Microclimatic Distribution Analysis of Bird Cherry Oat Aphid, *Rhopalosiphum padi* L. on Wheat

IBRAR-UL-HASSAN AKHTAR, HUMAYUN JAVED AND EHSAN-UL-HAQ
Department of Entomology, University of Arid Agriculture, Rawalpindi (IHA, HJ) and Pest Management Research Programme, IPEP, NARC, Islamabad (EH)

**Abstract.** Inqilab-91 wheat variety was sown in the experimental fields of the Crop Science Institute, NARC in Islamabad in winter 2003 under Randomized Complete Block Design with three replications. Data were collected on weekly basis through visual count method. Overall aphid morphs distribution of all three species of aphid was significantly different during 2003 on week basis. Population of *Rhopalosiphum padi* L. nymphs peaked to 9.141±1.847 / plant during 11th week in March 2003. Apterous population peaked to 1.228±0.131 / plant during 4th week in January and secondly peaked in 11th week in March (2.128±0.808 / plant). Alates were peaked to 3.625±1.04 / plant 4th week in January. Aphids plant distribution showed that they mostly preferred the leaf and spike parts of wheat plants.

**Key words:** Aphids, *Rhopalosiphum padi*, cereal aphids, wheat damage.

**INTRODUCTION**

Wheat (*Triticum aestivum* L.) being a major cereal occupies an eminent place in the economy of our country, provides about 60% of the calories and 50% of the protein to the human race (Chowdhry et al., 1998; Wittwer, 1980; Khan et al., 2000). It contributes 12.1% to the value added in agriculture and 2.9% to GDP (Govt. of Pakistan, 2001).

Aphids are probably the most familiar plant pests commonly known as green fly or black fly and there are only few plants that are not liable to be infested by this persistent and destructive insect pest. Majority of aphids suck sap of the leaves and young shoots causing distortion, stunting and sometime premature leaves fall (Akhtar and Khaliq, 2003). Aphids reproduce either sexually or parthenogenetically and occur mainly as winter pest in the world (Becker, 1997).

Rabbinge et al. (1983) reported that more important factors that caused yield losses were powdery mildew and cereal aphids. Aphid’s population has been increasing for the last few years on wheat crop and attaining the status of pest in Pakistan (Aheer et al., 1994; Zia et al., 1999). In Pakistan, aphid species reported on wheat crop include *Sitobion avenue* Fabricius, *Schizaphis graminum* Rodani, *Metapolophium dirhodum* Walker, *Macrosiphum granarium* Fabricius, *Rhopalosiphum padi* Linnaeus, *Rhopalosiphum maidis* Fitch, *Rhopalosiphum rufiabdominalis* Sasaki and *Sipha maydia* Passiriniae (Hashmi et al., 1983; Aheer et al., 1993; Pervaz and Zulfiqar, 1999).

Wheat is severely attacked by the wheat aphids which affect the produce adversely (Mohyuddin, 1981; Hamid, 1983). Bird cherry oat aphid, *R. padi* Linnaeus is heteroecious migrating between its primary host, the Bird cherry, *Prunus padus* and its graminaceous host and exhibit holocyclic life cycle between them (Naeem, 1996).

To prevent losses by aphids, several control methods have been used. These include cultural, physical, mechanical, biological, chemical and host plant resistance. Control through chemicals has created a number of problems by killing the beneficial insects and resistance development in the pests. In order to combat the increasing resistance in aphids and to reduce the pesticide load in environment, we need to adopt integrated pest management strategies. Abiotic factors affect the physiology and behaviour of insects and act as density independent factors which only determine the change in insect population. Abiotic factors can produce physiological effect on insect population in...
four major ways by modifying activity of endocrine system, survival, development and reproduction.

Keeping in view the importance of aphid on wheat, the present study was initiated to understand the populations build up of *Rhopalosiphum padi* under field conditions; and to determine the distribution of cereal aphids on different plant parts of wheat.

**MATERIALS AND METHOD**

Experiment was conducted to study the microclimatic distribution of bird cherry oat aphid on wheat under field conditions. Wheat crop Inqilab-91 wheat variety was sown during crop season in the experimental fields of Crop Science Institute (CSI), National Agriculture Research Centre (NARC), Islamabad, under Randomized Complete Block Design (RCBD). There were three replication of experimental material with total of 24 experimental plots. Total experimental area was 608 m² with dimension of 32 m length and 19 m in width. Size of experimental plot was 15 m² with dimension of 10 m length and 1.5 m in width. Each experimental plot was sown with six rows of wheat with 25 cm row to row distance and 15 cm plant to plant distance. There was 1 m treatment and replication path.

