IMPACT OF WEATHER FACTORS ON POPULATION OF WHEAT APHIDS AT MANDI BAHU-UD-DIN DISTRICT

Ghulam Mustafa Aheer, Muhammad Munir and Amjad Ali*

ABSTRACT

The impact of weather factors on the population of wheat aphids was studied at Entomological Research Institute, AARI, Faisalabad for two years (2001 and 2002) in the ecological conditions of Mandi Bahau-ud-Din district. The population of insect varied from year to year, it, however, reached its peak during March. Effect of maximum and average temperature on aphids was significant and positive but minimum temperature showed negative and significant correlation with aphid density during 2001. Relative humidity during both study years on cumulative basis showed negative and highly significant impact for aphid population. During 2002, rainfall played a positive and significant role on aphid population. On cumulative basis, effect of abiotic factors on aphid population was non-significant except minimum temperature. Optimum conditions for the development of aphid population were 28.3°C (maximum temperature), 9.57°C (minimum temperature) and 65 percent relative humidity. Multivariate models showed that maximum temperature and relative humidity during 2001, minimum temperature and relative humidity during 2002 and on cumulative basis were the most important factors which contributed major role in population fluctuation of aphids.

KEYWORDS: Triticum aestivum; aphids; air temperature, relative humidity; Pakistan.

INTRODUCTION

Wheat is one of the most important staple food crops of Pakistan and is attacked severely by the aphids which affect the produce adversely (13). Hashmi et al. (6) found four aphid species damaging wheat crop viz. Sitobion avenae (F.), Schizaphis graminum (Rond.), Rhopalosiphum ruhiaebdominalis (Sasaki) and Rhopalosiphum maidis (Fitch). Aphids cause substantial yield losses by direct effects of their feeding (9) and as a vector of several plant viruses (2). Kuroli and Nemeth (12) reported 5 and 76 percent loss in grain weight per yield in winter and spring wheat, respectively. The losses ranging from 430 to 40 percent at 15 aphids per plant have also been reported by Kichkhefer and Gellner (11). Others workers (4,5,7,8,11,14) reported that abiotic factors showed significant effects on the population fluctuation of wheat aphid.

*Entomological Research Institute, AARI, Faisalabad.
Kieckhefer and Elliot (10) reported that gross and net reproductive rates of both morphs were greater at low temperature regimes and declined with increase in temperature. Chen et al. (3) reported that population dynamics of wheat aphids was affected by temperature and relative humidity.

The present study was undertaken to observe the impact of abiotic factors on the buildup of aphids population.

MATERIALS AND METHODS

Wheat crop (cv. Inqalab-91) was sown at farmer’s field (64 x 57.91 m²) in Chak No.26, tehsil Malikwal, district Mandi-Baha-ud-Din during 2001 and 2002. Plot size was 57.91 21.23 square meter with three repeats. Observations on aphids population were recorded by selecting 10 tillers randomly from each plot at 7 days interval from January 8 to April 7, at 8 to 9 a.m. The selected tillers were clipped of very gently with pair of scissors. Aphids were counted by dropping them on a white paper with camel’s hair brush and then average population per tiller was worked out. The data regarding weather factors were taken from Meteorological Observatory, Mandi Baha-ud-Din, to correlate with aphid population. Regression models were also developed to forecast aphids population.

RESULTS AND DISCUSSION

The results (Table 1) reveal that aphid population during 2001 appeared in the first week of January (0.90/tiller). It increased rapidly during subsequent weeks and attained a peak (6.75/tiller) during second week of March. During third week, there was a slight decline but afterwards the fall in density was much higher and continued upto the first week of April (1.73/tiller). During 2002, population also appeared during first week of January (0.79/tiller) (Table 2). The population gradually increased during subsequent weeks and attained a peak (2.50/tiller) during third week of March. Afterwards aphid population showed a declining trend and reached 0.35 per tiller during 1st week of April.

The effect of maximum and average temperature was positive and significant with correlation coefficient values of 0.573 and 0.565, respectively, whereas minimum temperature and relative humidity had negative and significant effect on population during 2001. In same year, effect of rainfall on aphid population was non-significant. During 2002, relative humidity played highly

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Table 1. Aphid population on wheat crop and abiotic factors during 2001.

<table>
<thead>
<tr>
<th>Date of observation</th>
<th>Aphid/tiller</th>
<th>Temperature°C</th>
<th>R.H. (%)</th>
<th>Rainfall (mm)</th>
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<td>Maximum</td>
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*Figures in parenthesis are square root transformed.

Table 2. Aphid population on wheat crop and abiotic factors during 2002.

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<th>Date of observation</th>
<th>Aphid/tiller</th>
<th>Temperature°C</th>
<th>R.H. (%)</th>
<th>Rainfall (mm)</th>
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<td>Maximum</td>
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<td>(3.762)</td>
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*Figures in parenthesis are square root transformed.

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significant and negative role on aphid population with correlation coefficient value of 0.635, whereas rainfall played a positive and significant role. The effect of temperatures (maximum, minimum and average) was non-significant.

On cumulative basis, effect of abiotic factors on aphid population was non-significant except minimum temperature and relative humidity which contributed a negative and highly significant role for aphid population with r-values of 0.523 and 0.810, respectively (Table 3).

