Pakistan J. Agric. Res. Vol 23 No. 1-2, 2010.

ANTIBIOSIS RESISTANCE IN NATIONAL UNIFORM WHEAT YIELD TRIALS AGAINST *RHOPALOSIPHUM PADI* (L.)

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ABSTRACT: The germplasm of National Uniform Wheat Yield Trials (Normal) (2003-04) were screened against *Rhopalosiphum padi* L., bird cherry oat aphid at National Agricultural Research Centre, Islamabad. Twenty National Uniform Wheat Yield Trials (NUWYT), Normal and 12 (NUWYT) rainfed varieties/ lines were evaluated for seedling bulk test to know the resistant, moderately resistant and susceptible wheat varieties/ lines. These results revealed that varieties Diamond and Margalla-99 and lines V-99022, 99B2278 and 7-03 were partially resistant, two lines V-00125 and SD-66 were susceptible and three varieties and ten lines were moderately resistant in seedling bulk test. For antibiosis studies, 10 varieties/ lines out of 20 were selected to know the effect of host plants on the fecundity of *R. padi*. Two varieties Wafaq-2007 and Diamond were the least preferred for fecundity and one line V00125 was highly preferred for fecundity.

Key Words: Wheat; Varieties/Lines; Seedling; Bulk Test; Antibiosis; Rhopalosiphum padi.; Pakistan.

INTRODUCTION

Among the cereals, the wheat is the most vantage and pivotal crop of the country. During the 2008-09, the area and production of wheat crop were 22.36 million acres and 24.03 million tonnes, the highest ever in Pakistan. This staple food crop accounts for about 37% of the total cropped area of the country (Anonymous, 2010). The reduction in wheat yield may be due to the influence of some biotic and abiotic factors. Biotic factors include insects, diseases, weeds, vertebrate pests and birds. Abiotic factors include drought, salinity, climate and water logging etc.

In Pakistan damage to wheat by aphids is occasional and sporadic as compared to the other parts of the world. Direct crop yield reductions may range from 10% to 50% and indirect from 20% to 80% (Tradan and Mileboj, 1999), from 19% to 31% at the boot stage and from 14% to 20% during the anthesis stage of plant growth (Voss et al., 1997). Khan (2005) reported cereal aphid infestation in early days of December in D.I. Khan and Bannu, while *Rhopalosiphum padi* L. infestation at Kohat during mid January. Distribution of *R. padi* in Peshawar valley (Peshawar, Mardan, and Charsadda) was somewhat different from southern zone (D. I. Khan, Bannu and Kohat) and eastern zone as well.

Among the wheat pests, aphids are the most widely distributed and are posing a serious threat to wheat crop through out the world (Yadev, 2003). They cause direct damage by sucking cell sap of leaves, young shoots, causing distortion, stunting, leaf curling, wilting, twisting and transmitting plant viruses. They cause indirect damage by depositing honey dew that reduce photosynthetic activity and induce sooty mould production and premature leaf senescence (Stern, 1967; Robbinge et al., 1983; Karimullah and Ahmad, 1988; Ozder, 2002; Akhtar et al., 2006).

Different aphid species have been reported in Pakistan causing severe damage to the wheat crop (Hamid, 1983; Inayatullah et al., 1993). Bird cherry oat aphid is one of the most numerous and economically important aphid spp. on wheat (Schotzko and Perez, 2000; Akhtar et al., 1991; Dixon, 1987). The nymphs and adults

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both reduce the yield (Sekhar et al., 2001). Significant reduction in yield occurs when aphids inject salivary enzymes into the plant during feeding and subsequently removing the plant nutrients (Ryan et al., 1990).

The present studies were therefore conducted to evaluate the antibiosis resistance in 20 varieties/lines of wheat against *R. padi*.

