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EVALUATION OF RESISTANCE IN WHEAT AGAINST *RHOPALOSIPHUM PADI* (L.) (HOMOPTERA: APHIDIDAE) UNDER LABORATORY CONDITIONS

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ABSTRACT: For the evaluation of resistance, twelve rainfed wheat varieties/ lines of National Uniform Wheat Yield Trials (NUWYT) 2004-05 were used. Among the tested germplasm (one variety and 11 lines of wheat), V-5 line was found resistant and NRL-2017 line was found susceptible to *Rhopalosiphum padi*. The results of Antixenosis Test indicated that two wheat lines, V-5 and PR-83 were least preferred and three lines viz., NRL-2017, V-00055 and V-00BT004 were highly preferred by the test insect. The results of Antibiosis Test showed that PR-83 line was least fecund whereas NR-241 and V-00055 lines were highly fecund. The results of Tolerance Test indicated that four varieties, PR-83, V-5, SN-128 and NR-241 were highly tolerant, while only one line, V-00BT004 was least tolerant. To avoid harmful effects of this insect pest, only resistant, least preferred, least fecund and highly tolerant lines must be used in wheat breeding programmes.

Key Words: Wheat; Varietal Resistance; Susceptibility; Rhopalosiphum padi; Seedling Bulk Test; Antibiosis Test; Tolerance Test; Pakistan.

INTRODUCTION

All over the world different aphid species have been reported as the serious pest of cereals (Dixion, 1987). Wheat is severely attacked by wheat aphids, which affects the produce adversely (Hamid, 1983). Aphid population has been increasing for the last decade on wheat crop and attaining the status of pest in Pakistan (Zia et al., 1999). They cause direct damage to wheat through sucking phloem sap of leaves, blocking photosynthesis which results in leaf distortion, gall production, discoloration, stunting, leaf curling, wilting, twisting and premature leaf fall. They are directly involved in transmission of plant viruses such as maize mosaic stripe virus (MMSV) and barley yellow dwarf virus (BYDV) and indirectly, they induce the sooty mould production by depositing honey dew (Stern, 1967; Robbinge et al., 1983; Karimullah and Ahmad, 1998; Ozder, 2002; Akhtar and Khaliq, 2003; Akhtar et al., 2006). Aphid colonies on wheat persist through out the wheat growing season but are more numerous and troublesome in spring and early summer. Aphid reproduces either sexually or parthenogenetically and occurs mainly as winter pest in the world (Grigorove, 1976; Hinz and Daebeer, 1976; Wratten and Redhead, 1976; Mohyuddin, 1981; Hamid, 1983; Buczaki and Harris, 1981; Zia et al., 1999; Akhtar and Khaliq, 2003; Akhtar and Mujahid, 2006).

In Pakistan aphid species reported on cereal crops include, bird cherry oat aphid, *Rhopalosiphum padi* (L), wheat grain aphid, *Sitobion avenae* (Fabricius), grain aphid, *Sitobion miscanthi* (Takahashi), corn leaf aphid *Rhopalosiphum maidis* (Fitch), Greenbug, *Schizaphis graminum* (Rondani) and yellow sugar grain aphid, *Sipha maydia* (Passirinae) (Hamid, 1983; Inayatullah et al., 1993). Insect pest management (IPM) is a comprehensive approach of controlling insects, weeds and plant pathogens with environmentally and economically sound practices. In IPM, plant resistance to in-

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sects refers to the use of resistant crop varieties to suppress insect pest damage. Plant resistance has also been added to use in conjunction with other direct control tactics. To overcome the economic losses caused by aphid's attack, use of host plant resistance is more economical and environmentally sound method than using insecticides for control of aphids. The use of resistant varieties is an effective and efficient tool for the control of cereal aphids (Starks et al., 1983; Webster and Inayatullah, 1984; Webster et al., 1986; Tyler et al., 1987a,b; Dong et al., 1994; Sattar et al., 2001 and Akhtar et al., 2006). The use of resistant varieties will remain the most logical and economical way of reducing insect pest damage in cereals. Identification of the factors that confer resistance or susceptibility and the study of their inheritance in cereal crops would greatly improve breeding strategies to evolve resistant varieties. A proper understanding of mechanism of host plant resistance will also lead to breeding for long-term resistance.

