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A Study of the Population Density of Aphids and *Coccinella septempunctata* on Different Wheat Cultivars

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ABSTRACT

Background: Wheat is considered one of the primary and strategic grain crops in the world in terms of production and importance. The increment in both quantity and quality of wheat production renders it susceptible to various pests and diseases, including both insects and non-insect pests. The study aims to study the extent of infection of the IPA 99, IPA 22 and Abu Ghraib wheat varieties with aphids.

Methods: A general survey of aphids on Abu Ghraib, IPA 99 and IPA 22 wheat varieties was carried out in the fields of the College of Agriculture/ University of Baghdad in Abu Ghraib during the growing season 2021-2022.

Result: The results of the field survey indicated the presence of three species of aphids on the wheat crops belonging to the order *Hemiptera* and the family *Aphididae*: the wheat aphid [*Schizaphis graminum* (Rondani)], the oat aphid [*Rhopalosiphum padi* (L.)] and the corn aphid (*Rhopalosiphum maidis*). Wheat and oat aphids were the most commonly found on the crops. The presence of aphids on the plants was affected by the predominant environmental conditions like temperature, humidity, the chemical components of the host plants and the interactions between these factors. Additionally, we identified one type of predator belonging to the order of Coleoptera, the seven-spotted ladybug (*Coccinella septempunctata*), which was observed to be affected by the pest density. Aphids are a major pest of wheat in Iraq and they can cause significant losses of crops if their population is not controlled.

Key words: Aphids, Cereal aphid, Population density, Seven-spotted ladybugs.

INTRODUCTION

Wheat (*Triticum aestivum*) is considered one of the primary and strategic grain crops in the world in terms of production and importance. It holds the first rank globally, with China, India, the United States and Russia accounting for 25% of the world's production. In the Arab world, Syria leads the production, followed by Algeria according to FAO, (2011). The wheat production quantity in Iraq reached 3,088.6 thousand tons, with an average yield of 474.8 kilograms per donum. This production is significantly lower compared to the global average production rate of 1.5 - 2 tons per donum. Currently, Iraq imports 4.5 million tons annually. The Northern provinces of Iraq cultivate wheat using rain-fed methods, while in central and southern regions; wheat requires irrigation during most of its growth and development stages. The planting season extends from mid-October to mid-December (Iraqi Ministry of Agriculture, 2011); (Abebe *et al.*, 2020).

In a study by 'Jadou' *et al.* (2017) it was noted that the variety 'IPA 99' and 'Abu Ghraib' exhibited superior performance in all studied traits, indicating a competitive relationship between the main stem and branches. Cheyed *et al.* (2020) indicated that the Abu Ghraib and IPA 99 varieties gave the highest average number of spikes and the lowest average percentage of broken spikes and fallen grain stored upon storagein the warehouses.

Observations by Rikani *et al.* (2017) emphasized the significance of phosphate fertilization on wheat germination and its impact on grain weight per spike and the number of grains per spike. Furthermore, Fakhri *et al.* (2023); Meena *et al.* (2019) utilized modern techniques, including high-yield improved cultivars, foliar fertilization with micronutrients and Atlant® pesticide, to enhance both the quantity and quality of wheat production. Wheat crops are susceptible to various pests and diseases, including both insects and non-insect pests. Among these pests is the aphid insect, Hussein *et al.*, (2014) and Al-Obaidy (2019) pointed out that there are three species of aphids affecting wheat in Iraq: *Schizaphisgraminum* (Rondani), *Rhopalosiphumpadi* (L) and *R. maidis* (Fitch). The grain aphid, *Schizaphisgraminum* (Rondani), is a species that inflicts significant damage to wheat plants.

Large numbers of natural enemies are associated with aphid species, often maintaining a balance within the pest community. Numerous species of predators have been observed to coexist with aphids, such as ladybugs (*Coccinellidae*), green lacewings (*Chrysoperlasp*) and

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some *hemipteran* insects (Khan, 2005); (Alhomndawi *et al*., 2017); (Omran and Abdel Moaty, 2017). The predator *Coccinella undecimpunctata*, for instance, can be utilized to control aphid species like *Aphis fabae* and *A. gossyp* (Alhamawndy *et al.,* 2021). Khidr (2018) noted the presence of predatory insects, *Coccinella septempunctata* and *Syrphus corolla*, in wheat fields in Erbil province. Ahmad *et al.,* (2022) found that volatile organic compounds released by healthy and aphid-infested *Brassica oleracea* plants attract natural enemies. Furthermore, Al-Khafaji and Qassim (2023) mentioned three parasitoids, *L. fabarum*, *B. acalephae* and *A. asychis*, which could be used in biological control as an alternative to chemical pesticides for managing *A. fabae*., Chhangani *et al.,* (2022) mentioned the amount of predation on aphids by ladybugs and the importance of their use in biological control of aphids.

