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ENTOMOLOGY

ASSESSMENT OF APHID INFESTATION AND PARASITOID POPULATIONS IN RESPONSE TO TWO WHEAT CULTIVARS IN RAWALPINDI, PAKISTAN

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ABSTRACT

Among contributing factors to low crop yields, aphids are considered a significant factor. Current study aimed to understand tri-trophic interactions between aphid infestation and associated parasitoid in two wheat varieties, throughout the growing season in arid zone. For this purpose, two cultivars, AUR-809 and Chakwal-50, were sown at the research station PMAS Arid Agriculture University Rawalpindi under a RCBD design with three replications. The results described that the maximum aphid population was observed during the 5th and 8th weeks of the study, corresponding to the tillering and milking stages in both wheat cultivars. Interestingly, the 1st week of February exhibited the minimum population compared to subsequent weeks of sampling. Regarding parasitism, the parasitism rate varied significantly across the study period. The interaction between cultivar and week also displayed a significant effect on aphid parasitism rate ($F = 3.92$; $df = 9, 38$; $P = 0.0014$), indicating that the combined influence of cultivar type and week of study influenced the parasitism rate differently. In terms of the male-female sex ratio, the results showed that Diaeretiella rapae had 83 individuals with 67♀ and 16♂, and Aphidius colemani had 52 individuals with 39♀ and 13♂. The observed variability emphasizes the need for tailored pest management strategies based on the specific cultivar and timing of the study.

KEYWORDS: *Triticum aestivum;* tritrophic interactions; cultivars; aphids; parasitoids; sex ratio; arid zone; Pakistan

INTRODUCTION

Food is an absolute necessity for all living organisms. There are numerous food sources to meet these needs, but wheat is a significant staple crop for many countries (Nadeem *et al*., 2023). *Triticum aestivum* is Pakistan's supreme imperative staple food, contributing significantly to the GDP of Pakistan (Irshad *et al*., 1985; Aalbersberg *et al*., 1987; Carver, 2009; Chesneau *et al*., 2022). During 2023-24, 9.6 million hectares of wheat were sown, and signifying a 6.6% increase over the 9.0 million hectares cultivated the previous year. Wheat output increased by 11.6 percent to 31.4 million tonnes from 28.2 million tonnes the previous year (GOP, 2023). Since 2010, it has accounted for 39 to 42% of the country's total cultivated area annually. Wheat is thus a valuable commodity, and any factor that reduces its output should be taken seriously (GDP 2015).

Among the many factors that can impair wheat output, aphid infestation is regarded as a key one. Aphids (Hemiptera: Aphididae) are well-known wheat pests (Hashmi *et al*., 1983; Bouhssini and Nachit 2000) because they cause damage to the crop in a variety of methods, including injecting poisons, sucking cell sap, and transmitting diseases to healthy plants, all of which affect grain yield characteristics (Acreman and Dixon. 1985; Ciepiela, 1993; Wali *et al*., 2013). They are certainly vigorous vectors of the barely yellow dwarf virus, and aphid infestation is expected to cause approximately 30% yield losses (Capsincaneo and Gilet, 1996; Aslam *et al*., 2005). Date of sowing also impact significantly on aphid development (Bhambhro, 2002). In Pakistan, twenty nine species had been recognized on wheat crop (Geza, 2000). These species contain *S. graminum*, *R. padi, R. maidis, S. avenae, S. miscanthi*, and *D. noxia* which have assimilated as major insect pest status.

Aphids infest and severely harm this crop (Keyhanian *et al*., 2021), especially the cabbage/mealy aphid, which is one of its principal insect pests (Canassa *et al*., 2021 and Szwarc *et al*., 2021). Aphid can impair crop production by up to 75%, either directly owing to sap-sucking and/or indirectly through viral transmission. (Razaq *et al*., 2011; Khan *et al*., 2012). . *Rhopalosiphum padi,* also known as the bird cherry oat aphid, parasitises many graminaceous plant species

that act as secondary hosts (Hussein,1993; Kannan, 1999). *R. padi* and other cereal aphid species can reduce grain weight in crops most likely reduced 50% gain weight in wheat (Brewer *et al*., 1998 & 1999; Cai *et al*., 2009). The total output yield of wheat crop may be reduced due to heavy infestations of aphid (both nymph and adults sucks the cell sap of the plants) (Javed *et al*., 2022). The other species of aphid like *R. padi* can also spread harmful infections, which contributes to decreased agricultural yield (Cai *et al*., 2009; Zia *et al*., 2023). Late sown wheat has a higher aphid infestation, leading in a lower yield compared to regular planting (Aheer *et al*., 2007).

