Pakistan J. Agric. Res. Vol 22 No1-2, 2009.

SUSCEPTIBILITY IN WHEAT GERMPLASM TO INFESTATION 0F *RHOPALOSIPHUM PADI* (L.) (HOMOPTERA: APHIDIDAE)

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ABSTRACT: Susceptibility of 20 wheat lines/varieties was studied against wheat aphid *Rhopalosiphum padi* L. In seedling bulk tests, the germplasm under study was grouped into three categories i.e., resistant, moderately resistant and susceptible. Data from seedling bulk tests showed that five wheat lines namely V-01078, V-00055, KT-7, V-01180 and DN-47 were resistant with damage rating of 2-3. Twelve wheat lines/varieties, 99B4012, 99B2278, V-9021, V-002493, Wafaq 2001, PR-84, TW0135, CT-00062, 7-03, PR-86, V-02192 and Chakwal 97 were found moderately resistant. Three wheat lines/varieties namely RWM-9313, V-00125 and Diamond were moderately susceptible (MS) with damage rating of 6. No wheat line was found as susceptible during these studies. Results of antixenosis tests (after 24 hours) showed that out of 20 only three lines i.e., V-01180, DN-47 and PR-84 were least preferred. Fifteen wheat lines/varieties were moderately preferred and only one germplasm line, V-9021 was highly preferred by this aphid. Observations after 48h showed that only two wheat germplasm lines, PR-84 and V-01180 were least preferred. Seventeen wheat lines/varieties were moderately preferred. There was only one germplasm line, namely V-9021 that was highly preferred. Combined results of antixenosis test, indicated that three wheat lines V-01180, PR 84 and DN-47 were least preferred. Sixteen wheat lines/varieties were moderately preferred. Only one wheat germplasm line, V-9021, was highly preferred. Three least preferred wheat lines i.e., V-01180, PR-84 and DN-47 were recommended to be incorporated in future breeding programmes for better crop yield.

Key Words: Wheat; Germplasm; Infestation; Rhopalosiphum padi; Resistance; Susceptibility; Pakistan.

INTRODUCTION

Different aphid species are established pests of agricultural crops across the world. They are known for their direct and indirect damage to a wide variety of different field crops, vegetables, fruits and ornamental plants. They cause direct damage by sucking cell sap of leaves, young shoot, causing distortion, stunting, leaf curling, wilting, twisting and some time premature leaf fall. They are also involved in transmission of plant viruses and indirectly by depositing honey dew that reduce photosynthetic activity and induce sooty mould production and premature leaf senescence (Naeem, 1996; Karimullah and Ahmad, 1998; Akhtar and Khaliq, 2003). In Pakistan, different aphid species like bird cherry aphid, *Rhopalosiphum padi* (L); wheat grain aphid , *Sitobion avenae* (F.); grain aphid, *Sitobion miscanthi* (Takahashi); corn leaf aphid, *Rhopalosiphum maidis* (Fitch); greenbug, *Schizaphis graminum* (Rondani) and yellow sugar grain aphid, *Sipha maydia* (Passiriniae) are reported on different cereals (Hamid, 1983; Inayatullah et al., 1993). *Rhopalosiphum padi* L. is heteroecious, migrating between its primary host to secondary host and exhibits holocyclic life cycle between them (Naeem, 1996). It is one of the most numerous and economically important aphid on wheat and spring wheat, *Triticum aestivum* L. (Schotzko and Bosque-Perez, 2000).

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To overcome the economic losses caused by aphid's attack, economical and environmentally sound method for control of aphids is the use of resistant wheat cultivars in pest management programmes (Dong et al. 1994; Webster and Inayatullah, 1984; Tyler et al., 1987). Plant resistance to insect pests refers to the use of resistant crop germplasm 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 aphids attack, use of host plant resistance is more economical and environmentally sound method than using insecticides for control of aphids. Additionally, the use of resistant varieties is an effective and efficient tool for the control of cereal aphids (Starks et al., 1983; Akhtar et al., 2006). Identification of the factors that confer resistance or susceptibility and the study of their inheritance in cereal plants would greatly improve breeding strategies to evolve resistant varieties. Thus, an understanding of mechanism of host plant resistance will also lead to breeding for long-term resistance.