As a result of the widespread and large spread of these species in the irrigated wheat fields in central Iraq and the great damage they cause. The study aims tostudy the extent of infection of the IPA 99, IPA 22 and Abu Ghraib wheat varieties with oat aphid, cereal aphid and corn aphid.

MATERIALS AND METHODS

Infection of different varieties of wheat with oats and cereals aphids

Three varieties of wheat, name “IPA 99, IPA 22 and Abu Ghraib, were tested for their susceptibility to different species of the aphid insect from the seedling stage to the mature stage. The varieties “IPA 99” and “Abu Ghraib” were obtained from the General Commission for Seed Testing and Certification / Ministry of Agriculture, while “IPA 22” was obtained from the Seed Technology Center / Ministry of Science and Technology.

The experiment was conducted in the fields of the College of Agriculture / University of Baghdad in Abu Ghraib in during 2021-2022. All recommended pre-planting practices were followed, including plowing and leveling. The experimental field was divided into plots with dimensions of 5x3 meters, following a randomized complete block design with four replications. The seeds were sown in rows, with three rowsfor each variety, at a rate of 160 grams per variety. The distance between rows was 25 cm and the distance between varieties was 50 cm. Planting was done on the first of December and recommended agricultural practices were followed throughout the cultivation period for optimal production. No pest control measures were implemented during the experiment and the trial was left for natural infestation. Samples were collected every two weeks, with a total of 10 plants sampled for each variety within each replication. The samples were collected in polyethylene bags, transferred to the laboratory and examined under a magnifying lens. The types and numbers of aphids present were recorded, along with observations on the plant’s health status. The results were analyzed according to a randomized completely block design (RCBD) (Al-Rawi and Khalafallah, 2000).

RESULTS AND DISCUSSION

Types of aphids in wheat fields

The results of the field survey indicated the presence of three species of aphids belonging to the order Hemiptera and the family Aphididae: the Oat aphid *(Rhopalosiphum padi* L.), the Corn aphid *(Rhopalosiphum maidis*) and the Wheat aphid [*Schizaphis graminum* (Rondani)].

These species were identified by the researcher and through field observations throughout the growing season; it was found that the oat aphid, wheat aphid and corn aphid are the dominant and most damaging species. Therefore, they were the focus of the study.

Population density of *Rhopalosiphum padi*

The results of Table 1 showed the presence of oat aphid activity in the end of December in Baghdad province on different wheat varieties when the plants were in the seedling stage for the varieties IPA 22, IPA 99 and Abu Ghraib. The number of aphids continued to increase gradually until the end of February. The IPA 99 variety had

Table 1: Population density of *Rhopalosiphum padi* and *C. septempunctat* on different wheat cultivars during the study season.

Sample	Abu Ghraib		IPA 99		IPA 22	
date	*R. padi*	*C.septempunctata*	*R. padi*	*C. septempunctata*	*R. padi*	*C. septempunctata*
20/12/2021	0.111	0.0	1.111	0.000	0.000	0.000
30/12/2021	0.926	0.0	1.593	0.000	0.815	0.185
10/1/2022	0.667	0.0	1.333	0.000	1.000	0.000
20/1/2022	1.000	0.0	1.000	0.370	1.296	0.333
30/1/2022	1.593	0.0	0.926	0.074	1.889	.444
10/2/2022	2.111	0.0	0.667	0.000	2.667	0.519
25/2/2022	0.667	0.0	0.667	0.000	1.074	0.000
5/3/2022	1.333	0.0	0.111	0.000	0.704	0.000
17/3/2022	0.000	0.0	0.000	0.000	0.148	0.000
1/4/2022	0.000	0.0	0.000	0.000	0.148	0.000
LSD 0.05	0.765	*	0.763	0.095	0.688	0.161

the highest population density and was significantly different from the rest of the varieties Abu Ghraib and IPA 22, with the numbers being 1.593, 0.926 and 0.815 respectively. The number of aphids did not visibly affect the phenotypic traits of these varieties. In general, there is a similarity in the seasonal presence of aphid species and their natural enemies. Aphids are rarely found when temperatures are below 12°C and their population density peaks between 15-20°C. Temperatures of 15°C are the point at which natural enemies begin to increase in abundance, when aphid populations reach their peak. The population density of oat aphids begins to increase when temperatures approach an average of 15°C. In Baghdad, the relative humidity in February was 64.1%, which means that the relative humidity and temperatures are suitable for the growth and development of aphids.