MATERIALS AND METHODS

To screen out the resistant varieties/lines of wheat, laboratory experiments were conducted in Insect Pest Management Program (IPMP) at National Agricultural Research Centre (NARC), Islamabad during 2006. There was one variety i.e. Chakwal-97 and eleven wheat lines i.e. PR-87, NR-241, SN-128, V-00BT004, V-00055, V-5, NRL-2017, NR-234, V-002467, DN-44 and PR-83 of Rainfed National Uniform Wheat Yield Trials (NUWYT-RF) for 2004-05. Wafaq-2001 of year 2003-04 was designated as standard variety. All these varieties/lines were evaluated against bird cherry oat aphid, *R. padi* L. Experiments were performed under controlled environmental conditions (28±2°C, 40-70% RH and photoperiod of 16:8 h). Experiments for components of resistance were replicated five times. Resistance was evaluated by seedling bulk test, antibiosis test and tolerance tests.

Mass Rearing of Bird Cherry Oat Aphid, *R. padi* (L.)

Bird cherry oat aphid, *R. padi* L. was collected from cereals especially from wheat fields of NARC, Islamabad, and their culture was maintained in laboratory using aphid rearing iron racks. Twenty seeds of susceptible wheat, *T. aestivum* (L.) (Chakwal-97) were sown in a plastic pot of 11.5 cm diameter. Seedlings were obtained for mass rearing of aphids. Mass rearing was carried out and culture was maintained under controlled (RH 27±2°C, 45-70% and photoperiod of 16:8 h).

Evaluation by Flat Tests

Flat Tests were performed in metal trays measuring (51cm x 35cm x 9cm) filled with soil mixture. Eight rows of one cm depth were made with the help of wooden mould. Twenty-five seeds per genotype of one NUWYT-RF one wheat variety and 11 lines were sown in furrow made for each row of every test entry. When the seedlings attained height of 5-6 cm, ten *R. padi* were released per seedling. Damage rating (DR) was noted on visual damage rating scale of 0-9, where "0" stands for healthy and "9" stands for dead (Inayatullah et al., 1993). After 10-15 days of infestation when lodging and yellowing of seedlings started, data were recorded. 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.

Antibiosis Test

Two seeds of all NUWYT-RF genotypes, one variety and eleven lines along with Wafaq 2001 as standard were sown in a soil mix of 7 cm diameter pot. When seedlings attained height of 5-6 cm, two seedlings of each variety were thinned to one seedling. Under the provided lab conditions aphid reproduced 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 high having covered two side venitation holes and top with muslin cloth.

When the aphid started reproducing on seedling, all the nymphs were removed except one, that nymph was allowed to grow on test lines until it matured and started reproduction parthenogenetically. Nymphs reproduced daily were removed and counted from each seedling, until aphid stopped reproducing and died. The experiments was replicated for five times. The varieties were categorized as least fecund (LF), having least numbers of nymphs reproduced per seedling, moderately fecund (MF) having moderate number of nymph per seedling and highly fecund (HF) having highest numbers of nymphs reproduced per seedling.

Tolerance Test

Two seeds of one wheat variety and 11 lines of NUWYT-RF along with Wafaq 2001 as standard were sown as described in antibiosis test in 7 cm diameter pots. When seedlings attained height of 5-6 cm, they were infested with *R. padi* L. with an average of ten aphids per seedling in accordance with the prescribed methodology (Inayatullah et al., 1993). Ten adult aphids were maintained for 10-15 days. Extra aphids and nymphs were removed daily from each seedling. After 10 days of infestation when lodging and chlorosis was started, the data were categorized according to damage rating (DR) scale, highly tolerant (HT) lines were having an average DR of 3.2-3.6, moderately tolerant (MT) lines were having an average DR of 3.8-5.4 and least tolerant (LT) lines with an average DR of 6.2 (Akhtar et al., 2006).

RESULTS AND DISCUSSION

Level of Resistance of Wheat Varieties/ Lines Against *R. padi* in Flat Test.

One variety and 11 lines of NUWYT-RF, 2004-05 were evaluated through seedling bulk test (Table 1). Results showed that only one line, V-5 was resistant (R) to infestation of aphids with DR of 3. Nine lines PR-87, NR-241, SN-128, V-00BT004, V-00055, NR-234, V-002467, DN-44 and PR-83 were moderately resistance (MR) with DR of 4-6. Only one line NRL-2017 and one variety Chakwal 97 were susceptible (S) with DR 7. Akhtar et al. (2004) recorded that mean population distribution of aphids on leaf, stem and spike was significantly different, but non-significant on the flag leaf.