Insecticides are used to control aphid populations, but they must be handled carefully to avoid serious environmental consequences, insecticide resistance, outbreaks and resurgences (Atwal and Dahliwal. 2008). Hill *et al*. (1993) also emphasized on chemical techniques are only effective for population control and are not suitable for long-term management. However, they increase environmental contamination while also increasing the farmer's input costs. Understanding the economic worth of chemical measures for field crops, as well as executing timely control measures, is critical to avoiding aphid-related yield reductions.

Tritrophic interactions can benefit the population of their parasitoids and decrease the quantity of aphids (Bernal *et al*., 1994). The development of aphids and parasitism by their parasitoids are significantly influenced by the biochemical properties of plants, which also affect traits including behaviour, morphology, and progeny (Schoonhoven *et al*., 1998). In order to suggest the optimum variety for future cultivation in Pakistan's dry zone, the primary goal of the current study project was to assess the seasonal change of aphid populations and the parasitoids attacking aphids on two varieties in the arid zone.

MATERIALS AND METHODS

The experiment was conducted to assess aphid populations and parasitism on different wheat varieties during 2020-21. Two (02) wheat cultivars, namely AUR-809 and Chakwal-50, were sown at Koont research farm of PMAS Arid Agriculture University Rawalpindi, Pakistan with randomized complete block design and each treatment was repeated three times. The experimental plot size was 5 × 10 m, and all agronomic practices were adopted as per the latest production technology. Aphid populations (nymphs, wingless, and alate) were recorded from tagged selected plants in each replication and the average number of aphids per tiller was determined. Data recording commenced from the 1st week of February until the end of March.

For parasitism, aphid mummies were observed, counted, and collected from selected plants in each replication. Labeled gelatin capsules with a micro-hole for oxygen availability were used to preserve the collected mummies. To provide the necessary humidity for adult emergence, moist cotton was utilized. Adult parasitoids that had emerged were maintained for taxonomic identification after being frozen for ten minutes at -80ºC. To identify the parasitoids at the sex and species level, The Olympus binocular microscope with a 10× magnification power and the Raychaudhuri (1990) key were used . Emerging parasitoids were categorized based on the sex ratio of parasitoids and the species of mummified aphids.

Parasitism rate was determined by using following formula:

$$\text{Parasitism rate} = \frac{\text{Total count of mummies}}{\text{Total count (Aphid)}} \times 100$$

Statistical Analysis: Analysis of variance among parasitoid and aphid population in particular wheat cultivars at a 5% significance level was performed on all collected data. Tukey's HSD test was used to compare the means of significant results. Statistix 8.1 software was used for the statistical analysis, and Microsoft Excel 2013 was used to create the graphs.

RESULTS AND DISCUSSION

Aphid numbers per plant were calculated on two cultivars of wheat (AUR-809 and Chakwal-50) in the sample unit area from February 4, 2021, to April 7, 2021, encompassing 8 weeks of sampling. The results regarding cultivars and pest population showed a significant difference among cultivars ($F = 25.31$, $P < 0.001$) and weeks ($F = 41.92$, $P < 0.001$), while the interaction effect of both the mentioned factors was not significantly different from each other ($F = 0.40$, $P = 0.928$).

The highest aphid population was observed during the 5th and 8th weeks of the study which was corresponded to the shooting and milking stages in both wheat cultivars. Interestingly, the 1st week of February exhibited the minimum population as compared to subsequent weeks of the sampling. The recorded temperature during this period was 10.10°C. Later weeks showed a rising trend in aphid population, with the peak occurring in the 5th week on March 3 having an average temperature of 21.4°C. The figure 1 also highlights that Chakwal-50 experienced significantly higher infestation as compared to alternate cultivars. The pest peaks were continuously observed during the whole growing season. Population variability might be due to several climatic factors like temperature, Relative humidity and host stage were particularly

