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Effect of Plant Density on the Physiological and Quality Trait for Different Varieties of Wheat (*Triticum aesitivum* L.)

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Abstract. A factorial experiment was carried out in the experimental field of the Ankawa Research Center in Erbil Governorate, during the spring season of 2023 to know the effect of plant density on the morphological characteristics of different varieties of wheat. The randomized complete block design (RCBD) was used with three replicates, where three varieties of wheat were planted: Adana99, Hawler2, Hawler4, and three levels of plant or seed densities (450, 400, 350) m^2. The results showed significant differences between the average interference of plant density with wheat varieties for the studied characteristics, as the average overlap between the density exceeded (400) plants. m^2 and the Hawler2 variety in terms of significance and in terms of being the highest values of the averages in all the characteristics studied over the rest of the average overlap between densities and varieties. Returning to the average interaction between the density (400) plants. m^2 and class Hawler2 The average overlap values were (11.36) for chlorophyll content (A), (3.23) for chlorophyll content (B), (5.22) for carotene content, (206.05) for protein content in dry leaves and stems, (205.08) for proline content in leaves, (4.24) for ascorbic acid content, (42.77) for soluble sugars content, (80.73) for carbohydrate content, (4.99) for phosphorus percentage, and (36.15) for nitrogen percentage. And (15.61) for the percentage of potassium, (10.16) for the percentage of calcium, and (3.26) for the percentage of magnesium.

Keywords. RCBD, Seedling, Crop, Overlap.

1. Introduction

Triticum aestivum L. bread wheat is the most important cereal crop in the world and covers very large areas, as it ranks first in terms of cultivated areas globally, and provides about 70% of the world's population's food, and bread wheat represents the main material in providing the people's sustenance as it is the main food for the Iraqi individual and has strategic importance in achieving food security (Al-Saadoun et al., 2022).
The world's harvested area is about 215.9 million hectares, with a productivity of about 765 million tons (FAO, 2019). The selection of the appropriate variety and determining the seeding rate used in agriculture is one of the most important things that must be taken into account to obtain a high yield of good quality, as it is a determining factor for plants and has the greatest impact on most traits (Saudi et al, 2016) (Al-Hassan et al, 2014).

The quantity and rates of sowing vary according to the cultivated areas and according to the planting dates (Del-Cima and W. K Anderson, 2004). Previous studies have found differences in the response of different varieties of wheat to different plant densities (Daoud, 1999) (Singh and Stoskopf, 1971).
The seeding rate affects wheat growth characteristics, and morphological and physiological characteristics (Ansari et al., 2006). The seeding rate is one of the most important factors affecting most morphological and physiological growth characteristics, which is reflected in the quality and quality of yield (Saudi et al., 2016). (Wajid et al. 2004) pointed out that the seeding rate plays an important role in influencing seed yield, quality, and quality through its effect on the density of growing plants, which is reflected in the number and qualities of seeds.
In a previous study conducted to find out the effect of plant densities and seeding rates on the yield and quality of grains, it was found that the different quantities of seeds have a significant effect on the characteristics of seeds and the percentage of protein in them, as the percentage of protein increased according to the increase in the number of seeds (Neil et al., 1979).
Protein and carbohydrate ratios are among the most specific cereal traits affected by different seeding rates (Caglar et al., 2011) (Olaru and Matei, 2008).
As a result of the above and the absence of many recent studies in Iraq dealing with the subject of the effect of different plant densities on the physiological characteristics and quality of seeds, this research was carried out, which aims to determine the best seeding rate through which seeds characterized by physiological and qualitative qualities can be produced desirable compared to different seeding rates.

