https://doi.org/10.48047/AFJBS.5.3.2023.92-106

African Journal of Biological Sciences

Open Access Research Paper

"The Impact of Varieties and Treatment with Humic Acid on Irrigation Intervals, Yield Characteristics, and Protein Percentage in Two Wheat Varieties: Aba 99 and Adana 99"

Hareer Abd Ameen, Assoc. Prof. Hamid Salman Khamees,
Assist. Prof. Ayoub Jumaa Al-Bayati
Tikrit University/ College of Education for Women/ Department of Life Sciences
Dr_ayyub_bio@tu.edu.iq

Article Info

Volume 5, Issue 3, July 2023

Received:18 May 2023

Accepted :15 June 2023

Published: 24 July 2023

doi:10.48047/AFJBS.5.3.2023.92-106

Abstract:
This study was conducted in the gardens of the scientific departments at the College of Education for Women, Tikrit University, during the agricultural season of 2022-2023 to examine the impact of two varieties of bread wheat (Triticum aestivum L.), Aba 99 and Adana 99, on various concentrations of humic acid [0, 0.5, and 1 ml] and irrigation intervals of 25, 35, and 45 days with respect to yield characteristics and several qualitative traits of the wheat plant. The statistical analysis was performed at a significance level of ($P \leq 0.05$), yielding the following results:

The tripartite interaction between the Adana variety treated with 1 ml concentration of the acid and irrigated every 25 days surpassed the untreated Aba 99 variety irrigated every 45 days, exhibiting higher values in yield characteristics such as spike length, thousand grain weight, grain number per spike, plant yield, and protein percentage, recording 66.66%, 73.73%, 11.26%, 78.58%, and 18.81% respectively.

Keywords: Wheat, Varieties, Humic Acid, Irrigation Intervals.

Introduction:

There are several factors that significantly contribute to increasing the productivity of the wheat plant, including the selection of a good variety that is well-adapted to the region, which can notably enhance the crop yield. The wheat varieties vary in their productivity, which is a natural occurrence due to their genetic nature. Thus, introducing new high-yielding varieties can affect the increase in production, enhance quality, and reduce costs. Moreover, selecting varieties that are suitable for the region's conditions assists in augmenting production and improving quality (Al-Abbar, 2021). The quantity and quality of protein in the wheat crop is one of the most crucial metrics in determining quality due to its relation to the final product (Groeger et al., 1997). Consequently, there has been a global emphasis and focus on high-yielding wheat varieties with good quality, especially new varieties, along with considering the scientific and proper application of crop servicing processes and adopting effective methods for an integrated and well-planned system of adding and using organic fertilizers with the aim to achieve optimal results in increasing production, improving quality, reducing costs, and preserving the environment (Rollin, 2014).

Water stress is one of the most significant non-biological factors that dictate plant production. It leads to a decline in the available water content in the soil either through the scarcity of available water or continuous water loss via evaporation and transpiration (Al-Maamari, 2010). This drought condition induces alterations in the plants' natural environment, causing disruptions in physiological processes and a decrease in crop productivity, which exacerbates the issue of food shortage globally (Mohammed and Kazem, 2017). With the significant population increase and the rising demand for agricultural food, the problem of water scarcity has emerged as a main obstacle hindering the increase in productivity. Therefore, researchers have aimed to enhance traits of environmental stress tolerance in various ways to mitigate the effects of these non-biological factors, including the use of organic humic acids (humic acid). Recently, the importance of using organic fertilizers containing essential nutrients for plants has been highlighted, as they contain certain organic acids like humic and fulvic acids, amino acids, among other substances, which are characterized by their affordability, ease of use, lower environmental pollution, and contributions to the improvement of many physical, chemical, and biological properties of the soil, positively reflecting on growth and plant production (Muktamar et al., 2017; Ren et al., 2017). Lately, the world has been experiencing a decrease in rainfall and availability of irrigation water. This study was conducted to reduce the negative impact of water stress on the wheat plant using humic acid.

Materials and Methods

This study was conducted during the agricultural season of 2022-2023 within the gardens of the scientific departments at the College of Education for Women, University of Tikrit. The research utilized plastic pots from November 1, 2022, to May 1, 2023. The study adopted a Completely Randomized Design (CRD) with three replications and incorporated three factors:

1. Varieties of Wheat: Two varieties were chosen, Abba 99 and Adna 99, to compare their performance under the various experimental conditions.
2. Humic Acid Addition: The soil was treated with three different concentrations of humic acid: 0 ml (control), 0.5 ml, and 1 ml.
3. Irrigation Periods: The crops were irrigated at different intervals - every 25, 35, and 45 days, making up a total of 18 treatment combinations. These were randomly assigned across three replications.