<table>
<thead>
<tr>
<th>Aphid population</th>
<th>Temperature°C</th>
<th>R.H. (%)</th>
<th>Rainfall (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum</td>
<td>Minimum</td>
<td>Average</td>
</tr>
<tr>
<td>2001</td>
<td>0.573*</td>
<td>-0.553*</td>
<td>0.565*</td>
</tr>
<tr>
<td>2002</td>
<td>0.286 NS</td>
<td>0.126 NS</td>
<td>-208 NS</td>
</tr>
<tr>
<td>Cumulative</td>
<td>0.264 NS</td>
<td>-0.523**</td>
<td>-0.317 NS</td>
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</table>

*Significant (P<0.05). **Highly significant (P<0.01).

The data (Table 4) further reveal that maximum temperature contributed 32.8 percent in population fluctuation of aphids per tiller during 2001. This role increased and reached up to 38.9 percent when effect of minimum temperature was added. The combined effect of all abiotic factors on aphid population was observed to be 70.6 percent. Relative humidity alone had 24 percent contribution in population fluctuation of aphids. However, maximum temperature and relative humidity showed some significant effect with 32.8 and 24 percent contribution in population fluctuation of aphids per tiller, respectively.

During 2002, maximum temperature contributed 8.2 percent in population fluctuation of aphids per tiller and this role increased up to 17.2 percent when the effect of minimum temperature was added. All abiotic factors contributed by 53.3 percent in aphid population fluctuation. Relative humidity alone showed 22.7 percent contribution in population fluctuation of aphids per tiller.

The contribution of all abiotic factors in fluctuating aphid population on cumulative basis was found to be 71 percent. Minimum temperature and relative humidity showed significant effect with 34.1 and 18.9 percent contribution in population fluctuation of aphids per tiller on wheat crop, respectively.

In view of the results it was observed that combination of all abiotic factors contributed a significant role in aphid population fluctuation on wheat rather than a single factor. These findings are in conformity with those of some earlier workers (3, 7, 8).

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The present results lead to the conclusion that aphid population decreased when maximum temperature and minimum temperature reached to the optimum limits i.e. 28.30°C and 9.57°C, respectively during 2001, 30.60°C and 10.00°C, respectively during 2002. These findings are in partial agreement with those of Kieckhefer and Elliott (10), who reported that aphid population declined with the increase in temperature but range of minimum temperature reported by them was different. It has also been found during 2001 that aphid population decreased with the decrease in relative humidity. These findings are similar to those of Pesel and Poehling (14) who also found that growth rates of cereal aphids were reduced by drought. Attempts have also been made in the past (4) where a multi-linear regression equation was developed for aphid population and abiotic factors. Similarly, Holz and Wetzel (7) and Feng et al. (5) also developed models for forecasting aphid population in relation to environmental factors but under different set of environmental conditions.

Table 4. Multivariate models showing impact of weather factors on aphid population during 2001, 2002 and on cumulative basis.

<table>
<thead>
<tr>
<th>Regression equations</th>
<th>R²</th>
<th>100R²</th>
<th>Actual contribution(%)</th>
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<tbody>
<tr>
<td><strong>2001</strong></td>
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</tr>
<tr>
<td>$Y = -0.123848 + 0.3994X_1$</td>
<td>0.328</td>
<td>32.8</td>
<td>32.8</td>
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<tr>
<td>$Y = 0.743877 + 0.2590X_1 - 0.1021X_2$</td>
<td>0.389</td>
<td>38.9</td>
<td>6.1</td>
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<tr>
<td>$Y = 3.968089 - 1.451X_1 - 0.2992X_2 + 1.5945X_3$</td>
<td>0.433</td>
<td>43.3</td>
<td>4.4</td>
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<tr>
<td>$Y = 8.879876 - 1.298X_1 - 0.2992X_2 + 1.1631X_3 - 0.2684X_4$</td>
<td>0.673</td>
<td>67.3</td>
<td>24.0</td>
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<tr>
<td>$Y = 6.438240 - 1.1268X_1 - 0.1072X_2 + 1.0813X_3 - 0.5968X_4 + 0.2355X_5$</td>
<td>0.706</td>
<td>70.6</td>
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<tr>
<td><strong>2002</strong></td>
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<tr>
<td>$Y = -0.7353165 + 0.1146X_1$</td>
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<td>$Y = 0.004870X_1 + 1.3825X_2 - 0.3469X_3 - 1.5342X_4$</td>
<td>0.324</td>
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<td>$Y = 12.70247 + 0.34295X_1 - 0.03685X_2 - 0.2628X_3 - 1.2984X_4$</td>
<td>0.451</td>
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<td>$Y = 6.75361X_1 + 0.893X_2 - 0.4554X_3 - 0.8418X_4 + 3.8469X_5$</td>
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</table>

**Cumulative**

<table>
<thead>
<tr>
<th>Regression equations</th>
<th>R²</th>
<th>100R²</th>
<th>Actual contribution(%)</th>
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<tbody>
<tr>
<td>$Y = 0.6275689 + 0.1848X_1$</td>
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<td>$Y = 8.26076 - 0.3161X_1 - 0.1150X_2 + 0.3927X_3 - 0.7175X_4$</td>
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<td>70.7</td>
<td>18.9</td>
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<td>71.0</td>
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$Y$ = Population of aphids/stk, $X_1$ = Maximum temperature°C, $X_2$ = Minimum temperature°C, $X_3$ = Average temperature°C, $X_4$ = Relative humidity(%), $X_5$ = Rain fall (mm) and $R$ = Coefficient of determination.

REFERENCES