1.1. Literature Review

The wheat crop (*Triticum aestivum* L.) belonging to the family Gramineae is an important cereal crop on the World level, in terms of food and economic as well as in terms of production Space, the most important staple food for about 36 percent of the world's population, Being an important source of carbohydrates, starch, protein, and vitamins. and provide Spelt is 55% of carbohydrates and 20% of food calories consumed globally (Younis et al., 1987).
The global crop area is 218.5 million hectares, production of 713.18 million tons, and harvested area of Iraq (9464) is One thousand dunums and production (4234) tons for 2021 (FAO, 2021). The wheat crop because of its strategic role in food security lies in that Its grains are used to produce the loaf of bread that is indispensable for most of the peoples of the world (Omari, 2003).
Iraq is considered and many taxonomists believe that it is one of the original habitats for the emergence of wheat and that it is one of the countries where the factors for the success of its cultivation are available, but its productivity is still below the required level. The problem of low production in Iraq in particular is due to the fluctuation of production every year and the absence of High-yielding varieties and investigating and studying possible scientific means that would raise the productivity of wheat and improve its quality (Shawa, 2001).
According to (Lazaar, 1995), a grain of wheat chemically consists of:
Glycoside: plays an important role in hydrocarbon nutrition and interferes with proteins to give color, smell, and taste. It is represented by starch, which represents 02% to 10% of the whole wheat seed and contributes to the absorption capacity of flour for water.
Carbohydrate: Consists of Raffinose, Glucose, and Livosine and constitutes 2% to 33% of the whole seed.
Fat: localized in the sheaths and fetus.
Vitamins: Vitamins E, C, and B, these vitamins change their distribution according to soil and climate.
Salts: In seed engineering, the most important salts are Na K Mg P.
Proteins: According to (Osborne, 1970) wheat parchment contains many proteins.
Chlorophyll is one of the most important plant pigments in chloroplasts and has the ability to absorb visible light and conversion light energy from solar radiation into chemical energy used in the production of energy-rich compounds that contribute to the construction of organic materials (Hopkins, 2003).

2. Methodology

The seeds of the soft wheat varieties *Triticum aestivum* L. were planted on 30/11/2022 in the field of the Ankawa Research Center in Erbil Governorate, where the land was tilled before planting and the field land was divided into blocks with a length of 3 m and a width of 1.5 m and an area of 4.5 m 2 for each block and each experimental unit included 8 lines, and the distance between one block and another 1 m and between the repeaters 2 m and the total number of blocks 27 blocks, After preparing the land, three different planting densities were determined (350, 400, 450) plants per slab and three replicates of three different varieties of soft wheat (Hawler4, Hawler2, Adana99). After that, the seeds were sterilized with a fungicide Daxel before planting them, and when planting, DAP fertilizer consisting of N and P was added in different proportions, namely N 16% and P 46% with the seeds during planting. The seeds were distributed at different densities and planted in slabs randomly according to the design of the complete random sectors RCBD with two factors. The rainwater falling in the area was completely relied on for irrigation. Various and multiple measurements were taken physiologically and qualitatively over the different stages of plant growth, which included (chlorophyll A, chlorophyll B, carotene, protein content in dry leaves and stems, proline content in green leaves, ascorbic acid in green leaves, soluble sugars, carbohydrates, percentage of phosphorus, nitrogen, potassium, calcium, and magnesium until the plant is harvested.

Table 1. Physical and Chemical Properties of Experimental Field Soil at Ankawa Research Center in Erbil Governorate.

No.	Soil Sample	Particle size distribution			Texture Class	pH	EC	O.M	Total (N)	(P)	(K)
		Sand %	Silt %	Clay %	Silty clay	1:2	dSm^{-1}	%		ppm	
		g kg^{-1} soil									
1	Ankawast.	19	43	38		7.82	0.3	0.92	0.11	6.3	196

2.1. Studied Qualities

2.1.1. Chlorophyll Content (A, B)

The chlorophyll content (A, B) was estimated according to the method (Rocha, 1993) by taking a plant sample weighing 1 g of fresh leaves was washed well, cleaned of dust, and impurities, and air dried for two minutes, and crushed by mortar with 5 ml Aston to obtain plant sap and repeated the process 3 times until the color of the sample reached the brownish color and then filtered the sample to obtain the plant extract. The absorbability of chlorophyll A at 666 nm and chlorophyll B at 653 nm were measured by the Spectrophotometer and then the chlorophyll A and B content was calculated by applying the following equations mentioned (Dere et al., 1998):

$$C(A) = 15.65(A666) - 7.340(A653)$$

$$C(B) = 27.05(A653) - 11.21(A666)$$

2.1.2. Carotene Content

The carotene content was estimated according to the method used by (A.R. Davis 2007) by taking a weight of 200 mg of the plant sample and crushing with 20 ml of acetone at a concentration of 80% using a ceramic mortar and centrifuging the solution at 3000 rpm for five minutes. The filtrate was placed in a volumetric vial and completed to 20 ml by adding acetone at a concentration of 80%. The absorption reading was calculated by the Spectrophotometer at a wavelength of 480 nm and the amount of carotene was calculated according to the following equation:

$$\text{Total Carotene} = \text{optical density at Wavelength (480) x Total solution volume x } 1000\ 2500 \times 100$$