Seeds were sown on November 1, 2022, by placing 5 seeds in each pot, which were then evenly distributed and covered with a thin, smooth layer of soil (2 cm) to ensure proper germination.

The following attributes were studied:

1. Spike Length (cm): The average length of ten primary spikes was measured, excluding the awns, and the mean value was calculated.
2. Number of Grains per Spike: Calculated from the average number of grains in ten randomly selected spikes per experimental unit.
3. Weight of 1000 Grains (g): Calculated using the yield of seeds from each experimental unit, by weighing 500 seeds and multiplying by 2 (500 x 2).
4. Grain Yield per Plant (g): The yield was calculated for five plants and the average value was determined.
5. Protein Percentage (%): The protein percentage was estimated according to the C.C.A.A 1998 method, utilizing an Inframatic device supplied by Perten Company, which is based on Near-Infrared Reflectance (NIR), as per Gomez et al., 2010.

Statistical Analysis

Data was statistically analyzed using the SAS software (1989), and mean comparisons were made according to Duncan's Multiple Range Test (1955).

Results and Discussion

From the results presented in Table (1), it is apparent that the difference between the two varieties, Aba99 and Adna99, does not significantly influence the length of the spike. However, there were significant variations between different concentrations of humic acid regarding this trait, where the spike length reached its highest value of 10.85 cm at a concentration of 1 ml of the acid, showing an increase of 14.21% compared to the untreated, which had the lowest average spike length of 9.50 cm. Additionally, the irrigation intervals displayed a significant influence on the spike length, notably with the 25-day irrigation interval showcasing the highest length at 10.71 cm, an increment of 18.60%

compared to the 45-day interval which recorded a spike length of 9.03 cm, whereas it did not significantly differ from the 35-day interval.

The bivariate interaction between the studied factors had a significant influence on spike length. Specifically, treating the Adna99 variety with 1 ml concentration of humic acid resulted in longer spikes, measuring 11.04 cm, an increase of 17.45% compared to the untreated Aba99 variety, which had a spike length of 9.40 cm. Furthermore, irrigating the Adna99 variety every 25 days led to a longer spike, with a length of 11.03 cm, a surge of 23.51% compared to the same variety irrigated every 45 days, which yielded the shortest spike length of 8.93 cm. The treatment involving 1 ml concentration of the acid and irrigation every 25 days resulted in long spikes measuring 11.46 cm, a considerable increment of 38.91% compared to irrigation every 45 days without acid treatment, which produced the shortest spikes, measuring 8.25 cm. Notably, this treatment did not significantly vary from the treatment involving 1 ml acid concentration and irrigation every 35 days.The table's findings indicate a significant effect among the three studied factors in their influence on spike length, where the longest spike, measuring 11.92 cm, was observed as a result of treating the Adna99 variety with 1 ml concentration of the acid and irrigating every 25 days, an increase of 45.37% compared to the untreated Aba99 variety irrigated every 45 days, which had a spike length of 8.20 cm. This did not significantly differ from the treatment of the same variety with a 1 ml concentration of the acid every 35 days.The observed trends might be attributed to the impact of humic acid, which plays a role in stimulating the activity of acetic acid hormones, thus promoting plant growth. Additionally, it facilitates water and nutrient availability to the plant, subsequently enhancing photosynthetic activity, which ultimately reflects in increased spike length. The superiority of wheat plants irrigated at closer intervals in spike length could be due to the sufficient water supply, leading to the availability of nutrients and a positive influence on growth traits, subsequently affecting yield attributes, including spike length. The availability of water affects all phenotypic traits, growth characteristics, and yield (Islam et al., 2018). As observed from Table (2), the Adna99 variety significantly surpassed the Aba99 variety in the number of grains per spike, providing 57.40 grains, an increase of 7.45% compared to the Aba99 variety, which recorded 53.42 grains per spike. The treatment with varying concentrations did not display... (The text cuts off here and needs continuation.)

