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Effect of Different Sowing Dates on the Population of Wheat Aphids (Homoptera: Aphididae) on Different Wheat Varieties.

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Abstract: *The experiment was conducted in the Experimental field of Nuclear Institute of Agriculture (NIA), Tandojam. Five wheat varieties namely, TD1, TJ 83, Bhattai, Kiran 95 and Suassi were grown in the Experimental Farm. All the wheat varieties were grown on different sowing dates (20 October, 20 November and 20 December). Each variety were cultivated on (50 $m^{2)}$ plot with different sowing dates (20 October, 20 November and 20 December). Ten sub-plots from each variety were selected for collection of data. Five plants from each sub plot were taken for counting the population densities of the aphids. Whole plants were observed for examining the population densities of the aphids. Data were monitored on weekly basis. Data were taken after one month of the crop cultivation upto crop maturity. All the standard agronomic practices were conducted throughout course of the experiment. The metrological data were recorded throughout the experimental period. Data were subjected for statistical analysis.*

Keywords: Effect of different sowing date on the population of wheat aphids

INTRODUCTION:

Wheat is main staple food of Pakistan grown over 8.41 million hectares with the annual production of 21.83 million tones and average yield of 2596 kg/ha (Anonymous 2008). The environmental changes have been addressed at global level including Pakistan. The various research reports have estimated that the developing countries suffer 70-80% losses in agriculture sector due to pest attack. Wheat grain yields are highly affected due to biotic (insect pests) and abiotic factors especially high temperature, water stress and salinity. Currently, more emphasis has been given for the sustainable production of the cereal crops. Wheat is prime weapon to attain food security. A wide range of insect pests reduce the yield and production of the wheat crop (Hinz and Daebeler, 1976). Among the pests; aphids have been considered as production reducing agents of the wheat crop. They cause direct damage by feeding on leaves, stalks and ears, and indirect damage by excreting honeydew and the transmission of viruses. The main impacts are reduced yields caused by the removal of plant nutrients and reduced photosynthesis as caused by honeydew accumulations. Their damage also reduce number of heads, reduced number of grains per head, and reduced grain or seed weight (Rautapää, 1966; Kolbe and Linke, 1974). However, cultivation timings also have been documented as major source of aphid infestation on wheat crop. Nevertheless, little studies have been reported on effect of the sowing dates on the population densities of wheat aphids (Homoptera: Aphididae) on different wheat varieties in Sindh. Keeping this in view, five wheat varieties namely, TD1, TJ 83, Bhattai, Kiran 95 and Sasuie will be studied to observe aphids' population in different sowing dates. The output of the present studies will be helpful for managing the population densities of aphids in wheat crop.

REVIEW OF LITERATURE

Burd et al. (2006) determined Russian wheat aphid, *Diuraphis noxia* (Mordvilko) (Homoptera: Aphididae), as a major economic pest of small grains in the western United States. A new biotype of Russian wheat aphid damaged previously resistant wheat, *Triticum aestivum* L. Biotype development jeopardizes the durability of plant resistance, which has been a cornerstone for Russian wheat aphid management. They assessed the relative amount of biotypic diversity among Russian wheat aphid populations collected from cultivated wheat and barley, *Hordeum vulgare* L. They conducted field surveys from May through June 2002 and August 2003 from seven counties within Texas, Kansas, Nebraska, and Wyoming. Based upon a foliar chlorosis damage rating, three new Russian wheat aphid biotypes were identified, one of which was virulent to all characterized sources of Russian wheat aphid resistance. They reported that the future success of Russian wheat aphid resistance breeding programs would depend upon the continual monitoring of extant biotypic diversity and determination of the ecological and genetic factors underlying the development of Russian wheat aphid biotypes.