Population density of *(Rhopalosiphum maidis)*

The corn aphid was present from the beginning of the wheat plant's germination for all the cultivated varieties. It was observed that in the second third of December, the average population density of the corn aphid was 1.481, 0.926 and 0.778 insects per plant for the varieties IPA 22, Abu Ghraib and IPA 99, respectively were as shown in Table 2. Then, it began to increase with rising temperatures, reaching its highest density of 17.11, 9.630 and 8 insects per plant in the first third of February when the temperature was 14°C and the relative humidity was 58.95%. In March, it decreased gradually to reach its lowest density at the end of March, reaching the lowest population density of corn aphid, which was 0.852, 0.148 and 0 for the varieties IPA 99, Abu Ghraib and IPA 22, respectively. Ladybugs began to appear on the plants infected with insects of both the IPA 99 and Abu Ghraib varieties in early December with a density of 0.185 and 0.111 insects per plant, respectively. This was observed when the temperature was 10.8°C and the relative humidity was 68.01% (Fig 1). Then, their numbers gradually increased to reach their highest peak at the end of February with a density of 1.111 and 1.148 individuals plant-1on the IPA 99 and Abu Ghraib varieties, respectively. Then, 5 their numbers began to decrease during the months of February and March to reach their lowest density at the beginning of April, with 0 insect per plant for ladybugs at a temperature of 24.4°C. As for the number of ladybugs, they were not found on wheat plants infected with corn aphids of the IPA 22 variety throughout the study period, despite the presence of aphids in different numbers.

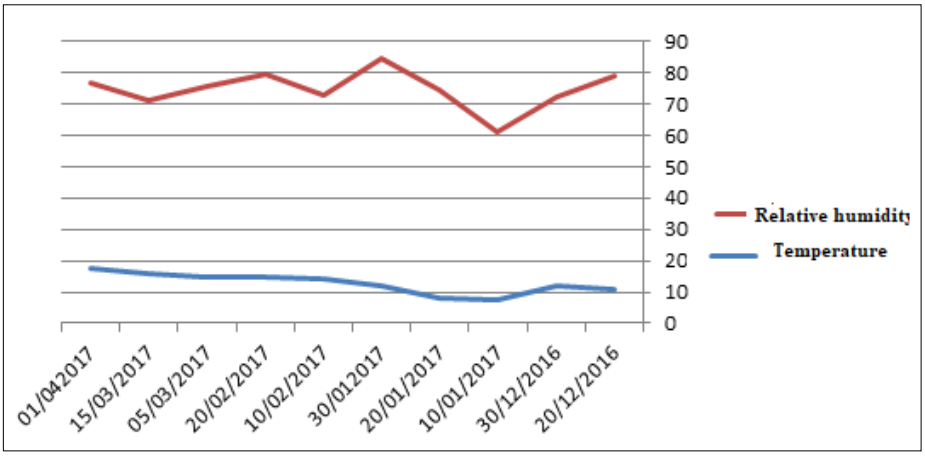

Fig 1: Average temperatures and relative humidity in Baghdad governorate / Abu Ghraib

Table 2: Population density of *Rhopalosiphum maidis* and *C. septempunctata* on different wheat cultivars during the study season.