Table (1) Effect of items, humic acid (ml) and irrigation periods (day) in the length of the bomb (cm2)

Effect of varieties	Interaction between varieties and acid	Watering intervals (day)			Humic acid levels (ml)	Categories
		45	35	25		
9.98a	9.40c	8.20f	10.00d	10.00d	0	IPA99
	9.86c	9.20e	10.18d	10.20d	0.5	

	10.67ab	10.0d	11.0b	11.0b	1	
10.26a	9.60c	8.29f	10.0d	10.50c	0	ADNA99
	10.16b	9.21e	10.60c	10.66c	0.5	
	11.04a	9.30e	11.89a	11.92a	1	
9.50c	The effect of acid	8.25f	10.00c	10.25bc	0	The overlap between acidity and irrigation periods
10.00b		9.20e	10.39bc	10.43b	0.5	
10.85a		9.65d	11.44a	11.46a	1	
		9.13c	10.39b	10.40b	IPA99	Overlap between cultivars and irrigation periods
		8.93c	10.83ab	11.03a	ADNA99	
		9.03b	10.61a	10.71a		Irrigation periods

The different concentrations of humic acid presented significant variations in this trait, wherein the diverse irrigation intervals also had a meaningful impact on this attribute. Notably, the irrigation interval of every 25 days was characterized by the highest number of grains per spike, amounting to 61.60 grains, an increase of 27.69% compared to irrigating every 45 days, although there was no significant difference compared to an irrigation interval of 35 days.

The bi-factorial interactions demonstrated a significant effect on the number of grains per spike. Specifically, the treatment of the Adna 99 variety with a 1ml concentration of the acid resulted in a higher grain count, reaching 61.85 grains, an increment of 17.18% compared to the untreated variant of the same variety, which yielded 52.78 grains per spike. Furthermore, irrigating the Adna 99 variety every 25 days led to a higher grain count, amounting to 64.46 grains, a 25.63% increase compared to the Aba variety irrigated every 45 days, albeit with no significant difference when compared to the same variety irrigated every 35 days. The treatment involving 1ml of the acid and irrigation every 25 days featured the highest grain count, reaching 64.87 grains, a surge of 47.23% in comparison to irrigation every 45 days without the acid treatment, with no significant variations between the treatments involving the acid and irrigation every 25 to 35 days. The tri-factorial interaction among the studied factors significantly influenced the number of grains per single spike. The plants of the Adna variety treated with a 1ml concentration of the acid and irrigated every 25 days exhibited the highest grain count, amounting to 68.33 grains, a substantial growth of 66.66% compared to the untreated and the 45-days irrigated variant of the same variety. However, no significant variation was observed when compared to the same variety treated with a 1ml concentration of the acid and irrigated every 35 days.

The variance in the varieties regarding the attribute of grains per spike-1 can be attributed to intrinsic genetic factors associated with the respective variety, as indicated. Our results align with Khalifa et al. (2009), who noted a discrepancy among wheat varieties concerning the number of grains per spike. The timely availability of water and preventing the plant from experiencing water stress leads to better growth and, consequently, prepares the nutritional elements during the onset of spike development, positively affecting the grain count per spike. Delay in irrigation results in a reduced number of grains per spike, as highlighted by Khan et al. (2007).

Table (2) demonstrates the impact of the varieties, humic acid concentration (ml), and irrigation intervals (days) on the grain count per spike.

Effect of varieties	Interaction between varieties and acid	Watering intervals (day)			Humic acid levels (ml)	Categories
		45	35	25		
53.42b	54.97c	59.60e	50.0h	55.32f	0	IPA99
	54.07c	43.11j	59.60e	59.50e	0.5	
	57.98b	51.22g	61.30c	61.41c	1	
57.40a	52.78c	41.0k	55.55f	60.60d	0	ADNA99
	57.97b	45.0i	64.47b	64.44b	0.5	
	61.85a	49.51h	67.70a	68.33a	1	
57.59a	The effect of acid	50.30c	52.78c	57.96b	0	The overlap between acidity and irrigation periods
56.02a		44.06d	62.03a	61.97a	0.5	
59.91a		50.36c	64.50a	64.87a	1	
		51.31c	56.97b	58.74b	IPA99	Overlap between cultivars and irrigation periods
		45.17d	62.57a	64.46a	ADNA99	
		48.24b	59.77a	61.60a		Irrigation periods

From Table (3), we observe that there is no significant effect between the two varieties concerning the thousand-grain weight trait, even when treated with various concentrations of humic acid significantly affecting the thousand-grain weight trait. The highest weight reached 39.73g, a 20.72% increase compared to untreated plants which registered a weight of 32.91g. Irrigation intervals significantly influenced the thousand-grain weight trait, with the 25-day irrigation interval recording the highest weight of 40.12g, a 40.18% increase compared to the 45-day interval which resulted in the lowest weight of 28.62g.