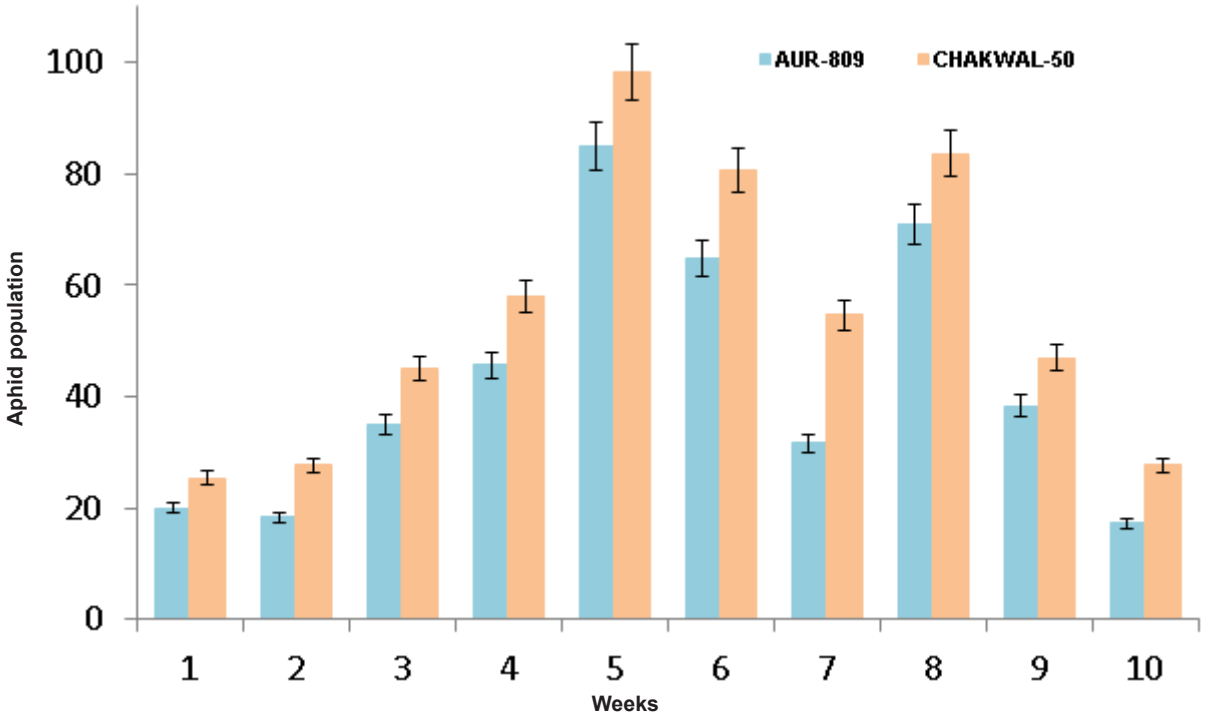

Fig 1: Weekly population of aphids on two wheat cultivars

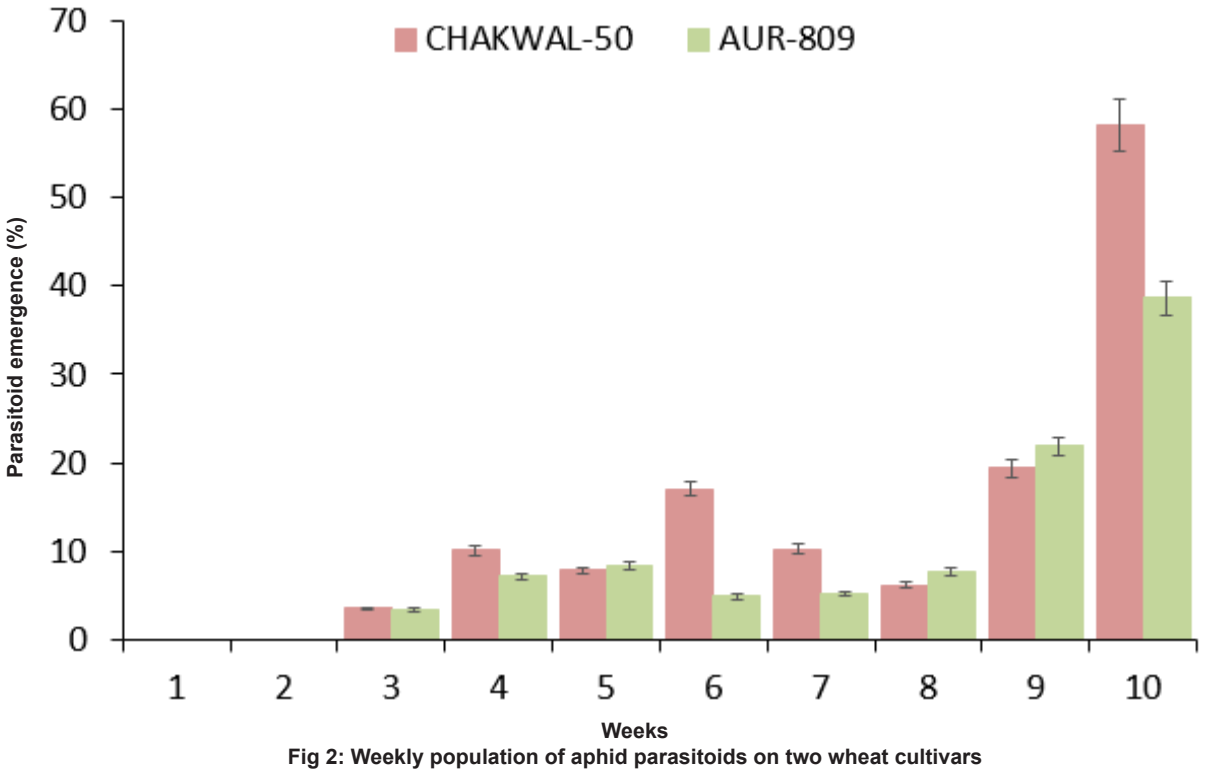

Fig 2: Weekly population of aphid