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A CRITICAL STUDY ON DIFFERENT APHID SPECIES ON VARIOUS GROWTH STAGES OF WHEAT CROP AND THEIR LOSSES

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ABSTRACT

The majority of aphid parasites belong to the order Hymenoptera, namely the families Aphidiinae and Aphelinidae, among others. The determining the efficacy of natural enemies. It wasn't until recent years that the Commonwealth Institute of Biological Control conducted a survey of the natural enemies of six economically important species of aphids and collected information on some other species. Aphids are very small sap sucking insects. They are commonly called as – (Mahu) Greenfly, Whitefly, Black fly and Plant louse. These are soft bodied insects and use their mouth parts for sucking and piercing the plant sap. They are found in colonies on the underside of tender terminal growth. Aphids are the parts of super family Aphidoidea and described as small sized (0.7-10mm) length soft-bodied insects with or without wings. Aphids show iteroparity. Aphid body consists of the head, three thoracic segments and eight abdominal segments. The three thoracic segments are called as – Prothorax, Mesothorax and Metathorax and each bears a pair of legs. The last two thoracic segment also bears a pair of wings (forewings and hind wings). The mouth part of aphid Consist of two pair of flexible stylets: a) labrum and b) labium. Their mouth parts are associated with salivary system which is well developed. Aphids are evolved about 280 years ago in the carboniferous period. The greatest crop in India is wheat (Triticum aestivum L.), which contributes significantly to the country's economic stability. The main pest responsible for the low wheat production is the aphid. Different wheat stages, including seedling stage (SS), tillering stage (TS), stem elongation stage (SES), heading stage (HS), dough stage (DS), and ripening stage (RS), were investigated to determine the most susceptible stage of the crop to aphid infestation over time. The most susceptible stage was explored by the most common aphid species, including *Rhopalosiphum padi, Schizaphis graminum, Sitobion avenae,*

Key Words: Aphid Species, Wheat Crop, Greenfly, Whitefly, Black Fly and parasites.

INTRODUCTION

Aphids are a kind of tiny bug that belongs to the order Homoptera that infects practically every plant. Aphids, also known as green flies and ant cows, are a significant group of insects that go by a variety of common names. Within the order Homoptera, they are classified as members of the class Insecta and Phylum Arthopoda, the superfamily Aphidoidea, and the family Aphididae.

They are often soft-bodied insects that feed on the sap of plants. As a result, their presence interferes with the normal growth of the plant. Aphids are mostly parthenogenetic insects that may colonise any part of a plant, including new leaves, twigs, inflorescences, fruits, and in rare circumstances, even the roots. Aphids are notorious for spreading plant diseases. They are also responsible for spreading numerous different plant viruses that cause illnesses.

They are also recognized as major pests of agricultural crops, horticulture plants, and many other kinds of forest plants and trees. They may be found all over the globe, with the greatest diversity of species occurring in temperate and subtropical climates. Aphids may have a significant impact on the economy due to their role as pests on a variety of agricultural and horticultural products, including oilseeds, cotton, wheat, vegetables, rice, and many other plant species.

They are an incredibly successful group that can be found all over the globe, spreading to tropical and subtropical areas, with the highest number of species in the warmer zones. They are found in a variety of habitats. There are around 4461 species of aphids that are known to exist across the whole planet (Remaudiere and Remaudiere 1997), and out of this total number of aphid species that are known to exist, more than 900 species have been documented taxonomically from India so far (Agarwala 2007). They are able to reproduce both sexually and asexually (also known as parthenogenesis), with equal success.

On the stem of a plant or the underside of a leaf, an aphid colony will often appear as a mass that is either green or black. It is possible for a population of aphids to rise to a few million individuals in a very short period of time, and then for that number to decrease in an even shorter period of time if the circumstances are not suitable.

Aphids are of significant interest to cytogeneticists because, during their life cycle, they engage in a variety of peculiar processes, such as cyclical parthenogenesis, heteroecious, and polymorphism. As a result of these processes, aphids serve as an excellent model organism for cytogenetic research. Aphids use what's known as a cyclical parthenogenesis reproductive mechanism. Aphids may reproduce without males. It begins with a

collection of generations that reproduce asexually via parthenogenesis and then moves on to a single generation that reproduces sexually.