The dual interventions among the three studied factors showed a significant effect on the thousand-grain weight trait. Specifically, treating the Abaa99 variety with an acid concentration of 1 ml resulted in the highest weight of 40.72g, a 26.97% increase compared to the untreated Adna variety which yielded the lowest weight of 32.07g. Moreover, irrigating the same variety every 25 days resulted in the highest weight of 41.04g, a 50.99% increase compared to the Adna variety irrigated every 45 days which reported the lowest weight of 27.18g. We note a significant effect of treatment with different acid concentrations and varying irrigation intervals on the thousand-grain weight trait, where the treatment with 1 ml acid concentration and irrigation every 35 days demonstrated the highest weight of 43.36g, a 27.35% increase compared to irrigation every 45 days without acid treatment, although it did not significantly differ from the 1 ml concentration and 35-day irrigation interval.

The results in the table indicate a significant effect of the three studied factors on the thousand-grain weight trait. The treatment of the Abaa99 variety with 1 ml acid concentration and irrigation every 25 days resulted in the highest weight of 44.51g, a 73.73% increase compared to the untreated and irrigated every 45 days Adna variety which yielded the lowest weight of 25.62g, albeit it did not significantly differ from treating the Abaa99 variety with a concentration of 1 ml of the acid and irrigated every 35 days. The reason for the grain weight increase when using high concentrations of humic acid is due to enhanced photosynthetic efficiency resulting from increased chlorophyll pigment content and facilitated ion exchange in the soil, making them more available to the plant as a result of using the acid, coupled with the nutrient elements contained in the acid that contribute to increased plant growth and positively reflect on yield components including grain weight. These components include potassium, which plays a crucial role in the formation of starch, sugars, and proteins, their storage, and transportation, thus positively influencing the increase in grain weight (Abu Dhahi & Al-Younis, 1988).

The decrease in thousand-grain weight in plants irrigated every 45 days can be attributed to the lack of necessary water for all vital processes and the deficiency in the nutrients accompanying water absorption. Water directly participates in the photosynthesis process and the production of energy compounds through the splitting of the water molecule by light photons. Hydrogen enters a series of transitional stages, producing energy compounds like ATP and NADH and NADPH (Mohammed, 1985). Approximately 30% of the production deficit results from water deficiency, while 40% of the yield decrease is due to nutrient shortage (Uddin et al., 2016).

"The results delineated in table 4 reveal no significant difference between the two cultivars in terms of individual plant grain yield. However, varying concentrations of humic acid exhibited a substantial influence on the grain yield. Notably, the 1 ml concentration emerged as superior, registering a highest yield of 32.42 grams per plant, an enhancement of 28.60% in comparison to the untreated plants which had a seed yield of 25.21 grams. Moreover, different irrigation intervals significantly affected this trait, with a 25-day interval yielding the highest seed output at 31.96 grams per plant, marking a 37.58% increase compared to a 45-day irrigation cycle, albeit not significantly different from a 35-day interval.

Furthermore, the interactions between the studied factors markedly influenced the grain yield. For instance, the treatment of the Adnah99 cultivar with a 1 ml concentration of the acid resulted in a grain quantity of 33.49 grams, contrasting with the non-treated Aba99 cultivar which had a yield of 24.42 grams. Irrigating both Aba99 and Adnah99 every 25 days facilitated the highest grain yield, recording 31.10 and 32.82 grams respectively, in comparison to every 45 days which resulted in yields of 22.30 and 24.15 grams correspondingly. Nonetheless, these figures did not significantly deviate from the yield when irrigating every 35 days. Moreover, the combination of different concentrations of the acid and varied irrigation intervals profoundly affected the grain yield, with a 1 ml concentration and a 25-day irrigation cycle realizing the highest yield of 35.62 grams, a surge of 65.52% compared to a 45-day interval without acid treatment, although not significantly differing from a treatment involving a 1 ml concentration and a 35-day irrigation cycle.