Sample	Abu Ghraib		IPA 99		IPA 22	
date	*R. maidis*	*C.septempunctata*	*R. maidis*	*C.septempunctata*	*R. maidis*	*C. septempunctata*
20/12/2021	0.926	0.111	0.778	0.185	1.481	0.000
30/12/2021	2.259	0.444	4.630	0.482	3.519	0.000
10/1/2022	4.889	0.593	9.407	0.885	7.222	0.000
20/1/2022	5.889	0.852	13.852	1.000	8.259	0.000
30/1/2022	8.222	1.111	15.741	1.148	9.259	0.000
10/2/2022	8.000	0.815	17.111	0.731	9.630	0.000
25/2/2022	1.259	0.000	3.000	0.259	1.259	0.000
5/3/2022	0.889	0.185	2.519	0.037	1.333	0.000
17/3/2022	0.148	0.000	0.852	0.111	0.000	0.000
1/4/2022	0.000	0.000	0.000	0.000	0.000	0.000
LSD 0.05	1.565	0.235	3.20	0.223	1.305	*

Table 3: Population density of *Schizaphis graminum* and the seven-spotted ladybug on different wheat cultivars during the study season.

Sample	Abu Ghraib		IPA 99		IPA 22	
date	*Schizaphisgraminum*	*C.septempunctata*	*R. maidis*	*C.septempunctata*	*R. maidis*	*C.septempunctata*
20/12/2021	1.926	0.000	2.852	0.000	2.667	0.000
30/12/2021	1.037	0.000	1.370	0.000	1.185	0.000
10/1/2022	0.815	0.000	0.85	0.000	0.667	.000
20/1/2022	1.444	0.000	1.185	0.000	1.222	.000
30/1/2022	1.815	0.000	1.815	0.000	1.852	0.000
10/2/2022	2.481	0.000	2.889	0.000	2.370	0.000
25/2/2022	0.519	0.000	0.000	0.000	1.148	0.000
5/3/2022	0.185	0.000	0.222	0.000	0.296	0.000
17/3/2022	0.000	0.000	0.000	0.000	0.000	0.000
1/4/2022	0.000	0.000	0.000	0.000	0.000	0.000
LSD 0.05	0.834	*	0.647	*	0.794	*

Population density of *Schizaphis graminum*

The results showed the presence of a few wheat aphids in the second third of December on all varieties and at the end of the month (Table 3). Their numbers continued to increase until they reached their highest density on February 10, with rates of 2.889, 2.481 and 2.370 on the varieties IPA 99, Abu Ghraib and IPA 22, respectively, when the temperatures were 11.8°C and the relative humidity was 48.8%. Then, their numbers decreased at the end of February and beginning of March and then gradually increased until March 5, reaching their highest density of 0.296, 0.222 and 0.196 at an average temperature of 15.5°C and a relative humidity of 45.8% (Fig 1) for the varieties IPA 22, IPA 99 and Abu Ghraib, respectively. Then, their numbers decreased again suddenly and quickly to reach their lowest population density at the beginning of April at an average temperature of 24.4°C and a relative humidity of 35.9% and the numbers were 0 for all varieties.

The results of the field survey indicated the presence of three species of aphids, the wheat aphid [*Schizaphis graminum* (Rondani)], the oat aphid [*Rhopalosiphum padi* (L.)] and the corn aphid (*Rhopalosiphum maidis*). It was observed that the wheat and oat aphids are the most commonly found on the crop. The presence of insects on the plants was affected by the predominant environmental conditions like temperature, humidity, the chemical components of the host plants and the interactions between these factors. Feng (1991) confirmed that a humidity of 35-53% in the spring can cause a significant increase in aphid populations. In a previous study by Ali *et al.* (2006) on the seasonal occurrence of oat aphids in Baghdad province, the study was conducted at two sites, one in Fadhiliyah and the other in Abu Ghraib, for three growing seasons. The results showed that oat aphids began to appear in the field in December, but their numbers were very few. They then began to increase in February and continued to increase as the season progressed and temperatures rose at both sites for the three years. The highest numbers of this type of aphid were reached in March of each year. In April, the number of insects began to decrease gradually and completely disappeared from the plant due to changes in environmental conditions and the plant reaching maturity. As for the natural enemies, a sharp decrease in the population density is observed in the first three months of crop growth, especially the lady bugs. This may be due to the influence of environmental conditions, especially the low temperatures during these months. It may also be due to the impact of pest control operations and the increasing use of pesticides in the control of aphids in the study areas, which are repeated annually. These results show that oat aphid can infect all varieties, but with different degrees of response. The reason for this may be due to environmental conditions that affect the nature of plant growth, the nutritional components in plant tissue, or the plant's own defensive chemicals. Studies have shown that secondary compounds produced in resistant and susceptible plants can help the plant defend itself against pests. For example, Velozo *et al.,* (1999) found that the increase in the substance (Gramine) may play an important role in enhancing the resistance of cereal crops to aphid infestation in various plants. Its role lies in determining the type of interaction that occurs between the host plant and the pest. Feng (1991) indicated that a humidity rate of 35-53% can cause a significant increase in the population density of wheat aphids. When comparing the population density rates of the pest on different varieties throughout the growing season based on the least significant difference, the highest population density of the pest was found on the IPA 99 variety, which differed significantly from the IPA 22 and Abu Ghraib varieties. The attraction of the pest to one variety over another is determined by the chemicals emitted from the plant. When the phenotypic characteristics and the chemical content of the tissue of the variety are not negatively affecting the life of the pest, it adapts to start developing and reproducing (Webster and Inayatuallah, 1988). Wheat aphids have enzymes in their saliva that are effective in stopping or inhibiting the function of the cell wall of chloroplasts in sensitive plants. This is clearly evident at the beginning of the pest's feeding on the