Random sampling technique was used for the whole crop research period. Wheat plants of each experimental plot were selected randomly for data collection. Two different sampling techniques were followed for cereal aphid populations (Akhtar and Khaliq, 2003). In plant based sampling, the wheat plants were sampled on different growth stages such as (i) Whole plant based sampling from seedling to tillering stage of wheat, (ii) tiller based sampling in which whole selected tiller were sampled after tillering of wheat, (iii) flag leaf based sampling in which sampling of cereal aphids population on the flag leaf of wheat crop. Ten flag leaves per plot were sampled, (iv) spike based sampling in which sampling of cereal aphids on spikes of wheat crop when at least 50% of plants were having the spike on them and 10 spikes per plot were sampled.

In insect based sampling, wheat plant was sampled for morph development. This technique included; morph based sampling of cereal aphids included, the sampling of nymphs, alates and apterous adults.

Data were recorded on weekly basis on random plant selection in all experimental plots. Data collection started after the wheat seedling emergence and continued until the harvesting of wheat crop.

Aphids of wheat crop were collected from the adjacent field of wheat crop as wet preservation in 70% alcohol. Aphids were identified by using different taxonomic characters based on identification keys (Blackmen and Eastop, 1984).

Data were analyzed by using different statistical computer software (SPSS 10, STATISTICA 5.0 and Minitab 13.0). Descriptive statistical analysis (mean, standard deviation, standard error, sum) and ANOVA was calculated from the data for results interpretations (Steel and Torrie, 1984). Graphical representation of data was done through MS-Excel and SPSS programs.

**RESULTS AND DISCUSSION**

Bird cherry oat aphid morph distribution was observed weekly on wheat plant. Morphs of aphid include nymph, apterous adult and alate adult (Fig. 1).

![Fig. 1. Mean numbers of morphs of Rhopalosiphum padi on wheat](image-url)
Table I.- Mean numbers of bird cherry oat aphid (*Rhopalosiphum padi* L.) on different plant parts.

<table>
<thead>
<tr>
<th>Date</th>
<th>Leaf Mean ± S.E</th>
<th>Stem Mean ± S.E</th>
<th>Flagleaf Mean ± S.E</th>
<th>Spike Mean ± S.E</th>
</tr>
</thead>
<tbody>
<tr>
<td>06–01–2003</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>13–01–2003</td>
<td>0.92 ± 0.19 ab</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>20–01–2003</td>
<td>3.81 ± 1.33 bc</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>27–01–2003</td>
<td>8.32 ± 2.36 c</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>03–02–2003</td>
<td>1.40 ± 0.26 ab</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10–02–2003</td>
<td>4.93 ± 1.38 cd</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>17–02–2003</td>
<td>1.48 ± 0.41 ab</td>
<td>0.09 ± 0.05 a</td>
<td>0.06 ± 0.04 a</td>
<td>0.03 ± 0.16 a</td>
</tr>
<tr>
<td>24–02–2003</td>
<td>0.48 ± 0.17 ab</td>
<td>0.09 ± 0.05 a</td>
<td>0.06 ± 0.04 a</td>
<td>0.03 ± 0.16 a</td>
</tr>
<tr>
<td>03–03–2003</td>
<td>1.17 ± 0.42 ab</td>
<td>0.24 ± 0.12 ab</td>
<td>0.15 ± 0.10 a</td>
<td>0.05 ± 0.03 a</td>
</tr>
<tr>
<td>10–03–2003</td>
<td>1.12 ± 0.25 ab</td>
<td>0.23 ± 0.12 ab</td>
<td>0.14 ± 0.12 a</td>
<td>0.30 ± 0.26 a</td>
</tr>
<tr>
<td>17–03–2003</td>
<td>7.21 ± 1.72 de</td>
<td>1.58 ± 0.60 c</td>
<td>0.73 ± 0.35 b</td>
<td>3.01 ± 0.86 b</td>
</tr>
<tr>
<td>24–03–2003</td>
<td>3.03 ± 1.25 abc</td>
<td>0.71 ± 0.29 b</td>
<td>0.28 ± 0.15 a</td>
<td>0.64 ± 0.27 a</td>
</tr>
<tr>
<td>31–03–2003</td>
<td>0.12 ± 0.08 a</td>
<td>0</td>
<td>0</td>
<td>0.05 ± 0.03 a</td>
</tr>
<tr>
<td>07–04–2003</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Population of nymphs, apterous and alates fluctuated significantly on weekly basis ($F=7.795$, $P=0.000$; $F=5.104$, $P=0.000$; $F=9.884$, $P=0.000$), respectively. Nymphal population was minimum during 1st week of January. Population increased to $2.751±1.147$/plant during 3rd week of January. During 1st week of February, population of nymphs declined to $0.228±0.120$/plant. Climatic changes were most probable reason for population fluctuation. Nymphal population peaked to $9.141±1.847$/plant during mid March 2003.