The term "Holocyclic" is used to describe organisms with this characteristic. These insect pests are able to quickly reproduce thanks to their parthenogenetic generations, while their sexual phase allows for genetic recombination. However, many aphid species no longer go through the sexual phase, and as a result, they are referred to be anholocyclic. Species with a large distribution range may exhibit either holocyclic or anholocyclic life cycles within a single population, depending on the environmental conditions (Wohrmann and Tomiuk, 1988).

The cytogenetical processes in aphids are quite complicated, and many of them are still contentious while being intriguing. Viviparity, telescoping of generations, the holocentric structure of the chromosomes, and the tiny size of the chromosomes all make it exceedingly challenging to conduct cytological examinations on these organisms.

Aphids lay parthenogenetic eggs, which mature by a single cell division and result in the formation of a single polar body. These eggs are fertilized by the female. The formation of chiasmata and pairing of homologous chromosomes is said to take place during the maturation of a parthenogenetically growing egg, according to one perspective about this issue. Following this step, the homologues split apart, but the nuclear membrane has not yet been damaged. This process is referred to as endometriosis, and it is believed to be responsible for the occurrence of genetic recombination (Cognettif 1961b).

RESEARCH METHODOLOGY

Five replications of the experiment were carried out in the fields of Bareilly and Moradabad under the RCBD. a single wheat variety, was sown for the study in the middle of November. All of the replicates that were sowed received the same agronomic treatment. Different stages of the wheat plant, including the seedling stage (SE), tillering stage (TS), stem elongation stage (SES), heading stage (HS), dough stage (DS), and ripening stage (RS), were carefully examined to track the aphid infestation over time and determine the stage that was most vulnerable to aphid attack. By visually counting each tiller, wingless aphids were tallied. The three most prevalent aphid species, *Rhopalosiphum padi, Schizaphis graminum*, and *Sitobion avenae*, were examined for dominance and feeding habits during various growth phases of wheat over the course of several months. Shaking aphids on white paper allowed researchers to count the number of wheat tillers. Based on physical

characteristics, three species were distinguished and enumerated independently. To calculate the losses, aphid-infested plants (>50/tiller) were kept under observation. To calculate the losses brought on by the wheat aphid in contrast to aphid-free plots, a number of characteristics, including the number of spikelets per spike, the length of the spike, the number of grains per spike, and the number of damage grains per spike, were analyzed. Five plants were chosen in each replicate for this purpose. Power water spraying was used to keep an area aphid-free. Statistics were applied to the data (- 0.05). Utilizing a window-based computer software, the analysis of variance was performed. At a 5% level of significance, statistic 8.1. The pair-wise comparison of means was determined using the Tukey HSD test.

RESULTS AND DISCUSSION

The experiment was conducted in 2020–2021 to assess the wheat crop's most vulnerable stage to wheat aphids. Seedling, tillering, stem elongation, heading, dough, and ripening stages were examined in Bareilly and Moradabad districts, where 0.25, 3.19, 12.82, 24.79, 10.56, and 4.13 aphid/tiller were observed, whereas 0.19, 1.57, 7.65, 19.67, 6.27, and 1.24 aphid/tiller were recorded in Moradabad. For the districts of Bareilly and Moradabad, the R2 values were 0.1021 and 0.0528, respectively. The heading, stem elongation, and dough stages were the most heavily infested with aphids, as demonstrated, despite all the stages being significantly different from one another in terms of aphid population. In the final week of December to the first week of January, traces of an aphid population were discovered.

These conclusions are supported by research by Rustamani *et al.,* (1999), who noted that an aphid infestation first developed in the third week of December. Aphid population peaked between the 15th of February and the end of March. It then started to decline suddenly and stopped after the first week of April. According to our investigation, the population trend increased from the tillering stage to the heading stage. Similar findings were made by Hussein (1993), who discovered that each aphid species was in abundance just before the flowering season after a sharp decline in population. He asserted that each aphid species reached its peak population at the start of the flowering cycle and then saw a quick decline.