MATERIALS AND METHODS

Twenty candidate lines of National Uniform Wheat Yield Trials (Normal) of 2003-04 were selected for screening against the bird cherry oat aphid. All the experiments were conducted under the controlled laboratory conditions (27±2°C; 45-60 % rh; 16:8 h L:D) in the rearing room at Insect Pest Management Programme, National Agricultural Research Centre, Islamabad. The test varieties/lines included were 99B4012, V-00125, SD-66, V-00183, Wafaq-2001, 91BT01084, 99B2237, V-01180, SARC-5, Inqlab-91, CT-00231, RWM-9313, 93T47, Diamond, V-99022, SN-122, NRDW-1, 99B2278, 7-03 and Margalla-99. A seedling bulk test was performed to find out the resistant (R), moderately resistant (MR) and susceptible (S) lines. All work was done following standard procedure of seedling bulk test:

Seeds of all candidate varieties/lines were sown in rows in metal trays. In each tray, there were eight rows and in each row, 20 seeds of each variety/line were sown. When seedlings attained the height of 5-6 cm, each seedling was infested with 10 aphids and allowed to reproduce on each seedling. Damage rating (DR) was recorded on visual damage rating scale of 0-9, where "0" stands for healthy and "9" stands for dead (Inayatullah et al., 1993). After 15-20 days of infestation when lodging and yellowing of seedlings started, data were recorded. The damage rating (DR) was recorded thrice visually. The first, second and third readings were recorded 19, 21 and 23 days after sowing on April 6, 8 and 10, 2005, respectively. Resistant lines (R) were having damage rating DR of 2-3. Moderately resistant (MR) lines were having DR, 4-6 and susceptible lines (S) were with DR, 7-9.

Based on the results of seedling bulk test, two resistant varieties (Diamond and Margalla-99) and one resistant line (99B2278), three moderately resistant varieties (Wafaq-2001, SARC-5, Inqlab-91), two moderately resistant lines (V-00183 and RWM-9313) and two susceptible (V-00125 and SD-66) lines were selected for antibiosis test.

In antibiosis test two seeds of each variety/ line were sown in a soil mixed in 7 cm diameter pot. When seedlings attained height of 5-6 cm, two seedlings of each variety were thinned to one seedling. Under the specified lab conditions aphid reproduces parthenogenetically (Inayatullah et al., 1993). One adult aphid was released on each seedling and then each pot was covered with plastic cage of 6 cm diameter and 30 cm in height having muslin cloth on top and having two side ventilation holes. When these aphids started reproduction on seedling, all the nymphs were removed except one, this nymph was allowed to grow on test varieties/lines until it was matured and started reproduction parthenogenetically. Numbers of nymphs reproduced daily were removed and counted from each seedling, until aphid stopped reproducing and died. The varieties were categorized as least preferred for fecundity (LPF), having least numbers of nymphs per seedling, moderately preferred for fecundity (MPF) having moderate numbers of nymphs reproduced per seedling and highly preferred for fecundity (HPF) having highest numbers of nymph reproduced per seedling.

RESULTS AND DISCUSSION

The results of seedling bulk test revealed that two varieties (Diamond and Margalla-99) and three lines V-99022, 99B2278 and 7-03 were resistant (Table 1). Three varieties (Wafaq- 2001, SARC-5 and Inqlab-91) and ten lines (99B4012, V-00183, 91BT01084, 99B2237, V-01180, CT-00231, RWM-9313, 93T347, SN-122 and NRDW-1) were moderately resistant. Two susceptible lines were V-00125 and SD-66.

Table 1. Damage rating of NUWYT (N) 2003-04 against bird cherry oat aphid through seedling bulk/ flat test during April 2005