Table 3: The effect of the cultivars, humic acid (ml) and irrigation intervals (days) on the weight of a thousand grains (grams)."

Table (3) Effects of varieties, humic acid (ml) and irrigation periods (day) in a thousand grains (g)

Effect of varieties	Interaction between varieties and acid	Watering intervals (day)			Humic acid levels (ml)	Categorie
		45	35	25		
36.98a	33.75c	26.30i	36.33e	38.61d	0	IPA99
	36.47bc	29.41h	40.0c	40.0c	0.5	
	40.72a	33.33f	44.33a	44.51a	1	
34.84a	32.07c	25.62g	34.0f	36.60e	0	ADNA99
	33.72c	24.61k	38.54d	38.0d	0.5	
	38.74ab	31.33g	42.40b	42.50b	1	
32.91c	The effect of acid	25.96g	35.17d	37.60c	0	The overlap between acidity
35.09b		27.01f	39.27b	39.0b	0.5	
39.73a		32.33e	43.36a	43.51a	1	

						and irrigation periods
		29.63c	40.22ab	41.04a	IPA99	Overlap between cultivars and irrigation periods
		27.18c	38.31b	39.03ab	ADNA99	
		28.62e	39.44b	40.12a		Irrigation periods

The tripartite interactions of the studied factors also demonstrated a significant influence on grain yield. Notably, the Adnah variety, treated with a 1 ml concentration of humic acid and irrigated every 25 days, distinguished itself with the highest yield amounting to 36.77 grams - a remarkable increase of 78.58% in comparison to the non-acid treated Aba99 variety irrigated every 45 days. This, however, did not show a statistically significant difference when compared to the yield of the same variety treated with a 1 ml concentration and irrigated every 35 days.

The superiority of the 1 ml concentration of humic acid might be attributed to its inherent advantage in aspects such as spike length (Table 1) and the weight of a thousand grains (Table 4), a result of improved soil texture and enhanced water absorption and ion exchange capacities. The availability of water is indeed vital for securing a high yield, as water stress influences germination and the absorption of nutrients from the soil, along with the soil's nutrient content. Additionally, the movement of water from the soil to the plant, facilitated by active physiological processes, coincides with water availability. Water plays a critical role in photosynthesis through the photolysis of water molecules and the incorporation of electrons in a series of transfer stages to produce energy compounds such as ATP and NADPH (Mohammed, 1985).

Table 4 illustrates that the two varieties did not exhibit a significant difference in terms of grain protein content. However, different concentrations of humic acid significantly affected the protein content in the grains. The 1 ml concentration stood out with the highest content, registering at 11.61%, which is an increment of 8.30% compared to plants untreated with the acid. Moreover, varying irrigation intervals also impacted the protein content in the grains, with the highest proportion being observed with an irrigation cycle of every 25 days, achieving 11.55%, a surge of 7.94% compared to plants irrigated every 45 days. This, nevertheless, was not significantly different from a 35-day irrigation interval.

Table (4) Effects of varieties, humic acid (ml) and irrigation periods (day) in grain crop plant-1. GM

Effect of varieties	Interaction between varieties and acid	Watering intervals (day)			Humic acid levels (ml)	Categorie
		45	35	25		
27.67a	24.42d	20.59b	24.0j	28.67f	0	IPA99
	27.23cd	21.10m	30.29d	30.30d	0.5	
	31.36ab	25.22i	34.55b	34.32b	1	
29.54a	26.0d	22.44l	26.0h	29.55e	0	ADNA99
	29.13bc	33.0k	32.23c	32.14c	0.5	
	33.49a	27.0g	36.68a	36.77a	1	
25.21c	The effect of acid	21.52f	25.0e	29.11c	0	The overlap between acidity and irrigation periods
28.18b		22.05f	31.26b	31.22b	0.5	
32.42a		26.11d	35.55a	35.62a	1	
		22.30b	29.61a	31.10a	IPA99	Overlap between cultivars and irrigation periods
		24.15b	31.64a	32.82a	ADNA99	
		23.23b	30.63a	31.96a		Irrigation periods

"The data presented in the table demonstrates that the binary interactions had a significant effect on the grain protein percentage. The Adnah99 variety, treated with 1ml concentration of humic acid, exhibited the highest content reaching 11.74%, an increase of 11.07% compared to the untreated Abaa variety, which had a lower protein percentage of 10.57%. The different irrigation intervals along with the varieties also had a substantial influence on this attribute, where the Adnah99 variety irrigated every 25 days revealed the highest grain protein content at 11.73%, an increase of 9.32% compared to the Abaa99 variety irrigated every 45 days, which registered the lowest percentage at 10.73%. Meanwhile, there was no significant difference observed with the same variety irrigated every 35 days.