Biotypic Variation Among North American Russian Wheat Aphid (Homoptera: Aphididae) Populations

Fox et al. (2004) studied the ability of the existing predator community in soybean to reduce *Aphis glycines* establishment in field studies using either predator exclusion, open, or leaky cages that allowed aphid emigration but limited predation. Cages were infested with uniform initial densities of *A. glycines* adults and subsequent populations of aphids and predators were monitored over 24 h. The most abundant predators in these trials included the carabid beetles *Elaphropus anceps*, *Clavina impressefrons* Le Conte, *Bembidion quadrimaculatum* Say and spiders (Salticidae and Lycosidae) . Foliar predators were less abundant and included; *Harmonia axyridis* Pallas, *Coccinella septempunctata* (L.), and *Orius insidious* (Say). Over the 2-year study, they found statistically significant predation on adult *A. glycines* in one out of six trials at 15 h and two out of six trials at 24 h. There was never significant evidence for predation of nymphs in any trial, however overall survival (adults + nymphs) was significantly reduced in one out of six trials at 15 h and three out of six trials at 24 h. Based on these results they suggested that generalist predators can be a significant but variable factor influencing the establishment of *A. glycines* populations in soybean.

Chen et al. (2004) cultivated spring wheat (Triticum aestivum) in pots under three atmospheric CO_2 concentrations (ambient, 550 and 750 p.p.m.) in field open-top chambers (OTCs), with half of the plants subjected to aphid *Sitobion avenae* Fabricius infestation. Increase in CO_2 levels increased host plant growth and grain yield, and decreased 1000-grain dry weight compared with ambient CO_2. On the contrary, aphids had a negative effect on 1000- grain dry weight. Host plants grown at elevated CO_2 generally had greater ear starch, sucrose, glucose, total non-structure carbohydrates (TNCs), ratio of TNC: nitrogen, free amino acids and soluble protein and less ear fructose and nitrogen. However, the aphids did not affect the ear nitrogen and ratio of TNC: nitrogen. The responses of apterous and alate aphids to enrichment CO_2 atmosphere were different. Local population of aphids, including apterous and alate forms infested on host plants in OTCs, increased with elevated atmospheric CO_2 concentrations. Emigrating alate aphids captured on sticky yellow paper decreased with rising CO_2 .CO_2 affected the reproductive activity of alate aphids. The alate forms deposited more offspring on plants grown at 550 and 750 p.p.m. CO_2 compared with ambient CO_2. Both population abundance of local aphids and reproductive activity of alate aphids correlated positively with ear starch, sucrose, glucose, TNCs, raito of TNC : nitrogen and free amino acids, while negatively with ear fructose and nitrogen. Moreover, emigration population abundance was related negatively with ear starch, sucrose, glucose, TNCs, ratio of TNC: nitrogen and free amino acids and positively with ear fructose and nitrogen.

Schotzko et al. (2002) conducted Field experiments in 1997 and 1998 to evaluate the impact of resistance to Russian wheat aphid, *Diuraphis noxia* (Mordvilko), on the cereal aphid complex in wheat. Two spring wheats were planted: the variety "Centennial" (Russian wheat aphid susceptible) and the advanced line IDO488 (Russian wheat aphid resistant). IDO488 incorporates the resistance found in PI 294994 into a Centennial background. Field plots were artiÞcially infested with adult *D. noxiaand* sampled weekly. The most abundant aphid species in 1997 were *Metopolophium dirhodum* (Walker), *Sitobion avenae* (F.), *D. noxia*, and *Rhopalosiphum padi* (L.). In 1998, the order of abundance was *M. dirhodum, R. padi, S. avenae,and D. noxia*. The resistant genotype had significantly fewer *D. noxia* than the susceptible one during both years. However, plant genotype had no significant effect on the other aphid species in either year. Both the initial density of *D. noxia* and plant growth stage, had a significant effect on *D. noxia* population development, but had no effect on the other aphid species. There was no interaction between *D. noxia* resistance and the population density of the other aphid species observed.

Laboratory studies were conducted to evaluate the preference and development of the seven-spotted (Coccinella septempunclata L.) and convergent (Hippodamia conuergens Guerin-Meneville) lady beetles on the Russian wheat aphid, *Diuraphis noxia* (Mordvilko), and green bug, *Schizaphis graminum* (Rondani), biotype E. Preference studies were conducted with fourth install' and approximately 2-d-old adults. Each predator species equally accepted green bug biotype E and Russian wheal aphid. Survivorship to adult celosion and adult weight by sex of both predators were similar on greenbug biotype E and Russian wheat aphid. However, developmental time (egg hatch to adult eclosion) was significantly longer for both predator species when they fed on Russian wheat aphid.