2.1.3. Protein Content in Dry Leaves and Stems

The protein content of both dry leaves and stems was estimated using the Kjeldahl Method for Crude Protein. 0.2 mg of the fully ground sample was weighed and 5 ml of concentrated sulfuric acid was added and 2 ml of perchloric acid was added as an oxidizing agent. The sample was gradually heated

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to a temperature of 450°C and when the acid boiled, the color changed from black to red, pale red, and colorless. The sample was diluted by adding distilled water and distilled using Kjeldahl after adding sodium hydroxide to make the medium basic and thus the ammonium salts were released and converted into methane gas. Methane is received by a mixture of dye and then immediately extorted with concentrated acid with a caliber 0.5-0.1 molar to calculate the nitrogen content and then the crude protein ratio is calculated (AOAC, 1980). The percentage of protein in the sample was calculated from the following equation (Apente, 2002):

$$\text{Total nitrogen} \times 5.7$$

2.1.4. The Percentage of Proline in Green Leaves

The content of proline acid was estimated according to the method of (Hyun et al. 2003) modified by (Bates et al. 1973), where samples weighing 100 mg were taken and placed in a mortar and 3 to 5 ml of an aqueous solution of Sulfo Salicylic Acid at a concentration of 3% were added and the samples were crushed well and placed in a centrifuge at a speed of 3300 rpm for 5 minutes. The filtrate was then poured into a glass tube and mixed with 3 ml of ice acetic acid and 3 ml of ninhydrin acid and the sample was placed in a boiling water bath for half an hour. The sample was then extracted and cooled until the red color resulting from the interaction of proline with ninhydrin, which was separated by adding 5 ml of toluene, and then the absorbance was measured by a spectrophotometer at a wavelength of 520 nm. The proline ratio was calculated by preparing a standard proline curve to determine the amount of proline at each absorption.

2.1.5. Ascorbic Acid in Green Leaves

The method of determination of ascorbic acid is based on oxidative and reduction redox processes, where 10 g of sample is drawn 5 ml of starch solution at a concentration of 1%, and 100 ml of water is added. In it, ascorbic acid is oxidized to dehydrogenated ascorbic acid, and the iodine formed immediately is reduced to iodide as long as there is ascorbic acid, and when all the ascorbic acid in the sample is oxidized, the excess iodine reacts with the starch used as a guide, giving the blue iodine complex of origin, and the titration ends at this point is an endpoint, and this is inferred when the solution turns blue. The reaction flask nozzle must be covered because the ascorbic solution is oxidized upon contact with atmospheric air oxygen (Adnan, 2015). The percentage of ascorbic acid is calculated by the following formula (Alkherraz et al., 2019).

$$1 \text{ ml of } I2 = 176.14 / 1000 \text{ x } 10 \times 2 = \text{GM of ascorbic acid}$$

2.1.6. Soluble Sugars

Sugars were estimated by phenol method according to (Dubois et al. 1956), where 100 mg of plant samples were taken and immersed in 3 ml of ethanol at a concentration of 80% for 48 hours in a dark place. The sample was placed in an incubator at a temperature of 80 °C to evaporate the alcohol and then 20 ml of distilled water was added to it. Put 1 ml of the extract in a glass tube and add 1 ml of phenol at a concentration of 5% and 5 ml of concentrated sulfuric acid, taking into account the descent of acid on the extract directly and not touching the walls of the tube to obtain a good reaction. The sample is placed in a shaker until the color is homogeneous. Then the sample is placed in an incubator at a temperature of 85 °C and then add 20 ml of distilled water. The absorbance was then measured by a Spectrophotometer at a wavelength of 490 nm. The concentration of dissolved sugars in the sample was analyzed using a standard sugar curve.

2.2. Carbohydrates

Carbohydrates were estimated using the phenol-sulfuric acid method by measuring visible density using an optical spectrometer at a wavelength of 499 nm (Herbert et al., 1971).

2.3. Percentage of Phosphorus

Phosphorus Determination Using Ammonium and Ascorbic Acid Molybdate Using a Spectrophotometer at a wavelength of 882 nm (Page, 1982).

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2.4. Percentage of Nitrogen

It was estimated according to the Kjeldahl Method for Crude Protein using the Micro Kjeldahl described earlier (Black, 1965) and was estimated in digested plant samples as explained by (Haynes, 1980).

