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Varietals Variability of Winter Rapes (*Brassica napus* L.) for Their Susceptibility to Green Aphid, *Myzus persicae* (Sulzer) (Homoptera: Aphididae)

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Abstract. - The green aphid, *Myzus persicae* (Sulzer), is an important and serious insect pest of oilseed crops, therefore, field experiments were conducted to determine the resistance of 30 rape genotypes (*Brassica napus* L.) against this pest grown during 2 consecutive crop seasons. The pest tolerance of rape genotypes was assessed by quantitative traits such as number of aphids on each infested genotype and mean dry weight of seeds per genotype. Studies on the susceptibility of various trailed rape genotypes to the pest invasion, showed the differences in overall rates of aphids development and seed yield. Among the entire rape genotypes tested, W-97-0.75/11and Hyola-42 were comparatively resistant to aphids pest, and showed low attack and increased seeds yield. The most pest population accommodating and yield suffering genotypes were Can-5-4 and Abasin-10. Experiments showed a marked mode of damage inflicted by aphids on rape *B. napus* plants tested, and the pest incidence was least on early sown crop compared to late sown that can be an effective management decision to reduce the risk of damage. With the availability of this information on host plant resistance and pest damage, the future strategies could be focused on the creation of virtual immunity in winter rapes against pests for development of new high yielding varieties.

Key words: aphid, rapes, *Brassica*, genotypes, resistance.

INTRODUCTION

Winter rapeseed in the *Brassica* family marketed as Canola (*Brassica napus* L.), is a new field crop being grown as an oilseed crop. This crop is heavily attacked by different species of aphids, which cause poor growth and low yield. In fall plantings, aphid [*Myzus persicae* (Sulzer) (Homoptera: Aphididae)] may exhibit population resurgence in winter oilseed rape (Desneux *et al.*, 2005). Aphid infestations reduce plant height, number of secondary branches per plant, number of siliquae per plant and seed weight (Vir and Henry, 1987; Sarwar *et al.*, 2011). Little (1987) assayed field populations of *M. persicae* collected from *Brassica* crops to determine the levels of a carboxylesterase (E4) present- the enzyme that confers resistance in this aphid to a wide range of insecticides. Analysis of the results established that approximately 85% of individuals had an elevated level of E4 above that of a standard susceptible clone, whereas, up to 12% had E4 levels higher than a standard resistant clone. With increase in pest problems like insecticides resistance and resultant indiscriminate use of pesticides, there are concerns of environmental pollution and ecological imbalance (Sarwar and Saqib, 2010). Host plant resistance has been successful to a greater extent to tackle with such pest intensity (Sarwar, 2013). The present study was therefore, conducted to evaluate the varietals variability of winter rapes (canola) for their susceptibility to green aphid *M. persicae* under natural field conditions.

MATERIALS AND METHODS

Field studies were conducted during the years 2004-2005 and 2005-2006 at Nuclear Institute of Agriculture (NIA), Tandojam. The crop was raised on well-prepared soil for 2 consecutive crop seasons, 02 December 2004 and 02 November 2005. Thirty canola genotypes *viz.*, Waster, CON-I, CON-II, CON-III, Abasin-95, Dunkled, Rainbow, Shiralee, Hyola-42, Hyola-308, Hyola-401, Oscar, W-97-0.75/11, W-97-75/13, AYT-Canola-1, AYT-Canola-2, AYT-Canola-3, AYT-Canola-4, AYT-Canola-5, RM-975/4-10, RM-975/4-8, RM-975/4-2, RM-975/4-7, RM-975/11-1, RM-971/5-1, RM-015/1-1 and RM-975/2-4 were selected for the experiment, and sown in Randomized Complete

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Block design with 3 replications. The seeds of all these genotypes were collected from Plant Genetics Division of this Institute and Nuclear Institute of Food and Agriculture, Peshawar. Study was also conducted to determine the effects of sowing time on the incidence of aphid on rape during the both cropping seasons to observe the impacts of aphid on yield. Customary agronomic practices were followed for crop husbandry for the whole experimental season. The unit plot sizes were 2.5 m^2 and inter row spacing of 30 cm having a constant of 9 cm plant-to-plant spacing. Seed sowing was done with double-disc drill, planted in 3 rows within each plot measuring 4 m in length and each plot separated by 1 m from each other. Fertilizers used were nitrogen and phosphorus applied at recommended doses. Three weeks after the seedling emergence, the plants were thinned to a distance of 9 cm apart. Hand weeding method was used to control weeds. The first irrigation was done one month after crop sowing and subsequent irrigations at 2 weeks intervals. The experimental field was left open to natural infestation of insect pests and no protective measures were undertaken against the insect pests.