Average Number of Nymphs Laid Reproduced during Life Cycle of *R. padi* on Wheat Lines/ Varieties in Antibiosis Test

Antibiosis test was performed on 11 rainfed wheat lines and one variety Chakwal-97 along with Wafaq 2001 as standard. Out of 13 lines/varieties, lines V-002467 and PR-83 was least fecund (LF) with 0.5 and 0.7 average numbers of

Table 1. Level of resistance of rainfed wheat lines against *R. padi* in Flat Test

S. No.	Varieties/lines of NUWYT-RF 2004-05	No. of seedlings	Damage Rating(DR)	Nature of resistance
1	PR-87	21	4	MR
2	NR-241	17	4	MR
3	SN-128	20	5	MR
4	V-00BT004	16	5	MR
5	V-00055	18	6	MR
6	V-5	20	3	R
7	NRL-2017	22	7	S
8	NR-234	15	5	MR
9	V-002467	15	4	MR
10	DN-44	18	4	MR
11	PR-83	25	5	MR
12	Chakwal-97	14	7	S

Damage rating (DR); 3=Resistant Lines (R); 4-6= Moderately Resistant lines (MR) and 7-9= Susceplibe variety (S)

Table 2. Average number of nymphs reproduced during life cycle of one *R.padi* on rainfed wheat lines/varieties in Antibiosis Test

S. No.	Wheat variety/ Lines NUWYT-RF 2004-05	Average no. of nymphs laid	Remarks
1	PR-87	1.3	MF
2	NR-241	1.3	MF
3	SN-128	1.5	HF
4	V-00BT004	1.3	MF
5	V-00055	1.2	MF
6	V-5	1.0	MF
7	NRL-2017	0.9	MF
8	NR-234	1.1	MF
9	V-002467	0.5	LF
10	DN-44	1.2	MF
11	PR-83	0.7	LF
12	Chakwal-97	1.6	HF
13	Wafaq- 2001	1.3	MF

LF= Least Fecund, MF= Moderately Fecund, HF= Highly Fecund

nymphs (Table 2). While nine lines PR-87, NR-241, V-00BT004, V-00055, V-5, NRL-2017, NR-234, DN-44 and variety Wafaq-2001 were moderately fecund (MF) with average numbers of nymphs as 1.3, 1.3, 1.3, 1.2, 1.0, 0.9, 1.1, 1.2 and 1.3 respectively. One line SN-128 and one variety Chakwal-97 were highly fecund (HF) with average numbers of nymphs 1.5 and 1.6 respectively. While remaining two lines V-00055 and NR-241 were highly fecund (HF) with average number of nymphs 1.8 and1.84. These varieties were not checked before so no comparison was possible. Sharma and Ashok (2002) studied that there were four nymphal instars of *R. maidis* and nymph survival was more than 95% in rearing on barley. The average longevity of adult female was 27.15-34.02 days. The average number of progeny laid by a female aphid was 51.28 - 66.07.

Tolerance Level in Wheat Varieties Against *R. padi* in Tolerance Test

In this experiment infestation due to *R. padi* was recorded on eleven lines and one variety of NUWYT-RF 2004-05. According to data (Table 3) four lines NR-241, SN-128, V-5 and PR-83 were categorized as highly tolerant (HT). Six lines PR-87, V-00055, NRL-2017, NR-234, V-002467, DN-44, and two varieties Chakwal-97 and Wafaq 2001 were categorized as moderately tolerant (MT) while only one line V-00BT004 was found to be least tolerant (LT). Akhtar and Mujahid (2006) found out that variety/ line Faisalabad-85 and lines DN-18, PR-77 and MAW-1 were tolerant line of wheat.

Table 3. Tolerance of rainfed wheat lines along with Wafaq- 2001 against *R. padi* L. in Tolerance Test

S. No.	Wheat lines/ varieties NUWYT-RF 2004-05	Average dr	Remarks
1	PR-87	3.8	MT
2	NR-241	3.6	HT
3	SN-128	3.6	HT
4	V-00BT004	6.2	LT
5	V-00055	4.4	MT
6	V-5	3.6	HT
7	NRL-2017	4.4	MT
8	NR-234	5.4	MT
9	V-002467	5.2	MT
10	DN-44	4.6	MT
11	PR-83	3.6	HT
12	Chakwal-97	4.2	MT
13	Wafaq-2001	4.6	MT

HT = Highly Tolerant, MT = Moderately Tolerant, LT = Least Tolerant.

Results of these studies indicated that in seedling bulk test line V-5 was highly resistant, in Antibiosis Test least fecund (LF) line was PR-83 and in Tolerance Test four lines NR-241, SN-128, V-5 and PR-83 were found to be tolerant to aphid *R. padi.* The use of resistant varieties will remain the most logical and economical way of reducing damage of pests in wheat germplasm. A proper understanding of the mechanisms of host plant resistance will also lead to breeding for long-term resistance (Saxena and Khan, 1989).

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