The present studies discuss the status of host-plant resistance in wheat lines/varieties against *R. padi* by determining the influence of infestation on growth of wheat and the ability of this germplasm to resist stunting caused by infestation of *R. padi.*

MATERIALS AND METHODS

To find out the resistant wheat lines, experiments were conducted in the Insect Pest Management Program (IPMP) Laboratories at National Agricultural Research Centre (NARC), Islamabad. There were 20 wheat lines/varieties of National Uniform Wheat Yield Trials (NUWYT) (N) which were evaluated against *R. padi.* Twenty wheat lines/varieties of 2004-2005 NUWYT (N), tested were: V-01078, 99B4012, Wafaq-2001, RWM-9313, V-00125, Diamond, PR-84, TW 0135, V-00055, 99B2278, KT-7, V-01180, DN-47, V-9021, CT-00062, 7-03, PR-86, V-02192, V-002493 and Chakwal 97. Evaluation of resistance was done by Seedling bulk test and antixenosis test. These experiments were performed under controlled environmental conditions (27 ± 2^{o}C and 45-70% R.H.). Experiments were of completely randomized design and replicated five times.

Mass Rearing of *R. padi*

R. padi was collected from cereals and wheat fields of NARC, Islamabad, and their culture was maintained in specially made iron racks measuring 112cm×50cm×62 cm, lightened with five florescent (20 W) tube lights. About 20 seeds of susceptible wheat lines/varieties were sown in a plastic pot (11.5 cm dia.). Seedlings were obtained for mass rearing from 20 wheat seeds sown per pot. Culture of aphids was maintained under controlled conditions of 27 ± 2^{o}C temperature, and 45-60% humidity, and of 16h:8h of day: night photoperiod in the rearing room. Resistance was evaluated by seedling and antixenosis test.

Seedling Bulk / Flat Test

The test was performed in three metal trays measuring 51cm×35cm×9cm. Trays were filled with soil and eight rows of one cm depth were made with the help of wooden mould. There were 20 seedlings of every test entry sown in furrows of each row. When the seedlings attained the height of 5.8 cm, *R. padi* were released on them with the average of 10 aphids per seedling. Damage rating (DR) data of each variety were evaluated on visual damage rating (DR) scale of 0-9 where 0 stands for healthy and 9 stands for dead. After 10-15 days of infestation, when lodging and chlorosis started, plants were observed and data was categorized as highly resistant lines/varieties having DR=2, resistant lines/varieties having DR=3, moderately resistant (MR) lines/varieties having DR=4-6 and susceptible lines/varieties were having DR=7-9 (Inayatullah et al., 1993).

Antixenosis Test

The randomized complete block design

tests of wheat germplasm of NUWYT (N), in five replications were conducted to find out the results of non-preference. Seeds of test lines/varieties were sown in a circular pattern about 3 cm from the edge of 30 cm diameter plastic pot. When seedling were of 5.8 cm height, 100 adult wingless bird cherry oat aphids, *R. padi* were released on the circular paper of 3 cm diameter in the centre of the pot and then pots were covered with plastic cages. After 24 hours *R. padi* settled on each seedling were counted. There were three categories for preference, least preferred (LP) having least number of aphids, moderately preferred (MP) having moderate number of aphids and highly preferred (HP) having highest number of aphid (Akhtar and Mujahid, 2006).

RESULTS AND DISCUSSION

Seedling Bulk Test

Out of 20 wheat lines/varieties four namely V-01078, K9-7, V-01180 and DN-47 were found resistant with damage rating of 2-3 (Table 1). Of the remaining 16 lines/varieties, five (V-01078, 99B4012, 99B2278, V-9021 and V-002493) were moderately resistant (MR) with damage rating of 4. Whereas, Wafaq 2001, PR-84, TW0135, CT-00062, 7-03, PR-86, V-02192 and Chakwal 97 were moderately resistant (MR) with damage rating of 5. Wheat germplasm RWM-9313, V-00125 and Diamond were found moderately susceptible (MS) with damage rating of 6. No wheat entry was found to be susceptible.

Table 1. Susceptibility in (NUWYT (N) 2004-05) Wheat germplasm against *R. padi L.*

Wheat line/ varieties NUWYT (N)	Damage Rating	Nature of Resistance
V-01078	2	R
99B4012	4	MR
Wafaq 2001	5	MR
RWM-9313	6	MS
V-00125	6	MS
Diamond	6	MS
PR-84	5	MR
TW 0135	5	MR
V-00055	3	R
99B2278	4	MR
KT-7	3	R
V-01180	3	R
DN-47	3	R
V-9021	4	MR
CT-00062	5	MR
7-03	5	MR
PR-86	5	MR
V-02192	5	MR
V-002493	4	MR
Chakwal 97	5	MR

R=Resistant, MR= Moderately Resistant, MS= Moderately Susceptible

Antixenosis Test

Results of antixenosis tests for 24 hours data showed that out of 20 wheat lines/varieties, only three were least preferred by *R. padi* with their respective mean preference rating of 7.0 (V-01180), 7.6 (DN-47) and 9.0 (PR-84) (Table 2). Sixteen wheat lines/varieties were moderately preferred while, only one line was highly preferred.

