y = -30.7728+2.2758^{**}X_1+2.9497X_2$	0.167	16.7	1.1
Faisalabad	$Y = -4.1390+2.9979^{**}X_1$	0.083	8.3	8.3
	$Y = 15.3696+2.1516X_1 -1.9503X_2$	0.110	11.0	2.7
Bahawalpur	$Y = -9.5359+3.83$	0.124	12.4	12.4
	$Y = 19.6532+3.3075^{*}X_1 -3.2270^{**}X_2$	0.226	22.6	10.2
Cumulative	$Y = -5.7798+3.0269X_1$	0.121	12.1	12.1
	$Y = 15.8691+2.2597^{**} -2.1300^{**}X_2$	0.169	16.9	4.8

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