The varietals variability of winter rapes for their tolerance responses in the test genotypes were determined by recording aphids population and seed yield. The data on aphid's population were recorded commencing from initial occurrence of pest and continued till the infestation ceased. The aphids population development was monitored every 10 days intervals and rated by average counts of aphids/ plant from 5 randomly selected plants per replicate. The crop at maturity was hand-harvested from each replicate to record seed weight for yield estimation. Information on Meteorological data during the crop years 2004-2005 and 2005-2006 were acquired from Regional Agromet Center, and Drainage Research Center, Tandojam. Data thus, obtained were analyzed statistically to compare the mean values of both the interactions using analysis of variance techniques by means of Duncan's Multiple Range Test to check the differences among treatment means (P= 0.05). The genotype with the highest yield potential in spite of pest incidence than its counterparts was considered as resistant in order to cope with threats created by aphids.

RESULTS

The results indicated that aphids equally preferred the canola varieties, but the variations in the number of aphids per plant differed significantly with variety. From the perusal of outcome tabulated, it emerged that all the genotypes were also varied in their yield potential.

Aphid's mode of damage on rape crop

The green aphid *Myzus persicae* was the most frequented pest species at the experimental site. Aphids pressure in crop year 2005 was relatively higher as compared with incidence measured during 2006. The activity of aphids was observed during 2^{nd} week of February. The maximum activities of aphids were recorded during last week of February. No aphid individuals were observed from second week of March to onward during both seasons. Observed adult aphids were winged or wingless, their infestations started when winged aphids flew into the crop from autumn weeds. Winged aphids that migrated to the crop gave rise to colonies consisting of mostly wingless aphids and formed characteristically dense clusters on plant. Aphids were observed sucking the sap from plants and found massed on growing points or lower leaves of rape. It preferred to feed on the undersides of plant leaves causing damage. Large populations of aphid that developed in late winter and early spring caused damage by feeding on the growing shoot tips, causing wilting, flower abortion and reduced pod setting. These also covered the plants with sticky honeydew, which encouraged the growth of black sooty mould, thereby reducing the plant's ability to photosynthesize and generally decreased plant vigor and caused significant yield losses.

Aphid's population on rape genotypes

Analysis of the results established (Table I) that aphids development on all genotypes of rape was much higher in the first year 2004-05 (63.33-191.33/ plant in December sowing) than the much lower rate of infestation in the second year 2005-06 (22.84-80.68/ plant in November sowing). During consecutive years, the experiment to determine the both seasons average population estimates of pest displayed that aphid counts were significantly lower

Table I.- Average values for aphids population and grain yield of different rape genotypes (*Brassica napus* L.) during the years 2004-2005 and 2005-2006.

Name of genotypes	Aphid population/ plant 2004-2005 & 2005-2006			Yield/ plot (2.5 m^2) (gm) 2004-2005 and 2005-2006		
	2004-2005	2005-2006	Pooled/ Average	2004-2005	2005-2006	Pooled/ Average
Waster	145.00 abcde	37.04 def	91.02 bcd	171.67 fghij	516.7 jk	344.2 hij
CON-I	112.00 cdef	28.22 ef	70.11 cde	216.67 cdef	556.7 ij	386.7 efg
CON-II	128.67 bcde	36.44 def	82.55 bcd	176.67 efghij	631.7 fgh	404.2 def
CON-III	90.333 ef	35.28 ef	62.81 de	275.00 ab	475.0 kl	375.0 fgh
Abasin-95	124.67 cde	38.29 def	81.48 bcd	173.33 fghij	640.0 fgh	406.7 cdef
Dunkled	142.35 abcde	33.55 ef	87.95 bcd	156.67 hij	583.3 hi	370.0 fgh
Rainbow	96.667 ef	30.60 ef	63.63 de	150.00 ij	746.7 bc	448.3 b
Shiralee	121.67 cde	38.24 def	79.95 bcde	153.33 hij	633.3 fgh	393.3 defg
Hyola-42	89.333 ef	23.71 ef	56.52 de	296.67 a	791.7 ab	544.2 a
Hyola-308	118.67 cdef	31.44 ef	75.05 cde	233.33 bcd	673.3 def	453.3 b
Hyola-401	103.16 def	41.22 cdef	72.19 cde	236.67 bc	505.0 jk	370.8 fgh
Oscar	113.33 cdef	28.80 ef	71.07 cde	183.33 efghij	711.7 cd	447.5 b
W-97-0.75/11	63.333 f	22.84 f	43.09 e	306.67 a	833.3 a	570.0 a
W-97-75/13	121.67 cde	50.44 bcdef	86.05 bcd	223.33 bcd	611.7 ghi	417.5 bcde
AYT-Canola-1	159.67 abcd	29.93 ef	94.80 bcd	210.00 cdef	646.7 efg	428.3 bcd
AYT-Canola-2	115.87 cdef	40.99 cdef	78.43 cde	186.67 defghij	500.0 k	343.3 hij
AYT-Canola-3	109.00 cdef	53.08 abcdef	81.04 bcd	193.33 cdefghi	598.3 ghi	395.8 def
AYT-Canola-4	92.000 ef	32.80 ef	62.40 de	180.00 efghij	651.7 efg	415.8 bcde
AYT-Canola-5	122.33 cde	32.75 ef	77.54 cde	190.00 cdefghi	700.0 cde	445.0 bc
RM-975/4-10	123.33 cde	35.11 ef	79.22 cde	233.33 bcd	475.0 kl	354.2 ghi
RM-975/4-8	117.33 cdef	66.44 abcd	91.89 bcd	200.00 cdefgh	433.3 l	316.7 ij
RM-975/4-2	92.667 ef	54.98 abcde	73.82 cde	206.67 cdefg	440.0 l	323.3 ij
RM-975/4-7	162.67 abc	44.34 cdef	103.5 abc	210.00 cdef	416.7 lm	313.3 j
RM-975/11-1	131.00 bcde	45.13 cdef	88.06 bcd	170.00 fghij	363.3 mn	266.7 k
RM-971/5-1	133.33 bcde	46.11 cdef	89.72 bcd	180.00 efghij	365.0 mn	272.5 k
RM-015/1-1	95.333 ef	46.11 cdef	70.72 cde	200.00 cdefgh	433.3 l	316.7 ij
RM-975/2-4	114.67 cdef	51.00 bcdef	82.83 bcd	160.00 ghij	333.3 n	246.7 k
CAN-5-4	191.33 a	80.68 a	136.0 a	76.667 l	256.7 o	166.7 l
CAN-9-1	165.00 abc	69.77 abc	117.4 ab	140.00 jk	330.0 n	235.0 k
Abasin-10	182.33 ab	75.89 ab	129.1 a	93.333 kl	276.7 o	185.0 l
LSD value	57.156	25.33	31.02	47.187	51.75	35.31