parasitoids on two wheat cultivars

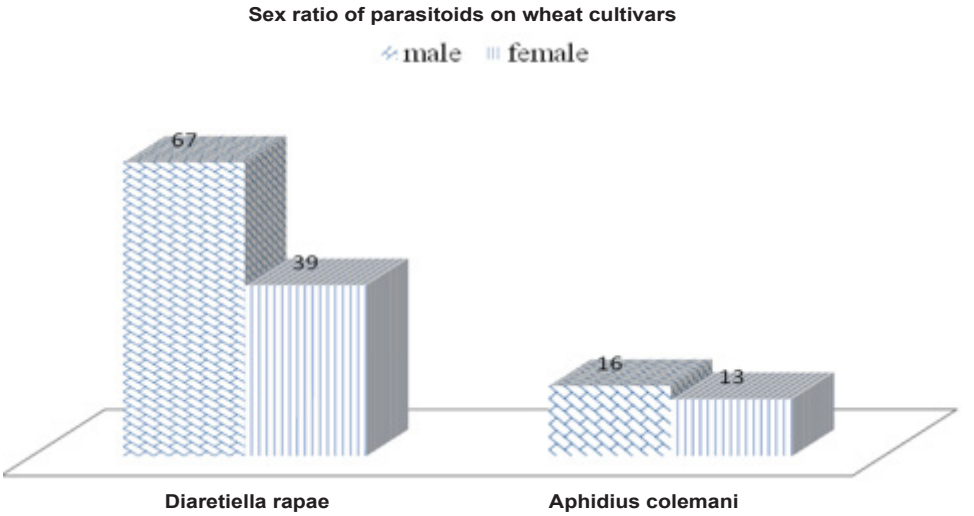

Fig. 3: Sex ratio of parasitoids on wheat cultivars

influential in pest infestation in both varieties.