The Russian wheat aphid, Diuraphis noxia (Mordvilkol, is a serious pest of barley in western North America. To help manage this pest, a Russian wheal aphid-resistant germplasm line STARS-9301B was recenUS released to barley breeders for incorporation inlo their cultivars. [nformation about the antixenosis and antibiosis mechanisms of resistance in the 1st-leaf stage was previously reported, but information about these mechanisms of resistance in later plant growth stages has not been available. This study reports on antixenosis and antibiosis tests conduct.ed under controlled conditions on three growth stages of STARS·930lB and ~lorex', a Russian wheat aphid-susceptible malting barley cultivar. In general, aphid reactions in the laler growth stages were similar to those on lst~leaf stage plants except that antixcnosis was demonstrated in STARS-930lB when data from all growth stages were combined. Antibiosis continues to contribute to resistance in more mature plants of STARS·9301B. Previous work showed that tolerance is the most important resistance mechanism or STARS-9301B seedlings. Tolerance data for comparing barley entries beyond the seedling stage are not available because a practical, uniform test to determine tolerance levels at these older plant growth stages has not been developed. The results or this study show that spring barley entries can be reliably tested in early growth stages for antixenosis and antibiosis to the Russian wheat aphid.

The spatial and temporal distribution of the grain aphid Sitobion avenae F. (Homoptera: Aphididae) was studied within a field of winter wheat during the summer of 1996. Sampling was done using four nested grids comprising 133 locations. Analysis by Taylor's Power Law gave results typical for insect populations. Analysis by SADIE (Spatial Analysis by Distance Indices) showed spatial pattern due to edge effects and sampling scale, and positive but mild spatial ssociation, although spatial patterns were ephemeral. Reasons for these findings and the implications for integrated crop management are discussed. The spatial and temporal distribution of the grain aphid Sitobion avenae in winter Wheat .

MATERIALS AND METHODS:

The experiment was conducted in the Experimental field of Nuclear Institute of Agriculture (NIA), Tandojam. Five wheat varieties namely, TD1, TJ 83, Bhattai, Kiran 95 and Suassi were grown in the Experimental Farm. All the wheat varieties were grown on different sowing dates (20 October, 20 November and 20 December). Each variety were cultivated on (50 $m^{2)}$ plot with different sowing dates (20 October, 20 November and 20 December). Ten sub-plots from each variety were selected for collection of data. Five plants from each sub plot were taken for counting the population densities of the aphids. Whole plants were observed for examining the population densities of the aphids. Data were monitored on weekly basis. Data were taken after one month of the crop cultivation upto crop maturity. All the standard agronomic practices were conducted throughout course of the experiment. The metrological data were recorded throughout the experimental period. Data were subjected for statistical analysis..

RESULTS:

A field experiment on the effect of sowing dates on the population of wheat aphids (Homoptera: Aphididae) on different wheat varieties was undertaken in the Experimental Farm of Nuclear Institute of Agriculture (NIA), Tandojam during 2012-13. Five different wheat varieties including TD-1, TJ-83, Kiran, Bhatti and Sussi were cultivated under field conditions. Data on the aphid populations on different sowing dates on different wheat varities was undertaken. The population densities of the aphids on different wheat varieties on different sowing dates are shown in table 1, 2 and 3.

Early Sowing

The significant differences ($F_{3.57}$ df = 48; P < 0.05) were recorded in the aphid populations on different wheat varieties when the crop was grown earlier. However, results revealed that during January 2013 no population of aphids was recorded on all the tested varieties except TJ-83 which was 3.33. Furthermore, highest densities of the aphids were observed on TJ-83 which was 19.33 followed by TD-1 (10.33) and minimum on Bhitai (2.33). However, no population of the aphids was monitored during March 2013 in early sowed wheat genotypes as shown in table 1.

Table. 1. Mean population of aphids on early cultivated wheat varieties during 2013

Varieties	January	February	March	Mean
TD1	0.00 b	10.67 b	0.0 a	3.55 b
TJ-83	3.33 a	19.33 a	0.0 a	7.56 a
Karan	0.00 b	5.0 cd	0.0 a	1.66 c
Bhitai	0.00 b	2.33	0.0 a	0.78 c
Sussi	0.00 b	7.33	0.0 a	2.44 bc
LSD	2.57	3.93	0.0 a	1.87

Means in the same column followed by different letters are significantly different (Duncans multiple range test,P < 0.05).