NUWYT N 2003-04	Ist DR	2nd DR	3rd DR	Rem-arks
99B2278	3.0	4.0	3.0	R
Margalla-99	3.0	3.0	3.0	R
Diamond	3.0	3.0	3.5	R
V-99022	3.0	4.5	3.5	R
7-03	3.0	3.0	3.0	R
99B4012	3.0	4.5	5.0	MR
V-00183	3.0	4.0	6.0	MR
Wafaq-2001	3.0	3.0	4.0	MR
91BT01084	3.0	3.0	4.0	MR
99B2237	4.0	5.0	5.0	MR
V-01180	3.0	4.5	6.0	MR
SARC-5	4.0	4.5	5.0	MR
Inqlab-91	4.5	5.0	5.0	MR
CT-00231	3.0	4.0	4.0	MR
RWM-9313	3.0	5.0	4.0	MR
93T347	4.5	5.0	4.0	MR
SN-122	3.0	4.5	4.0	MR
NRDW-1	3.0	3.0	4.0	MR
V-00125	4.0	5.0	8.0	S
SD-66	4.0	4.5	7.0	S

The results of antibiosis test showed variable responses of the test material on fecundity of *R. padi* (Table 2). For instance on a certain day, less progeny was developed on a given wheat line while the following day, more progeny was noted on that line. On first day of recording the progeny data, maximum number of nymphs was recorded on SARC-5 with mean population of 5.7 aphids. This showed that one variety SARC-5 was highly preferred for fecundity (HPF) followed by lines 99B2278 (1.7 aphids), V00183 (1.3 aphids). Three varieties (Diamond, Wafaq-2001 and Margalla-99) and two lines (SD-66, RWM-9313) with mean populations of 1.0 aphid, respectively, were moderately fecund. One variety Inqlab-91 and one line V00125 with mean populations of 0.7 aphids showed least fecundity (F = 3.784, P = 0.0063). Next day, maximum number of nymphs were found on line (SD-66) with mean population of 5 aphids followed by three varieties SARC-5 (2.0 aphids), Margalla-99 (1.7 aphids) and Inqlab-91(1.3 aphids) were highly preferred for fecundity (HPF). Two lines (V00183 and RWM-9313) and one variety (Diamond) with mean populations of 1.0 aphids were moderately preferred for fecundity (MPF) and one variety (Wafaq-2001) and two lines (99B2278 and V00125) with mean populations of 0.7, 0.3 and 0.3 aphids, respectively, were least preferred for fecundity (LPF) (F= 6.415, P$\leq$ 0.0003).

Similarly from start of the recording data (day 1) to the end (day 13), there was great variation and difference in fecundity noted on the test varieties/lines. Therefore, to assess the fecundity level and antibiosis effect of the test lines, averages of mean populations developed were taken (Table 2). Comparatively higher number of nymphs were recorded on V00125 (3.154 aphids) and was highly preferred for fecundity (HPF) means most susceptible followed by lines SD-66 (2.949 aphids), 99B2278 (2.923 aphids), RWM-9313 (2.795 aphids) and V00183 (1.923 aphids) and varieties SARC-5 (2.744 aphids), Inqlab-91 (2.487 aphids) and Margalla-99 (2.077 aphids) were moderately preferred for fecundity (MPF) means moderately resistant. Varieties Diamond (1.769 aphids) and Wafaq (1.308 aphids) were least preferred for fecundity means resistant varieties. Results of Akhtar and Mujahid (2006) indicated that two rainfed wheat varieties V-4 and 95022 were resistant to *R. padi.* The results of the present study are compatible with Li et al. (2001) who evaluated wheat varieties in a similar way as highly resistant, moderately resistant and least resistant wheat varieties against wheat aphids. Similarly, Akhtar and Mujahid (2006) evaluated 16 NUWYT (RF) wheat varieties antibiosis mechanism of resistance and found three varieties as least preferred for fecundity, nine varieties as moderately preferred for fecundity and four varieties as highly preferred for fecundity.