The findings of current studies was in line with the conclusions of Ahmed and Nasir (2001) as he found that the aphid population climbed gradually from February to mid of the march, but less population was observed during early and matured stages.. According to Hussein (1993) described that this declined in pest population could be attributable to various quality factors of accessible sap during the early stages. The aphid population gradually increased with the crop as similar evidenced by the findings of Ali *et al.* (2013) who observed a peak value in the first week of March. However, a study was lead out in Bhakkar concluded that the fourth (4th) week of February was ideal for the aphid population. Similarly, the adult and nymph population's pattern followed the conclusions of Wains *et al.* (2008) and Aheer *et al.* (2008). The detected drop in the population of aphid count after 15th of March may be linked with the rising of temperature, wheat ripening, and favorable environments for natural enemy fauna (Aslam *et al*., 2005; Aheer *et al*., 2007). The documented species and their parasitoids in present studies are compatible with those found by Bodlah *et al.* (2011) in the rainy areas. The results assess significant difference between the aphid parasitism rate across different cultivars and weeks. The results revealed a significant effect of cultivar on aphid parasitism rate ($F= 9.85$; $df = 1, 38$; $P = 0.003$), indicating varying levels of susceptibility to aphid parasitism among different cultivars. Additionally, Week had a highly significant impact on aphid parasitism rate ($F= 63.97$; $df = 9, 38$; $P < 0.001$), suggesting significant variation in parasitism rate across the weeks of the study period. The interaction between Cultivar and Week also showed a significant effect on aphid parasitism rate ($F= 3.92$, $df = 9, 38$; $P = 0.001$), indicating that the combined influence of cultivar type and week of study affected the parasitism rate differently. The current results align closely with the results of Raza *et al.* (2015) which described that AUR-809 cultivar shows most favorable physiognomies for aphid parasitoids which leads to maximum parasitism as compared to the Chakwal-50 cultivar in the Potohar region. However, Ali *et al.,* (2013) presented different results by observing the least number of mummies of aphid population at the ripening stage of the crop while in the present research, it was observed that the highest number of mummies in the ripening stage when the aphid population count was nearing its conclusion. The variation in these findings may be attributed to differences in host range or climatic factors.

160 mummies from both cultivars were collected during the course of the research work sampling period. These mummies were grown in the Biocontrol Laboratory of the university. The results showed that 135 exhibited appearances from theses mommies and two (02) parasitic species were identified using known keys. *Diaeretiella rapae* had 83 (67♀ and 16♂) while *Aphidius colemani* had 52 (39♀ and 13♂) (Fig 3). Bodlah (2010) has previously observed both of the parasitoids found on wheat in the arid zone. Khan *et al.* are (2012) reported that *D. rapae* is less effective in parasitism compared to *A. colemani*. However, the current study revealed that *D. rapae* performed exceptionally well in AUR-809 and to some extent in Chakwal-50 while *A. colemani* exhibited less preference for these varieties. The overall observation showed that *D. rapae* is a potent parasitoid in both varieties with a high parasitism rate.

In the present study, *Schizaphis graminum* presented a preference for AUR-809 compared to Chakwal-50 cultivar. More studies in this regards could be planned to explore this aspect, potentially yielding more insights

into these interactions. Overall, these findings highlight the importance of both cultivar selection and timing in managing aphid infestations, with specific cultivars and weeks demonstrating distinct susceptibility patterns. The observed variability underscores the need for tailored pest management strategies based on the specific cultivar and timing of the study.

REFERENCES

Aalbersberg, Y.K., V.M.C. Westhuizen and P.H. Hewitt.1987. Asimple key for the diagnosis of the instars of the Russian wheat aphid, *Diuraphis noxia* (Mordvilko) (Hemiptera :Aphididae). Bull.Entomol.Res.,77:637-640.

Acreman, T.M. and A. F. Dixon. 1985. Developmental patterns in the wheat and resistance to cereal aphids. Crop Port., 4:322-328.

Aheer, G.M., A. ALI and M. Ahmad. 2008. Abiotic factors effect on population fluctuation of alate aphids in wheat. J. Agric. Res. 46(4): 367-371.

Aheer, G.M., M. Munir and A. Ali. 2007. Impact of weather factors on population of wheat Aphid at MandiBaha-ud-Din district. J. Agric. Res. 45(1): 61-66.

Ahmed, H.M., J.L. Phil and O.H. Thomas. 2000. Abundance and Effects of Predators and Parasitoids on the Russian Wheat Aphid (Homoptera: Aphididae) Under Organic Farming Conditions in Colorado. Environ. Entomol., 29: 360-368.

Ali, L., M.A. Ali, M. Ali and M.Q. Waqar, 2013. Inorganic fertilization of wheat in relation to aphid infestation, natural enemies population, growth and grain yield. Int. J. Agric. Biol., 15: 719–724

Aslam, M., M. Razaq, F. Ahmad, M. Faheem and W. Akhter. 2005. Population of (*Schizaphis graminum* R.) on different varieties/lines of wheat (*Triticum aestivum* L.). Int. J. Agric. Biol., 6: 974-977.