Mean numbers followed by the same letters in a column are not significantly different (P= 0.05).

on W-97-0.75/11 and Hyola-42 with 43.09 and 56.52 aphids/ plant, respectively, and noted fairly resistant to aphid and showed low pest contamination than on all other accessions. Aphid counts were significantly higher on Can-5-4 (136.0/ plant) and Abasin-10 (129.1/ plant) that were rather susceptible to pest incidence. Further, on all other varieties pest intensity ranging from 62.40-117.4 aphids/ plant was determined.

Grain yield of rape genotypes

Rape grown early (first week of November) produced increased grain due to decreased pest incidence, while, the crop when sown on first week of December, seed yield declined as a result of heavier aphids infestation. The cumulative yield losses in the various genotypes were 76.66-306.67 gm per 2.5 m^2 in the first year (2004-05), and 256.7-833.3 gm in the second (2005-06) season. In both years, the smallest average yield losses were recorded in W-97-0.75/11 (570.0 gm per 2.5 m^2) and Hyola-42 (544.2 gm per 2.5 m^2) showing lowest pest contamination, but increased pods yield. The most yield suffering genotypes were Can-5-4 (166.7 gm per 2.5 m^2) and Abasin-10 (185.0 gm per 2.5 m^2) (Table I). Hence, crop yield and resistance increased with earlier sowing period (November grown) due to minimum pest incidence, but, yield and resistance reduced due to heavier aphid infestation in later sowing stage (December grown).

DISCUSSION

Field experiments carried out to evaluate the resistance/ susceptibility of various varieties/ genotypes of rape evidenced that some genotypes were significantly highly preferred and few less preferred by aphids than the others and thus classified as susceptible and resistant, respectively. The studies revealed significant negative relationships among aphid populations and rape yield. Such variations in different varietals response of rapes towards aphids infestation and grain yield were also observed by some of the other research workers like, Talpur *et al.* (1991), Kher and Rataul (1991), Amjad and Peters (1992), Anwar and Shafique (1999) and Sarwar *et al.* (2004). Kalra *et al.* (1987) exposed leaves of *Brassica* genotypes to nymphs of aphid *Lipaphis erysimi*. On the basis of nymphal and oviposition periods, fecundity and rate of aphid multiplication, genotypes were considered fairly resistant to attack and recommended for use in breeding for resistance. Study conducted to determine the effect of rape sowing dates on the incidence of aphid showed least aphid incidence on early sown (November) crop as compared with late sown crop (December). Correspondingly the highest yield was obtained in crop sown early in the season and the crop sown after this date recorded drastic reductions in yield. This trend observed in present study is consistent with analogous studies conducted by Roy and Baral (2002), Lasker *et al.* (2004), and Takar and Jat (2005), had reported similar findings where early sown crop had attracted lower number of aphids. Xu and Ni (1987) observed yield, number of leaves on the main stem and resistance to low temperature increased with earlier sowing. Hence, early crop sowing during the month of November at experimental site is recommended to protect the canola plants from aphid's incidence.