Furthermore, the interactions between the acid and the irrigation periods also manifested a significant influence on the grain protein percentage. The treatment with 1ml of acid and irrigation every 25 days featured the highest percentage at 12.0%, a growth of 18.81% compared to the 45-day irrigation interval without acid treatment, which had the lowest percentage of 10.10%. As evident from the table above, the tripartite interaction of the studied factors significantly affected the grain protein percentage. The treatment of the Adnah99 variety and irrigation every 25 days resulted in the highest protein percentage of 12.15%, an increase of 21.3% compared to the untreated same variety irrigated every 30 days, which had a protein percentage of 10.20%.

This elevation in the protein percentage in plants treated with 1 ml concentration of humic acid might be attributed to the acid's role in supplying nutrients, enhancing soil texture, facilitating water absorption, and ion exchange, thus promoting plant growth which in turn reflects positively on both the quantitative and qualitative yield of the plant. Humic acid improves the chemical and physical characteristics of the soil, markedly increases the biological mass, besides providing the plant with essential nutrients and reducing ammonia volatilization in the form of ammonia gas, hence enhancing the efficiency of ammonia assimilation which contains nitrogen, a constituent of protein structure (Muter et al., 2015).

The superiority of the 25-day irrigation periods in protein percentage can be attributed to the fact that water availability leads to the continuity of the carbon assimilation process and the transfer of all materials manufactured from this process to the spikes, significantly reflecting on the qualitative attributes of the grain. Water affects the initial stages of protein formation. Insufficient moisture or increased moisture stress in plant cells results in decreased nitrate reduction activity, leading to ammonia and amino acid deficiencies, consequently decreasing the net rate of protein formation from amino acids consistently (Abduljawad et al., 2007).

Table (4): The influence of varieties, humic acid (ml), and irrigation intervals (days) on the grain protein percentage (%)"

Effect of varieties	Interaction between varieties and acid	Watering intervals (day)			Humic acid levels (ml)	Categori
		45	35	25		
11.10a	10.57c	10.20h	10.70g	10.80g	0	IPA99
	11.27b	11.0f	11.40d	11.40d	0.5	
	11.47ab	11.0f	11.50d	11.90b	1	
11.36a	10.87c	10.0i	11.20e	11.40d	0	ADNA99
	11.47ab	11.00f	11.70c	11.70c	0.5	
	11.74a	11.0f	12.13a	12.0a	1	
10.72c	The effect of acid	10.10a	10.95d	11.10c	0	The overlap between acidity
1.17b		11.0cd	11.55b	11.55b	0.5	
11.61a		11.0cd	11.82a	12.15a	1	

						and irrigation periods
		10.73c	11.20b	11.37b	IPA99	Overlap between cultivars and irrigation periods
		10.67c	11.68a	11.73a	ADNA99	
		10.70b	11.44a	11.55a		Irrigation periods

References:

Abdeljawad, Abdelazim Ahmed; Nemat, Abdelaziz Nour El-Din; & Fahed, Taher Bahjat. (2007). Crop Science: Principles and Foundations. Arab House for Publishing & Distribution, Nasr City, Cairo, Arab Republic of Egypt, 141-218.

Abu Dahhi, Yousef Mohammed, & Mueid Ahmed Al-Younis. (1988). Plant Nutrition Guide. Ministry of Higher Education and Scientific Research, University of Baghdad, College of Agriculture. p. 411.

Al-Abbar, Salam Dhunun Khamil. (2021). Yield Response and its Components in Three Varieties of Wheat (Triticum aestivum L.) to Nitrogen Fertilizer Fractionation and Flag Leaf Removal. Master's thesis, Department of Field Crops, College of Agriculture and Forestry, University of Mosul.

Al-Faris, Abbas Munir; Arslan, Ouedes Bashir; & Qanshaw, Aneya Shafeeq. (2014). The Influence of Different Levels of Irrigation and Auti Fertilizer and Its Addition Timings on Quality Attributes in Durum Wheat (Triticum turgidum L. var. durum). Tishreen University Journal for Studies and Scientific Research - Biological Sciences Series, 36(5), 123-130.