Results of antixenosis tests for 24h data showed that only three wheat lines, V-01180, DN-47 and PR-84 were least preferred (Table 2). Fifteen wheat lines/varieties were moderately preferred and only one line, V-9021 was highly preferred. Results of antixenosis tests for 48h showed that only two germplasm lines PR-84 and V-01180 were least preferred. Seventeen wheat lines/varieties namely TW 0135 (13.8), V-002493, (14.0), DN-47 (14.6), V-01078 (17.0), CT-00062 (17.2), 99B2278 (17.8), 99B4012 (19.2), PR-86 (19.4) RWM-9313 (20.5), V-00055 (22.6), Chakwal 97 (22.6), 7-03 (22.8), Wafaq 2001 (23.2), KT-7 (23.7), Diamond (24.2), V-02192 (24.2) and V-00125 (24.7) were moderately preferred. There was only one wheat line, V-9021 that was highly preferred.

Results of antixenosis test, wherein data was taken after 48h of aphid release, showed that only two wheat germplasm lines were least preferred (Table 2, Figure. 1). Moderately preferred wheat germplasm with their respective mean preference rating were TW 0135 (13.8), V-002493, (14.0),

Table 2. Number of *R. padi L.* attracted to different wheat germplasm under Antixenosis test

Wheat cultivar	Av.No. of aphids after 24h	Nature of preference	Av.No. of aphids after 48h	Nature of preference	Mean value	Overall preference
V-01078	11.8bc	MP	17.0bc	MP	28.8	MP
99B4012	14.8abc	MP	19.2abc	MP	34.0	MP
Wafaq 2001	18.2ab	MP	23.2ab	MP	41.4	MP
RWM-9313	16.2ab	MP	20.5abc	MP	36.7	MP
V-00125	19.0ab	MP	24.7ab	MP	43.7	MP
Diamond	18.8ab	MP	24.2ab	MP	43.0	MP
PR-84	9.0c	LP	11.8c	LP	20.8	LP
TW 0135	10.4bc	MP	13.8bc	MP	24.2	MP
V-00055	13.8abc	MP	22.6ab	MP	36.4	MP
99B2278	15.2abc	MP	17.8abc	MP	33.0	MP
KT-7	12.5bc	MP	23.7ab	MP	36.2	MP
V-01180	7.6c	LP	9.8c	LP	17.4	LP
DN-47	7.0c	LP	14.6c	MP	21.6	LP
V-9021	21.6a	HP	29.8a	HP	51.4	HP
CT-00062	12.0bc	MP	17.2abc	MP	29.2	MP
7-03	14.2abc	MP	22.8ab	MP	37.0	MP
PR-86	12.4bc	MP	19.4ab	MP	31.8	MP
V-02192	15.2abc	MP	24.2ab	MP	39.4	MP
V-002493	10.2bc	MP	14.0bc	MP	24.2	MP
Chakwal 97	17.6ab	MP	22.6abc	MP	40.2	MP

HP= Highly prefered; MP = Moderately prefered; LP= Least prefered
Means followed by same letters do not differ significantly at 0.05%
LSD for average number of aphids after 24h=0.0699 at 0.05%
LSD for average number of aphids after 48h=0.8119 at 0.05%

DN-47 (14.6), V-01078 (17.0), CT-00062 (17.2), 99B2278 (17.8), 99B4012 (19.2), PR-86 (19.4) RWM-9313 (20.5), V-00055 (22.6), Chakwal 97 (22.6), 7-03 (22.8), Wafaq 2001 (23.2), KT-7 (23.7), Diamond (24.2), V-02192 (24.2) and 00125 (24.7). There was only one highly preferred wheat germplasm line (V-9021) with mean preference rating of 29.8.

Combined results of data recorded after 24h and 48h indicated that in antixenosis tests, least preferred wheat germplasm lines with their respective mean preference rating were V-01180 (17.4), PR 84 (20.8) and DN-47(21.6) (Table 2). Sixteen wheat germplasm lines/varieties were moderately preferred while only one wheat germplasm line V-9021 was highly preferred. Least preferred wheat germplasm lines i.e., V-01180, PR 84 and DN-47 were most suitable against this pest. It is, therefore, recommended that these germplasm lines must be incorporated in breeding programmes for better crop yield.

Li et al. (2001) evaluated 590 wheat germplasm lines as the highly resistant, moderately resistant and less resistant against wheat aphids accounted for 3.39%, 5.76% and 11.86% respectively while 7.63% of the cultivars showed better resistance against *Macrosiphum miscanthi* T. and 19.49% showed better resistance to *R. padi*. Koric et al. (2005) observed that due to aphid wheat and barley crops were heavily infected, resulting in yield losses of up to 30%. In the autumn of the same year at 28 locations throughout Croatia, severe infection was observed. It was revealed that *R. padi*, *R. maidis* and *Sitobion avenae* were dominant at all locations. The hosts of the aphid species were prevalent from harvesting to the establishment of new winter cereal crops in autumn.