Crop yield losses in all genotypes studied due to aphid in 2004-05 were much higher due to increased pest incidence than in 2005-06, because the rate of aphid's infestation was much lower in the second year. Obviously, it may also be due to the combination of other different abiotic factors like temperature and relative humidity on crop, but no single factor could be responsible for it. At the time of research trial, the maximum and minimum temperature was variable, 12.1 and 27.9°C, and 13.2 and 28.1°C during the crop growing seasons of the years 2004-2005 and 2005-2006, while, the relative humidity was 67.2 and 75.2%, respectively. Both the key factors contributed towards pest's incidence, so, aphids population was related with temperature and relative humidity that decreased down the aphid populations during 2005-06. In this case, particularly during 2004-05 the seasonal conditions were more conducive to aphid's buildup due to low temperature. Nevertheless, none of the ecological parameters alone can be regarded as responsible for rapid multiplication of pest. Chandra and Kushwaha (1986) studied the role of key abiotic factors regulating the field population of *M. persicae*. The highest population was observed from mid-January to the end of February. During the initial phase of increase and final phase of decline in abundance, populations of aphid species were correlated negatively with temperature and positively with humidity. Reza *et al.* (2004) reported the aphids population was positively related with temperature, but relative humidity had shown slight response on its intensity and without any significant response of little rainfall. Further research work is required to establish the research trials in different regions under the varying climatic conditions.

Field experiments conducted by Sarwar *et al.* (2009); and Sarwar (2011) to study the effects of weather factors on aphid populations in *Brassica* crops showed variations in the density of aphids owing to all weather parameters. The weather parameters namely maximum and minimum temperature and relative humidity were found to have considerable direct positive contributions with aphid populations that increased per plant with increase in minimum and maximum temperature and percent increase in relative humidity. Barriers to aphid's feeding may also involve phenological factors and the reason might be the difference in canola crop phenology (Marghub *et al.*, 2009). The aphids infestation increased gradually with plant phenology of reproductive stages of canola varieties (Solangi *et al.*, 2007).

These variations in rape genotypes for their susceptibility or tolerance to aphid may be explained by the opinions of earlier researchers. Sachan and Sachan (1991) studied the relationship of several biochemical characters in cultivars of mustard for their susceptibility to the aphid. Higher contents of protein, sugar and oil in susceptible varieties, followed by moderately susceptible varieties, were positively correlated with aphid populations. In the stalk and seed pod, significantly higher phenol contents were observed in resistant varieties, followed by moderately resistant varieties, and low in susceptible varieties. A significant negative correlation was found between aphid population and phenol content. Singh *et al.* (1991) studied the inheritance of apetalous character in mustard and their reaction to mustard aphid infestation. The use of apetalous material in breeding for tolerance against this pest was recommended. According to our opinion, on the basis of biochemical analysis of the trailed rape, the tests on natural resistance of 'W-97-0.75/11 and Hyola-42', and those of the susceptible 'Can-5-4 and Abasin-10' based on values of all biochemical properties (defensive proteins, secondary metabolites and changes in sugar/ pH gradients) of the plants, can reveal considerable levels of variability of resistance to aphid. Thus, the biochemical tests may surely be very useful for preliminary selection of newly introduced strains of rape in respect of their resistance to aphid. Of the rape genotypes examined, characteristics of leaf surface morphology may be useful in selecting germplasms with reduced susceptibility to aphid. The higher incidence of pest may be associated with genotype having rough and granulated leaf topography than those with smoother leaf surfaces. Genotypic related differences in leaf morphology and biochemical characteristics for their susceptibility to the aphid would be easily detectable traits that could serve as a marker in cultivar breeding programs to select genotypes with reduced susceptibility to pests. These results would lay the groundwork for extensive work and further research could be planned in the future course of studies on rapes.

Overall, W-97-0.75/11 and Hyola-42 had significantly least aphid counts and best tolerance to pest than other genotypes evaluated. Both genotypes for having average resistance and the highest seed yield capabilities are recommended as suitable for growing in a range of environments. Recent results of feeding damage trial showed that the release of cultivars more susceptible to aphid colonization had increased the risk of aphid feeding damage and yield losses to canola in this area. The aphid's incidence would be least on early sown crop compared to late sown that can be effective management decision to reduce the risk of pest damage. With the availability of this information on host plant resistance and pest damage, the future strategies could be focused on the creation of virtual immunity in winter rapes for development of new high yielding varieties.

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