Rhopalosiphum padi, *Schizaphis graminum*, *Sitobion avenae*, and *Rhopalosiphum maidis* are the four main aphid species that infest wheat, and their periods of infestation differ.

R. padi was the first species to appear in Bareilly from February through the second week of April and in Moradabad from February through the first week of April. Population grew throughout time and peaked in the

first week of March in Bareilly (12.65 and 10.55/tiller, respectively) and Moradabad (10.55/tiller). *S. graminum* first occurred in the Bareilly and Moradabad districts in February's third and fourth weeks, respectively. Its population peaked in the fourth week of March in Bareilly and Moradabad, with corresponding densities of 14.33 and 10.57/tiller. As shown in figures 2 and 3, *S. avenae* also appeared in the Bareilly and Moradabad districts during the fourth week of February and the first week of April, with peaks during the last week of March (6.99/tiller) and the first week of April (5.70/tiller) and continuing through the third and second weeks of April (0.98/tiller) and second weeks of April (2.13/tiller), respectively. The first species to occur in a wheat crop was *R. padi*, which primarily consumed leaves and shoots. After the *R. padi*, *S. graminum* emerged and mostly consumed the shoots and ears. *S. avenae* first appeared after the two aforementioned species and generally stayed on the flowers/ears. This study was corroborated by Jarosik *et al.*, (2003), who found that *S. avenae* and *R. padi* are the most harmful species on winter wheat, with *S. avenae* primarily feeding on wheat ears and *R. padi* primarily feeding on leaves and ears. At Bareilly and Moradabad districts, *R. padi* predominated from mid-February to mid-March, *S. graminum* during the month of March, and *S. avenae* from mid-March to the first week of April. Shahzad *et al.*, (2013).'s observation of two species, *R. padi* and *S. graminum*, on wheat crops, where *S. graminum* was dominant over *R. padi* during the last week of March, validated the findings of this study. These species were found in the following order: *R. padi*>*S. graminum*>*S. avenae*. *R. maidis* was only detected in the Moradabad district, where it persisted in activity from the third week of February to the beginning of March and preyed primarily on leaves and stems.

Table 1 Percent population of different species at different time intervals during 2020-2021.

Aphid Species	**13-Feb**	**20-Feb**	**27-Feb**	**DIS 06-Mar**	**13-Mar**	**20-Mar**	**27-Mar**	**03-Apr**	**10-Apr**	**17-Apr**
District – Bareilly										
R. padi	100.0	89.12	79.54	59.76	48.62	24.56	5.430	4.160	0.760	00.00
S. graminum	000.0	10.88	15.06	33.98	43.96	62.86	67.03	69.60	73.53	51.09
S. avenae	000.0	00.00	5.400	6.260	7.420	12.58	27.54	26.24	25.71	48.91
R. maidis	000.0	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00
Total %	100	100	100	100	100	100	100	100	100	100
CV (%)	40.24	27.8	18.7	22.1	7.24	19.8	25.7	20.1	7.24	30.8

P value	P<0.64	P<0.041	P<0.056	P<0.060	P<0.014	P<0.034	P<0.066	P<0.050	P<0.004	P<0.074
District - Moradabad										
R. padi	100.0	95.12	84.43	61.11	40.60	21.06	4.580	0.870	00.00	00.00
S. graminum	000.0	00.00	9.050	27.09	39.16	46.21	63.12	68.66	57.35	000.0
S. avenae	000.0	00.00	00.00	1.570	3.770	15.40	26.22	27.02	42.65	100.0
R. maidis	000.0	4.880	6.520	10.23	16.47	17.33	6.080	3.450	00.00	000.0
Total %	100	100	100	100	100	100	100	100	100	100
CV (%)	53.24	26.1	12.4	10.6	6.24	11.8	15.7	20.5	17.24	39.1
P value	P<0.94	P<0.061	P<0.006	P<0.000	P<0.004	P<0.020	P<0.000	P<0.001	P<0.060	P<0.265