To overcome the economic losses caused by aphid's attack, use of resistant germplasm is most economical and environment friendly method for sustainable production. The use of resistant varieties

Table 2. Mean population analysis of *Rhopalosiphum padi* L on NUWYT (N) 2003-04 wheat lines/varieteis in antibosis test June 2005

Variety	June 12	June 13	June 14	June 15	June 16	June 17	June 18	June 19	June 20	June 21	June 22	June 23	June 24	Averages
99B2278	1.667^{b}	0.667^{b}	3.000^{ab}	3.333^{ab}	4.000^{ab}	6.333^{a}	2.000^{cd}	2.333^{bc}	3.000^{ab}	2.000^{b}	6.667^{a}	3.000^{b}	0.000^{b}	2.923^{a}
Diamond	1.000^{b}	1.000^{b}	3.000^{ab}	2.000^{b}	3.333^{ab}	0.333^{c}	0.333^{d}	5.000^{ab}	0.333^{c}	3.000^{b}	2.000^{b}	1.000^{b}	0.667^{b}	1.769^{ab}
RWM-9313	1.000^{b}	1.000^{b}	6.333^{a}	2.333^{b}	3.667^{ab}	3.000^{bc}	3.67^{abcd}	5.333^{ab}	3.000^{ab}	2.000^{b}	2.333^{b}	2.333^{b}	0.333^{b}	2.795^{ab}
Inqlab-91	0.667^{b}	1.333^{b}	1.333^{ab}	4.000^{ab}	2.000^{ab}	2.000^{bc}	6.667^{a}	4.333^{ab}	1.333^{bc}	3.667^{ab}	1.333^{b}	1.000^{b}	2.667^{b}	2.487^{ab}
SARC-5	5.667^{a}	2.000^{b}	3.333^{ab}	3.000^{ab}	3.667^{ab}	2.667^{bc}	2.33^{bcd}	2.000^{bc}	1.667^{bc}	6.333^{a}	0.667^{b}	1.667^{b}	0.333^{b}	2.744^{ab}
V-00183	1.333^{b}	1.000^{b}	2.333^{ab}	2.667^{b}	3.000^{ab}	2.000^{bc}	3.33^{abcd}	2.333^{bc}	2.000^{bc}	3.333^{b}	1.333^{b}	0.000^{b}	0.667^{b}	1.923^{ab}
SD-66	1.000^{b}	5.000^{b}	1.667^{ab}	6.333^{a}	6.000^{a}	4.000^{ab}	2.000^{cd}	4.667^{ab}	1.667^{bc}	3.333^{ab}	0.333^{b}	1.000^{b}	1.000^{b}	2.949^{a}
V-00125	0.667^{b}	0.333^{b}	1.333^{ab}	2.333^{b}	1.000^{b}	3.000^{bc}	5.667^{ab}	7.000^{a}	3.333^{ab}	4.000^{ab}	2.000^{b}	7.000^{b}	3.333^{b}	3.154^{a}
Wafaq-2001	1.000^{b}	0.333^{b}	0.333^{b}	0.667^{b}	3.000^{ab}	1.000^{c}	3.67^{abcd}	0.333^{c}	2.000^{bc}	0.667^{b}	2.000^{b}	2.000^{b}	0.000^{b}	1.308^{b}
Margalla-99	1.000^{b}	1.667^{b}	2.333^{ab}	1.333^{b}	1.333^{ab}	0.667^{c}	4.000^{abc}	2.000^{bc}	4.667^{a}	4.000^{ab}	1.667^{b}	1.333^{b}	0.667^{b}	2.077^{ab}

Means followed by same letter do not differ significants ($P \leq 0.05$)

is an effective and efficient tool for the control of wheat aphids (Starks et al., 1983; Webster and Inayatullah, 1984; Webster et al., 1986; Tyler et al., 1987a; 1987b; Dong et al., 1994; Sattar et al. 2001; Akhtar et al., 2006). The use of resistant varieties will remain the most logical and economical way of reducing insect pest damage in wheat crop. Identification of the factors that confer resistance or susceptibility and the study of their inheritance in wheat crop would greatly improve breeding strategies to evolve resistant varieties. A proper understanding of mechanism of host plant resistance will also lead to breeding for durable resistance. Results of these studies if incorporated in varietal breeding programs, the wheat crop in the field will suffer comparatively less losses. These findings will augment the efforts being made in devising non-chemical pest management techniques in wheat.

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