Al-Maamari, Bushra Khalil. (2010). Study of Some Physiological Responses and Mineral Compositions of Local Lentil Plant Under Water Stress and Dusting. Research Journal of the Basic Education College, 9(4), 519-530.

Gomez,B, H, F ; A . Abugalieva; A. Morgounov and I. Cakmak .2010. Phenotypic correlations, G X E interactions and broad sense herit- ability analysis of grain and flour quality characteristics in high latitude spring bread Wheats from Kazakhstan and Siberia. J. Euphytica . 171 (1): 23-38 .

Hashem, Imad Khalil; & Al-Haidari, Hanaa Khudeir. (2012). Response of Some Growth Traits of Bread Wheat to Planting Dates and Irrigation Intervals. Iraqi Journal of Agricultural Sciences, 43(5), 42-51.

Islam,S.T.;Huque,M.Z.;Hasan,M.M.;ABMMM,Kh. 2018. Efeect of Differenr Levels on the Performance of Wheat.Progressive Agriculture.,29(2):99.106.

Khalifa, Khalf Mahmoud; Rahim, Ali Hussein; & Abdelrahman, Ayoub Jum'ah. (2009). The Effect of Nitrogen Fertilizer Fractionation on the Growth and Yield of Three Varieties of Wheat (Triticum aestivum L.). Tikrit University Journal for Agricultural Sciences, 9(2), 109-115.

Khan,M.J;Sarwar,T.;Shahzadi,A.and Malik,A. 2007.Effect of Different Irrigation Schedules on Water use and Yield of Wheat.Sarhad J.Agric.,23(4):1061-1066.

Mohammed, Abdelazim Kazem. (1985). Plant Physiology Science. University Printing Directorate, University of Mosul, Ministry of Higher Education and Scientific Research- Republic of Iraq.

Mohammed, Aliaa Khayoon; & Fawzi, Abdelhussain Kazem. (2017). The Effect of Water Stress on Yield and Its Components in Genetic Compositions of Bread Wheat. Iraqi Journal of Agricultural Sciences, 48(3), 729-738.

Muktamar, Z., Sudjatmiko, S., Fahrurrozi, F., Setyowati, N. and Chozin, M., 2017. Soil chemical improvement under application of liquid organic fertilizer in closed agriculture system. International Journal of Agricultural Technology, 13(7.2):1715-1727.

Muter, O., Limane, B., Strikauska, S. and Klavins, M., 2015. Effect of humic-rich peat extract on plant growth and microbial activity in contaminated soil. Material Science and Applied Chemistry, 32(1).

Ren,H.,Hu,Y.,Yang,G.and Zhang,Y., 2017.Diveregence of compost extract and bio-organic manure effects of lucerne plant and soil.Peer J.5:3775.

Rollin G. S. 2014. Agronomy Wheat Production Handbook. Kansas State Research and Exlention, Manhattan, Kansas., P: 2-7.

SAS/ STAT . (1989). Guide for personal computers. Statistical Analysis system institute . cary , NC Agric. Vol 20 No. 1.

Uddin,N.;Islam,M.A.&Baten,M.A. 2016. Heavy Metal Determination of Brinjal Cultivated in Soil With Wastes.Progresssive Agriculture,27(4):453-465.

Zaboon, Najat Hussein; Baqir, Haider Abdelrazak; & Abdelhassan, Shatha. (2016). The Impact of Potassium Addition Timing and Quantity on the Quality of Bread Wheat Grains and Other Characteristics. Iraqi Journal of Agricultural Sciences, 47(5), 1166-1170.

Karupusamy, S., Mustafa, M. A., Jos, B. M., Dahiya, P., Bhardwaj, R., Kanani, P., & Kumar, A. (2023). Torque control-based induction motor speed control using Anticipating Power Impulse Technique. The International Journal of Advanced Manufacturing Technology, 1-9.

Govindarajan, S., Mustafa, M. A., Kiyosov, S., Duong, N. D., Raju, M. N., & Gola, K. K. (2023). An optimization based feature extraction and machine learning techniques for named entity identification. Optik, 272, 170348.

Sudha, I., Mustafa, M. A., Suguna, R., Karupusamy, S., Ammisetty, V., Shavkatovich, S. N., ... & Kanani, P. (2023). Pulse jamming attack detection using swarm intelligence in wireless sensor networks. Optik, 272, 170251.