plant, where the leaves turn yellow or red spots appear on the leaves. Continued feeding leads to a general yellowing of the plant, followed by the drying of the leaves and roots and then the death of the plant. If the plant survives, it affects the size of the plant and the amount of yield in sensitive varieties (Al-Mousawi. *et al.,* 1983). However, this condition was not observed on the plants in the field, perhaps because the population density did not reach the level that caused that damage.

CONCLUSION

The population density of aphids on wheat crop in Iraq can vary depending on the aphid species, the wheat variety, the sowing date and the weather conditions.

Aphids are a major pest of wheat in Iraq and they can cause significant yield losses if their population is not controlled.

There are a number of different ways to control aphids on wheat in Iraq, including:

- Cultural controls: These include practices such as crop rotation, planting resistant varieties and destroying volunteer wheat plants.
- Chemical controls: These include insecticides that can be applied to the wheat crop.
- Biological controls: These include using natural enemies of aphids, such as ladybugs and lacewings.

It is important to monitor aphid populations on wheat crops in Iraq regularly and to take control measures as soon as the population density reaches the economic threshold. By taking these measures, farmers can help to protect their wheat crops from aphid damage and ensure a good yield.

Conflict of interest

All authors declare that they have no conflicts of interest.

REFERENCES

Abebe, N., Negeri, M., Getu, E. and Selvara, T. 2020. Yield Reductions of Wheat Cultivar Obora (UTIQUE96/FLAG-1) due to Russian Wheat Aphid (*Diuraphis noxia*) Infestation under Field Conditions at Selected Districts of West Showa Zone. Ethiopia. Agricultural Science Digest. (42)2: 177-181.

Ahmed, Q., Agarwal, M., Alobaidi, R., Zhang, H. and Ren, Y. (2022). Response of Aphid Parasitoids to Volatile Organic Compounds from Undamaged and Infested *Brassicaoleracea* with Myzuspersicae. Molecules Journal. 5(27): 1522-1530.

Al-Hamawndy, S.A.K., Al-Ghadban, Z.A.M. and Al-Asadi, M.A.A. (2021). Predatory Efficiency of the Eleven-Point Ladybird *Coccinella undecimpunctata* Aphis Fabae A. Gossypii. Indian Journal of Ecology. 48(Special Issue). 357-360.

Al-Hamawndy, S.A.K., Najm, S.M., Abdel-Razzaq, S.I. and Salman, S. (2017). Seasonal density of aphids and seven-spotted ladybug *Coccinellas uptempunctata* on jute crop. Tikrit University Journal of Agricultural Sciences, Proceedings of the Sixth Scientific Conference of Agricultural Sciences (Special Issue). 105-111.

Ali, A.S.A., Al-Din, E., Al-Shamaa and Muhammad, J.K. (2006). The relative susceptibility of some wheat varieties to infection with oat aphid L) (Rhopalosiphum padi (Aphididae: Homoptera)). Iraqi Agriculture Journal. 11(1): 48-51.

Alkhafaji, S.M.S. and Ahmed, Q. (2023). Predation potential of flower fly Eupeodesnuba (Wiedemann, 1830) (Diptera: Syrphidae) on black bean aphid Aphis *fabae scopoli* (Hemiptera: Aphididae) and the parasitoids species on its host in the field. Journal of Aridland Agriculture. 9: 53-57.