The *T. durum* germplasm were graded as highly resistant and there was least

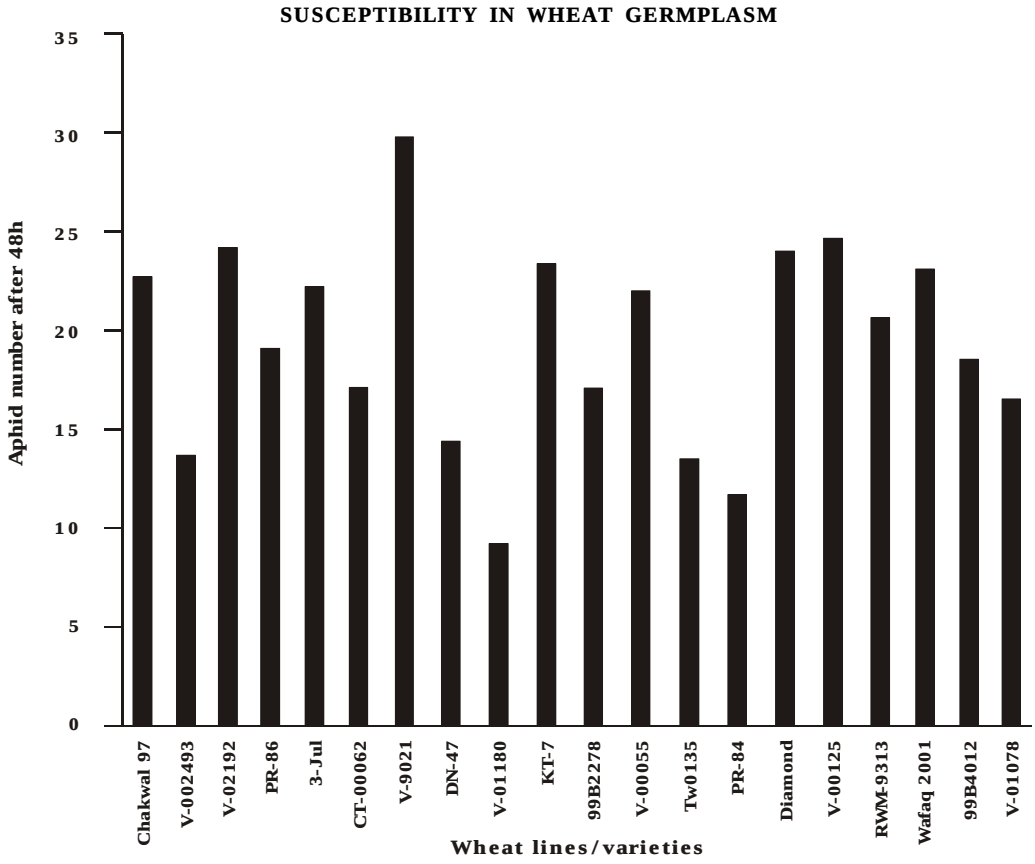

Figure 1. Number of *R. padi* L. attracted to different wheat germplasm under Antixenosis test after 48h

aphid population (< 5.0) whereas, *T. aestivum* germplasm were graded as highly susceptible and there was maximum aphid populations (> 30.0) against *R. madis*, *M. miscanthi* and *Aphis craccivora* (Tiwari and Sharma, 2002). Under controlled conditions yield losses of barley variety RD 387 were recorded as 32.38%, 42.85% and 60.00% when infested at 5, 10 and 15 aphids per plant, respectively (Sharma and Ashok, 2004). Regardless of the density of aphids it was noted that significantly greater aphid infestation was on maize plants at fourth stage (Mello et al., 2005). Mechanical wounding of transgenic plants had no effect on nymphiposition or final numbers of *R. padi* (Hesler et al., 2005). Wheat variety Inqalab-91 was the most resistant to population of aphid (*S. graminum*) and PND-1 was the most susceptible among the tested wheat cultivars/lines (Aslam et al., 2004).

Identification of the factors that confer resistance or susceptibility and the study of their inheritance in cereal plants would greatly improve breeding strategies for resistant varieties. A proper understanding of mechanism of host plant resistance will also lead to breeding for long-term resistance. The use of resistant varieties will remain the most logical and economical way of reducing insect pest damage in cereals. There will be reduced use of chemicals with much economic benefits. These are important studies and if the derived results are incorporated in varietal breeding programme, the wheat crop in the field will suffer comparatively less losses.

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