Atwal, A. S. and G. S. Dahliwal. 2008. Insect pests of South Asia. Kalyani Publishers, Ludhiana, India: 487.

Bernal, J. S., T. S. J. Bellows and D. Gonzalez. 1994. Functional response of *Diaeretiella rapae* (McIntosh) (Hym., Aphidiidae) to *Diuraphis noxia* (Mordvilko) (Hom., :Aphididae) hosts. J. Appl. Entomol., 118: 300-309.

Bhambhro, S. A., 2002. *Schizaphis graminum* Treat of aphids to wheat crop. DAWN Business, T Aphididae). Canadian Entomol.,126: 61-6.

Bodlah, I. (2010). Biosystematics of aphid parasitoids from Punjab province of Pakistan. Ph.D. Thesis from Department of Entomology, PMAS- Arid Agriculture University Rawalpindi, Pakistan.

Bodlah, I., M. Naeemand and A. Mohsin. 2011. Checklist distribution host range and ecology of Aphidoidea (Homoptera) from the rain fed region of Punjab province of Pakistan. Sarhad J. Agri., 27(1): 93-101.

Bouhssini, E.I. and M. Nachit. 2000. New sources of resistance in durum wheat and wild relatives to Russian wheat aphid (Homoptera: Aphidiade). Options Mediterr 40:393-395.

Brewer, M. J., J. M. Struttmann and D. W. Mornhinweg. 1998. *Aphelinus albipodus* (Hymenoptera: Aphelinidae) and *Diaeretiella rapae* (Hymenoptera: Bracondae) parasitism on *Diuraphis noxia* (Homoptera: Aphidian) infesting barley plant differing in plant resistance to aphid. Biol. Control, 11: 255-261.

Brewer, M. J., Mornhinweg, D. W., and Huzurbazar, S. 1999. Compatibility of insect management strategies: *Diuraphis noxia* abundance on susceptible and resistant barley in the presence of parasitoids. *Bio Control* 43**:** 479–491.

Cai, Q.N., X.M. MA, X. Zhao, Y.Z. Cao and X.Q. Yang. 2009. Effect of host plant resistance on insect pests and its parasitoid: A case study of wheat-aphid parasitoid system. Biol. Control, 49: 134-138.

Canassa, V.F. E.L.L. Baldin, M.G. Sacilotto, A.L. Lourencão and T.L.M. Fanela,. 2021. Assessing the resistance of collard greens genotypes to the cabbage aphid (*Brevicoryne brassicae*) (Hemiptera: Aphididae). Phytoparasitica 2021, 49, 633–644.

Capsincaneo, C. and Gilet. A., 1996. Viral Diseases of Cereals and their control measures. Cultivar's Hors. Ser., 408: 28-30.

Carver, B.F. 2009 Wheat: science and trade. Wiley-Blackwell. Iwoa USA.

Chesneau, C. , F. Jamal and S. Shafiq. 2022. Statistical Analysis of Determinants of Wheat Crop: A Case Study of Bahawalpur. J. Stat. 26: 65-73.

Ciepiela, A.P. 1993. The harmful effect of cereal aphid on winter wheat crop. *Ochrona–Roslin*, 37: 9-10.

Geza, K. 2000. Aphid flight and change in abundance of winter wheat pests. Archives phytopatholgy. *Plant Prot*., 33: 361-373.

GoP. Economic Survey. 2015. Finance Division, Economic Advisor's Wing, Govt. of Pakistan Islamabad.

GoP. Economic Survey. 2023. Agriculture. Page. 24. https://finance.gov.pk/survey/chapter_24/2_agriculture.pdf

Hashmi, A. A., M. M. Hussain and M. Ulfat. 1983. Insect pest complex of wheat crop. Pak. J. Zool., 15

(2): 169-176.

Hill, B. D., R. A. Butts and G. B. Schaalje. 1993. Reduced rates of foliar insecticides for control of Russian wheat aphid (Homoptera: Aphididae) in western Canada. J. Econ. Entomol. 86:1259-1265.

Hussein, I.A.A., 1993. Abundance dynamics of cereal aphids (Homoptera, Aphididae) and their natural antagonists on different wheat type in Deir Ezzor (Sayrian Arab Rep.). *Arch. Phytopath.* Plant-Protect., 28: 439-445.