Medium Sowing

The population densities of aphids were significant differences ($F_{53.53}$ df = 48; P < 0.001) on different wheat varieties sowed at medium dates. However, in medium sowing dates TJ-83 harbored maximum densities of aphids as compared rest of the tested wheat varities as shown in table 2. Furthermore, highest densities of the aphids were observed on TJ-83 during Feb 2013 which was 29.33 followed by TD-1 (21.33) and minimum on Bhitai (9.33). However, similar trend was observed on the scales of the aphid populations during March 2013 in medium cultivated wheat genotypes.

Table. 2. Mean population of aphids on medium cultivated wheat varieties during 2013

Genotypes	January	February	March	Mean
TD-1	7.33 B	21.33 B	10.67 B	13.11 B
TJ-83	14.0 A	29.33 A	14.33 A	19.22 A
Karan	0.0 D	13.67 C	3.33 C	5.67 CD
Bhitai	0.0 D	9.33 C	0.0 D	3.11 D
Sussi	3.0 C	11.67 C	5.33 C	6.67 C
LSD	2.64	5.82	2.8	3.08

Means in the same column followed by different letters are significantly different (Duncans multiple range test,P < 0.05).

Late sowing

The population densities of aphids were significant differences ($F_{665.30}$ df = 48; P > 0.001) on different wheat varieties sowed at late dates. However, in late cultivation dates TJ-83 also harbored maximum densities of aphids (16.33) during January 2013 as compared rest of the tested wheat varities as shown in table 3. Similarly, highest densities of the aphids were observed on TJ-83 during Feb 2013 which was 72.00 followed by TD-1 (54.00) and minimum on Bhitai (15.33). However, similar trend was observed on the scales of the aphid populations during March 2013 in late cultivated wheat genotypes.

Table. 3. Mean population of aphids on late cultivated wheat varieties during 2013

Genotypes	January	February	March	Mean
TD-1	12.0 B	54.0 B	30.67 B	32.21 B
TJ-83	16.33 A	72.0 A	44.67 A	44.33 A
Karan	7.33 C	29.33 D	21.33 C	19.33 D
Bhitai	2.67 D	15.33 E	10.0 D	9.33 E
;Sussi	10.67 BC	36.67 C	28.67 B	25.33 C
LSD	3.53	6.92	3.29	2.11

Means in the same column followed by different letters are significantly different (Duncans multiple range test,P < 0.05).

Discussion

In the current experiment five wheat varieties were sown to study the impact of aphid populations on them under similar ecological conditions at NIA, Experimental Farm. It was observed that very slight population or no populations were recorded on the early sown wheat varities as compared with medium and late sown crop. Moreover crop stage has also impact on construction of the population magnitude of the aphids. Population reached in highest peak in the February and March in medium sown crop as compared with early cultivated wheat crop. Interestingly, no higher trend was observed in early sown crop as both medium and late sown crops. Our results are in line with Muddathir (1976), who reported cereal aphid population decreases as the ear began to develop and leaves ceased to grow. Aphids multiply at a faster rate under favorable conditions to form dense colonies of nymphs and adults on leaves, stem and inflorescence (Hussain, 1983). According to Ahmed and Aslam (2000) aphid is a sucking pest which prefers to insert its stylets in soft parts of the plant to get easy and increased food supply. Jones and Jones (1984) observed food availability, temperature and humidity as important factors in population build up of aphids. Heat stress due to high temperature causes reduction in the reproductive potential and fecundity of aphids (Richer and Balde, 1993). Major activities of aphid species were correlated with the rising temperature in the month of February but as the crop mature, fewer aphids were found on the tested wheat varieties.

Conclusion

It was concluded from study that all the above mentioned wheat varieties should be cultivated earlier rather than medium and late in order to skip from the aphid infestation. TJ-83 wheat variety found most susceptible in terms of aphid infestation. The Bhittai variety inhibited aphid attack.

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