Karupusamy, S., Mustafa, M. A., Jos, B. M., Dahiya, P., Bhardwaj, R., Kanani, P., & Kumar, A. (2023). Torque control-based induction motor speed control using Anticipating Power Impulse Technique. The International Journal of Advanced Manufacturing Technology, 1-9.

Govindarajan, S., Mustafa, M. A., Kiyosov, S., Duong, N. D., Raju, M. N., & Gola, K. K. (2023). An optimization based feature extraction and machine learning techniques for named entity identification. Optik, 272, 170348.

Sudha, I., Mustafa, M. A., Suguna, R., Karupusamy, S., Ammisetty, V., Shavkatovich, S. N., ... & Kanani, P. (2023). Pulse jamming attack detection using swarm intelligence in wireless sensor networks. Optik, 272, 170251.

Hassan, J. A., & Rasheed, M. K. (2022, November). Synthesis and characterization of some benzimidazole derivatives from 4-methyl ortho-phenylene diamine and evaluating their effectiveness against bacteria and fungi. In AIP Conference Proceedings (Vol. 2394, No. 1). AIP Publishing.

Nijris, O. N., Khaleel, Z. I., Hamady, S. Y., & Mustafa, M. A. (2020). The effectiveness of Aqueous Extract of Grape Seeds Vitis vinifera as an antibiotic for some microorganisms and its Protective Role Histology for Liver, Kidney in Mice. Indian Journal of Forensic Medicine & Toxicology, 14(2), 1838-1845.

Mustafa, H. A., Majid, H. H., Abdulqader, A. T., Mustafa, M. A., & Salih, A. A. (2019). Study On Some Physiological, Biochemical And Hormonal Parameters Of Seminal Fluid Of Infertile Men. Biochem. Cell. Arch, 19(Supplement 1), 1943-1947.

Fadhil, K. B., Majeed, M. A. A., & Mustafa, M. A. (2019). Electronic study of fresh enzyme complexes of antifungal drugs-P450 and Aspergillus kojic acid biosynthesis. W: w saccharose flavus: fructose as a substratum. Annals of Tropical Medicine and Health, 22, 65-72.

Abdulazeez, M., Hussein, A. A., Hamdi, A. Q., & Mustafa, M. A. (2020). Estimate the Complications That Resulting from Delayed Management of Dental Trauma in Tikrit City. Journal of Cardiovascular Disease Research, 11(2), 80-82.

Hama Hasan, T. A., Erzaiq, Z. S., Khalaf, T. M., & Mustafa, M. A. (2020). Effect of Equisetum Arvense Phenolic Extract in Treatment of Entamoeba Histolytica Infection. Systematic Reviews in Pharmacy, 11(11).

Hama Hasan, T. A., Erzaiq, Z. S., Khalaf, T. M., & Mustafa, M. A. (2020). Effect of Equisetum Arvense Phenolic Extract in Treatment of Entamoeba Histolytica Infection. Systematic Reviews in Pharmacy, 11(11).

Nijris, O. N., Khaleel, Z. I., Hamady, S. Y., & Mustafa, M. A. (2020). The effectiveness of Aqueous Extract of Grape Seeds Vitis vinifera as an antibiotic for some microorganisms and its Protective Role Histology for Liver, Kidney in Mice. Indian Journal of Forensic Medicine & Toxicology, 14(2), 1838-1845.

Ali, A., Jassim, A.F., Muhsin, S.N., & Mustafa, M.A. (2020). Study of Lycium Shawii Phenolic Compounds in Treatment of Hyperlipidemia. Journal of cardiovascular disease research, 11, 196-199.

Ibrahim, H. M., Jumaah, L. F., Khalaf, S. A., & Mustafa, M. A. (2021). KNOWLEDGE AND PRACTICE OF BREASTFEEDING AND WEANING IN MOTHERS LIVES SAMARRA CITY, IRAQ. Biochemical & Cellular Archives, 21.

Cite this article as: **Hareer Abd Ameen (2023).**
"The Impact of Varieties and Treatment with Humic Acid on Irrigation Intervals, Yield Characteristics, and Protein Percentage in Two Wheat Varieties: Aba 99 and Adana 99"
African Journal of Biological Sciences. 5(3), 92-106. doi: 10.48047/AFJBS.5.3.2023.92-106