Population of apterous adults was minimum during start and end of season. Population was zero during 1st week of January but population peaked twice during season. First peaked population of $1.228±0.131$ aphids/plant was observed during 4th week of January, second peaked population of $2.128±0.808$ aphids/plant was recorded during 11th week in March.

Alate adults population recorded was mostly less than 1 alate/plant. First peaked population of alate adults was recorded during end of January ($3.625±1.04$/plant). This population declined to less than 0.2 alate/plant towards early March, second alates population peaked to $1.370±0.240$ aphids/plant during 11th week in March.

Percentage morphs distribution of *R. padi* was different on wheat plants. Nymphs were dominant stage (63.7%) followed by alates (19.0%) and Apterous form (17.3%). According to Salem (2003) infestation of adult females of greenbug (especially winged females) was initiated on wheat as soon as seedling emerged. The winged adult females appeared on wheat seedling at the beginning of the growth season. Nymph population reached the highest counts between mid February to the end of March in both seasons, *i.e.* during vegetative growth, spike emergence and grain filling. The highest number of nymphs was $504.2$ and $158.77$ per tiller for the 1st and 2nd seasons, respectively. Akhtar and Khaliq (2003) reported that alates of aphid occur least in number than apterous and nymphs. Nymphal stage was most prominent in aphids than other stages of development. Sekhar and Singh (1999) concluded that both adults and nymphs of *R. padi* reduce the yield of crop by infesting leaves and stem of the crop. Nymphs and adults of cereal aphids gradually disappear as the crop move near maturity (Rustamani *et al.*, 1999).

Mean population distribution on leaf, stem, flag leaf and spike was significantly different on week basis ($F=6.630$, $P=0.000$; $F=5.676$, $P=0.000$; $F=3.109$, $P=0.001$; $F=10.212$, $P=0.000$) during 2003 respectively. Minimum population on all plant parts was observed during start and end of season. Peaked population was observed on leaf ($8.322±S.E./tiller leaf$), stem ($1.583±S.E./Tiller stem$), flagleaf ($0.725±S.E./spike$) in 11th week during 2003 (Table I).
Difference was observed in percentage distribution of cereal aphids on different plant parts of wheat. Maximum percentage of *R. padi* was observed on leaf part (84.4%). This was followed by spike (9.6%) < stem (6.7%) and flagleaf (3.2%).

According to Akhtar and Perveen (2002) *Schizaphis graminum* and *Rhopalosiphum padi* density per leaf varied during January 9, 1998 to April 14, 1998 and was maximum on February 26, 1998. At the end of February, aphids started shifting to the ears. Maximum aphid population per ear (48.0) was recorded on March 27, 1998. Sattar et al. (2001) observed that the population reached a peak of 4.545 aphids / leaf during second week of March. With the maturity of the leaves, the aphids shifted to the ears during last week of March and disappeared towards the end of April when the ears were almost dry. The indole alkaloid contents of flag leaves and ears in most resistant lines were higher than those in susceptible lines, especially in ears. The indole alkaloid content of ears was highly correlated to pest resistance, whereas that of flag leaves was only slightly related to pest resistance (Cai et al., 2002). The greater aphid densities were recorded on leaves and spikes. Aphids were recorded more on leaves and on succulent terminal portion because of soft nature of leaves and maximum food supply towards terminal portion of the plant. Being a sucking pest aphid prefer to insert their stylets at soft surface with maximum food supply (Ahmed and Aslam, 2000). Sekhar and Singh (1999) concluded that both adults and nymphs of *R. padi* reduce the yield of crop by infesting leaves and stem of the crop. Ahmed (2002) reported that a large population of aphid transferred to spike as compared to leaves and stem. Maximum abundance of aphids occurred with the emergence of grain ears at the beginning of the flowering period (Hussein, 1993). According to Satter et al. (2001) aphids multiplied much rapidly during the reproductive growth stage of the plant resulting in higher number of aphids on plant.

**REFERENCES**


(Received 11 March 2004, revised 17 May 2006)