Al-Mousawi, A.H., Richardson, P.E. and Burton, R.L. (1983). Ultrastructural studies on greenbug (Hemiptera: Aphididae) feeding damage to susceptible and resistant wheat cultivars. Annals of the Entomological Society America. 71: 964-971.

Al-Obaidy, S.H. (2019). Induced resistance in wheat plants to aphids by silicon. Biochem. Cell. Arch. 19(1): 1369-1371.

Al-Rawi, K.M. and Khalafallah, A. (2000). Introduction to statistics. Dar Al-Kutub for Printing and Publishing, University of Mosul.

Chhangani, A., Mahla M.K., Swaminathan R., Lekha, H. Swam, N.L., Dangi, A. (2022). Comparative Functional and Numeric Response of Two Coccinellids (*Coccinella septempunctata* and *Cheilomenes sexmaculata*) Preying Cowpea Aphid (*Aphis craccivora*). Legume Research. 45(4): 521-526. doi: 10.18805/LR-4697.

Cheyed, S.H., Al-Fahad, A.Ch. and Al-Rawis, A.S. (2020). Storage characteristics of spikes and grains of bread wheat cultivars. Iraqi Journal of Agricultural Sciences. 51(1): 252-258.

F.A.O organization. (2011). Annual Report on Wheat Productivity.

Fakhri, A.R.T., Jubara, O.K. and Jubair, B.N. (2023). Improved seeds and some modern technologies in increasing the supply of wheat crop in Iraq for the agricultural season 2019-2020. Iraqi Journal of Agricultural Sciences. 54(1): 176-188.

Feng, M.G., Johnson, J.B. and Halbert, S.E. (1991). Natural control of cereal aphids (Homoptera:Aphididae) by entomopathogenic funji (Zygomycetes: Entomophthorales) and parasitoids (Hymenoptea: Braconidae and Encyrtidae) on irrigated spring wheat in southwestern Idaho. Enviro. Entomol. 20(12): 1699-1710.

Hussein, H.M., Hamo, N.N. and Al Nuaimi, K.T. (2014). Aphid species and their biological enemies on wheat in central Iraq. Iraqi Research Journal of Agriculture. 91(6): 72-80.

Iraqi Ministry of Agriculture. (2011). A Report on the Reality of Wheat and Barley Cultivation in Iraq.

Jaddo, K. A., Zeboon, N.H. and Baqer, H.A.A. (2017). Effect of tillers removal and nitrogen levels on some growth traits of two bread wheat varieties. The Iraqi Journal of Agricultural Sciences. 48(1): 274-284.

Khan, S.A. (2005). Studies on the Aphid's Distribution Pattern and Their Natural Enemies in Wheat and Maize Crop. Ph.D thesis. NWFP. Agri. Uni. Peshawar. 65(4): 23-63.

Khidr, S.K. (2018). Effects of organic fertilizers and wheat varieties on infestation by, corn leaf aphid, *Rhopalosiphum maidis* and wheat thrips, Haplothripstritici and their predators. The Iraqi Journal of Agricultural Sciences. 49(1): 93-104.

Meena, R.K., Singh Y.V., Meena V.K., Kumar R. and Ram H. (2019). Growth, productivity and profitability of Wheat (*Triticum aestivum* L.) under rice-wheat cropping system as influenced by of in-situ microbial inoculated rice residue and nitrogen management. Bhartiya Krishi Anusandhan Patrika. 34(3-4): 170-177. doi: 10.18805/BKAP194.

Omran, S.A.R. and Abdel Moaty, Z. (2017). A study of the seasonal presence of aphid species on the wheat crop, var. IPA 99, in the city of Baghdad. Journal of the College of Basic Education. 23(98): 135-142.

Rekani, O.A.O., Dohuk, M.S.S. and Hussain, M.A. (2017). Effect of phosphate fertilizer on growth and yield of five cultivars bread wheat. The Iraqi Journal of Agricultural Sciences. 48(6): 1796-1804.

Velozo, J.A., Alvera, R.A., Wacher, G.A., Timmermenn, B.N. and Corcuera, L.G. (1999). Increase in gramine content in barley infested by the aphid *Schizaphis graminum* R. phytochemistry. 52(6):1059-1061.

Webester, T.A and Inanayatullah, C. (1988). Assesment of experimental designs for greenbug (Homoptera:Aphididae) antixenosis test. J. Econ. Entomol. 81: 1246-1250.