Irshad, M.A., U.K. Baloch, M. Irshad and A. Khan. 1988. Losses in wheat in public sector storage in Rawalpindi region during 1984-85. Pak. J. Agric. Res., 9: 136-140.

Javed, M.W. M.U. Hasan, M. Sagheer, S.T. Sahi, R.W. Mankin. 2022 Foliar and Soil Treatments of *Brassica napus* That Elicit Antibiosis in *Brevicoryne brassicae*. Agron.. 12:882.

Kannan, N. O. 1999. Population dynamics of wheat aphid *Schizaphis graminum* (Rondani) (Homoptera: Aphididae) and its natural enemies in the field. Sudan J. Agric. Res., 2: 65-68.

Keyhanian, A.A., G.G. Reza and A. Mohammadipour. 2021. A. Effect of application time of insecticides on cabbage aphid*, Brevicoryne brassicae* population and yield of canola crop. J. Appl. Res. Plant Prot. 9: 75–82.

Khan, A. M., A. A. Khan, M. Afzal and M.S. Iqbal. 2012. Wheat crop yield losses caused by the aphids infestation. J. Biofertil. Biopestici., 3:122.

Nadeem, I., Q. Ali, M.K. Malik, A. Aslam, I. Tariq, M.B.B. Iqbal, M.F. Akhtar, S. Ali, M.J. Saleem, M. Zubair and A. Abbas. 2023.Eco-friendly management of pink bollworm (Pectinophora gossypiella) in cotton. Pak. J. Agric. Res., 36(2): 155-160.

Raza, A., Z. Ali, M. Imtiaz and W. Mohammad. 2016. Identification of nitrogen-use-efficient and deep rooted wheat genotypes. Pak. J. Agri., Agril. Engg., Vet. Sci., 2016, 32 (1): 1-8.

Razaq, M. A. Mehmood, M. Aslam, M. Ismail A. Afzal and S.A. Shad. 2011. Losses in yield and yield components caused by aphids to late sown *Brassica napus* L., *Brassica juncea* L. and *Brassica carrinata* A. Braun at Multan, Punjab (Pakistan). Pak. J. Bot. 2011, 43, 319–324.

Schoonhoven, L. M., T. Jermy, J.V. Loon. 1998. Insect-plant biology, from physiology to evolution. 1998. Chapman & Hall, London.

Szwarc, J. J. Niemann, J. Bocianowski, M. Jacobus and M. Mrówczýnsk. 2021 Connection between nutrient content and resistance to selected pests analyzed in *Brassicaceae* hybrids. Agric. 11: 94.

Wains, M.S., Aziz-ur-Rehman, M. Latif and M. Hussain. 2008. Aphid dynamics in wheat as affected by weather and crop planting time. J. Agric. Res. 46(4): 361-366.

Wali, M., M. Nasir, S. K. Abbas, M. Irshad, M. W. Abbas, A. Nawaz and A. Rehman. 2013. Resistance Pattern Against Aphid (Diuraphis noxia) in Different Wheat Varieties /Lines at District Layyah. Acad. J. EntomoL. 6 (3): 116-120.

Zia, S., Q. Ali, M.Y. Umar, M.F. Akhtar, A. Aslam, N.A. Anjum, M. Shehzad and M.U. Qasim. 2023. Potential impact of nitrogen on population fluctuation of aphid and yield parameters in Barley. J. Agric. Res., 61(2):129-134.

CONTRIBUTION OF AUTHORS

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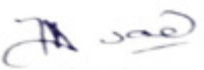
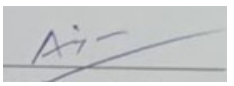
2.	Asma Bibi	Assisted to execute the trial	
3.	Qurban Ali	Assisted in the research work	
4.	Asad Aslam	Wrote the manuscript	
5.	Ata-ul-Mohsin	Conceived the idea	
6.	Tariq Mukhtar	Supervised the trial	
7.	Muhammad Faheem Akhtar	Analysed the data statistically	
8.	Muhammad Bilal Bin Iqbal	Assisted in the manuscript wrote-up	
9.	Muhammad Kamil Malik	Analyzed the research data statistically and proof read the manuscript