At Bareilly and Moradabad, the maximum *R. padi* percent population was 100 and 100, 89.12 and 95.12, 79.54 and 84.43, 59.76 and 61.11, 48.62 and 40.6 during the second, third, and fourth (February), first, and second (March) weeks, respectively. At Bareilly and Moradabad, the maximum percent population of *S. graminum* was 62.86 and 46.21, 67.03 and 63.12, 69.6 and 68.66, 73.53 and 57.35, and 51.09 and 0.00, respectively, during the third, fourth (March), first, second, and third (April) weeks. Similar to other locations, during the fourth (March), first, second, and third (April) weeks in Bareilly and Moradabad, the maximum percent population of *S. avenae* was 27,54 and 26,22, 26,24 and 27,02, 25,71 and 42.65, 48.91, and 100, respectively. *R. maidis* was only detected in the Moradabad area, where the greatest percent population for the first, second, and third weeks of March was 10.23, 16.47, and 17.33, as indicated in table 1. The number of spikelets per spike, the length of the spike, the number of grains per spike, the number of damaged grains per spike, and the weight of 1000 grains were all analyzed in order to determine the yield losses. Between the aphid-free and aphid-infested areas, there was a considerable variation in losses. As indicated in Table 2, the aphid-infested area had 5.64% fewer spikelets per spike, 3.7% less spikes, 7.22% fewer grains per spike, 0.72 % more damaged grains per spike, and 2.75% more 1000 grain weight than the aphid-free area. In order to estimate losses, Elmali and Toros (1997) studied a number of characters, including 1000 grain weight, spikelets/spike,

grain/spike, plant height, and spike length. He discovered that there had been losses of 10.16% in 1000 grain weight, 6.70% in the length of the spike tiller-1, and 1.22% in the length of the tiller. The remaining metrics showed no obvious losses. The most harmful species to the grains was *S. avenae*. These findings were supported by Wratten *et al.*, (1979), who discovered that *S. avenae* decreases the quality of flour for breadmaking by causing the greatest losses on wheat crops between ear emergence and flowering.

It has been determined that throughout the months of February and March, stem elongation, dough, and ripening stages are the most vulnerable growth stages to aphid assault. *R. padi* dominated during the stage of stem elongation. While *S. avenae* was the most harmful species on the ripening stage and causes production losses by lessening the number of grains/spike and reducing grain weight, *S. graminum* feeds on dough and ripening phases. By looking for and eliminating their alternate host plants or by applying any botanical at the time of each specie's emergence, this information will be useful in devising a management strategy for the control of each species at different growth stages.

Table 2 Losses assessment of wheat aphid in wheat grains

Sr. No.	Parameters Premeditated	Aphid Infested Area	Aphids % Free Area	Change due to Aphid	LSD
1	No of spikelets/spike	22.67±2.51	21.39±1.95	-5.64	0.79
2	Length of spike (cm)	13.22±2.36	12.73±2.03	-3.70	1.15
3	No of grains/spike	49.69±3.29	46.10±2.15	-7.22	3.34
4	Damage grains/spike (%)	05.40±0.83	06.12±0.41	0.72	0.41
5	1000 grain weight (gm)	39.27±1.68	38.72±2.63	-2.75	2.26

CONCLUSION

Aphids are a kind of tiny homopteran bug that may cause significant economic damage to a wide variety of agricultural crops. They are insects that feed on the sap of plants and infest both the aerial and the subaerial sections of plants, including the parts of plants that are most important from an economic standpoint (apical leaves, inflorescence, flower, buds, pods, fruits, and so on) (Raychaudhuri 1980).

In India, the females that are capable of parthenogenetic reproduction are the most prevalent pests, and they are often suspected of being vectors for the transmission of viral illnesses from one plant to another. They also

result in the deformation and production of galls on the affected plants. They are capable of spreading illnesses that are caused by viruses. Aphids feed on a wide variety of plants, including vegetables, fruit trees, cereals, grains, fiber crops, pulse crops, oil seed crops, medicinal plants, and decorative plants. Aphids may even cause damage to attractive plants. Some species of aphids have a polyphagous feeding Behaviour, which means they may infest a wide range of host plants from a number of plant families. In the plains of India, a huge number of aphids reproduce parthenogenetically for many generations exclusively by this method, but a few of them display a short period of sexual reproduction during the winter season. This is because parthenogenesis is the only method necessary for their survival. Aphids are parasitic insects that feed on the sap that flows through the phloem vessels of plants. This sap is being held under a significant amount of pressure. After a phloem vessel has been pierced, the phloem tissue inside of it will be pushed into the food canal.

Aphids are known to spread plant viruses to the plants on which they feed while they are feeding. These viruses may even cause the plants to perish completely. The life histories of many different animals are quite diverse (Behura 1978). The regular seasonal migration between the two morphs that are often distantly related to host plants is an important aspect of the aphid's life history. One of the host plants is referred to as the primary host, and it is used for reproduction (both sexual and asexual). The other host plant is referred to as the secondary host, and it is only infested with the parthenogenetic morphs. Aphid colonies on herbaceous plants typically consist mostly of apterous females throughout their early stages of development. Aphids are very important to agriculture because of their role as plant parasites and as carriers of viruses that cause plant illnesses.

It has been determined that throughout the months of February and March, stem elongation, dough, and ripening stages are the most vulnerable growth stages to aphid assault. *R. padi* dominated during the stage of stem elongation. While *S. avenae* was the most harmful species on the ripening stage and causes production losses by lessening the number of grains/spike and reducing grain weight, *S. graminum* feeds on dough and ripening phases. By looking for and eliminating their alternate host plants or by applying any botanical at the time of each specie's emergence, this information will be useful in devising a management strategy for the control of each species at different growth stages.

REFERENCES

- Iqbal, J., M.Ashfaq and A. Ali (2008). Screening of wheat varieties/advanced lines against aphids. *Pak. Entomol*. 30 (1):77–81.
- Jarosik, V., A. Honek and A. Tichopad (2003). Comparisonof field population growths of three cereal aphid

specieson winter wheat. *Plant Protect. Sci.,* 39: 61-64.

- Kannan, H.O. (1992). Investigations in pest problems in wheat at Rahad. In: Annual report of the Nile ValleyRegional Program on cool season food legumes andcereals.ARC-FCR. Giza, Egypt. pp.161-172.
- Karimullah, and K. F. Ahmad (1989). Incidence of the cereal aphid *Sitobion avenae* on different cultivars of wheat. *Sarhad J. of Agric.* 5:59-61.
- Khakwani, A. A., M. D. Dennett, M. Munir and M. Abid (2012). Growth and yield response of wheat varieties to water stress at booting and anthesis stages of development. *Pak.J. Bot*. 44:879-886.
- Khan, A. M., A. A. Khan, M. Afzal and M. S. Iqbal (2012). Wheat Crop Yield Losses Caused by the Aphids Infestation. *J. Biofertil. Biopest*. 3(4):1-3.
- 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. doi:10.4172/2155- 6202.1000122.
- Khan, H, M. Ayaz, I. Hussain, Z. Khan and M. K. Khattak (2000). Effect of sowing methods and seed rates on grain yield and yield components of wheat variety Pak-81. *Pak.J. Biol. Sci*. 3:1177-1179.
- Khattak, M. K., Riazuddin, M. Anayatullah (2007). Population dynamics of aphids (aphididae: homoptera) on different wheat cultivars and response of cultivars to aphids in respect of yield and yield related parameters. *Pak. J. Zool*. 39:109-115.
- Kibe, A. M., S. Singh, N. Kalrac (2006). Water-nitrogen relationships for wheat growth and productivity in late sown conditions. *Agric. Water Manage*. 84:221-228.
- Kieckhefer, R. W. and J. L. Gellner (1992). Yield losses in winter wheat caused by low–density cereal aphid populations. *Agron. J.*84:180.
- Kieckhefer, R. W., N. C. Elliott, W. E. Riedell and B. W. Fuller (1994). Yield of spring wheat in relation to level of infestation by greenbug (Homoptera: Aphididae). Canadian Entomologist. 126:61-6
- Kolbe, W. and W. Linke (1974). Studies of cereal aphids; their occurrence, effect on yield in relation to density levels and their control. *Annals of Applied Biology*. 77:85-87.
- Memon, R. A., G. R. Bhatti, S. Khalid, A. Mallah and S.Ahmed (2013). Illustrated weed flora of wheat crop of Khairpur District, Sindh. *Pak. J. Bot*. 45:39-47.