2.5. Potassium Percentage

The method proposed by (Haynes 1980) was followed in estimating the percentage of potassium in plant samples using a flame photometer, where the absorbed potassium was calculated through the following equation:

Percentage of potassium = potassium absorbed / dry weight of the sample

2.6. Percentage of Calcium

Calcium was determined by titration, where the murexide and EBT evidence were used for the determination of calcium as illustrated by (Black 1965).

2.7. Magnesium Percentage

Magnesium was determined by titration, where the murexide and EBT evidence were used to determine magnesium as illustrated by (Black 1965).

2.8. Statistical Analysis

The data obtained for growth characteristics and components of the obtained statistically were analyzed according to the method of analysis of variance for the design of R.C.B.D by the experiment of its two factors and the least significant difference test (LSD) was used to compare the arithmetic averages at the level of probability 5% (Destro et al, 2001).

3. Results and Discussions

3.1. Chlorophyll Content (a, b)

The results of Table (2) on the effect of interaction between plant densities and varieties on the physiological characteristics of chlorophyll content (a, b) showed that the average interaction between the densities exceeded 400 plants. 1 m^2 and the variety Hawler2 significantly in the content of chlorophyll (A, B) on the rest of the average interaction between the different densities and the rest of the varieties, where it gave the highest average in the content of chlorophyll (A) and reached (11.36) and the highest average in the content of chlorophyll (B) and amounted to (3.23). The lowest average chlorophyll content (A) was (8.26) and the lowest average chlorophyll content (B) was (1.84), both of which overlapped plant density (350) plants. 1 m^2 and the variety Hawler4. The increased chlorophyll content (A, B) is attributed to plant density (400) plants. 1 m^2 to low chlorophyll content at high density (450) plants. 1 m^2 as a result of competition between plants for water and chlorophyll constituent nutrients and this result is consistent with his findings (Subedi and Ma, 2005). While it increased the plant density (350) plants. 1 m^2 as a result of the nature of the genetic varieties to adapt to the higher density levels, where the varieties gave a higher chlorophyll content at the density level of (400) plants. 1 m^2 and (450) plants. 1 m^2 of the level of (350) plants. 1 m^2 the overlap between the two experimental factors showed a significant effect on the total chlorophyll content of the leaves and these results are consistent with the findings of (Keyvan 2010), (Al-Fahdawi 2019), and (Ali and Hamza 2013).

3.2. Carotene Content

The results of Table (2) on the effect of interaction between plant densities and varieties on the physiological characteristics of the carotene content trait showed that the average interaction between the density is more than 400 plants. 1 m 2 and the variety Hawler2 significantly in the content of carotene on the rest of the average overlap between the different densities and the rest of the varieties, where it gave the highest average in the content of carotene and amounted to (5.22) while the lowest

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average in the content of carotene and amounted to (3.44) of the overlap between plant density (350) plants. 1 m^2 and the variety Hawler4.

3.2.1. Protein Content in Dry Leaves and Stems

The results of Table (2) on the effect of interaction between plant densities and varieties on the physiological characteristics of the protein content trait in dry leaves and stems exceeded the average density interaction of 400 plants. 1 m^2 and the variety Hawler2 significantly in the protein content on the rest of the average overlap between the different densities and the rest of the varieties, where it gave the highest average in protein content and amounted to (206.05) while the lowest average in protein content amounted to (149.34) of the overlap between plant density (350) plants. 1 m^2 and the variety Hawler4. Various studies have indicated that the protein content in dry leaves and stems is affected by seeding rates (Jedel and Helm, 1995), (NoworoLink, 2010). Previous studies have indicated that the superiority of Hawler2 in protein content over other taxa may be due to genetic differences between the taxa under study and thus the reflection of these differences in protein content (Balouchi et al., 2005), (EL-Banna et al., 2011), (NoworoLink, 2010), (O'Denovan et al., 2011), (Shafi et al., 2011).

3.3. Proline Content in Green Leaves

The importance of proline lies in the protection of cell membranes and proteins from high concentrations of metal ions and their negative effects on leaves (Santarius, 1992). They play an important role in the occurrence of various physiological processes such as cell division and elongation and increase of green leaf space, which is the active part in photosynthesis and the manufacture and accumulation of dry matter in plants (Al-Khateeb, 2002). The plant's ability to make and accumulate proline is one of the physiological processes of resisting and tolerating environmental stress such as high temperatures (Salman and Sadeq, 2017). The results of Table (2) on the effect of interaction between plant densities and varieties on the physiological characteristics of the proline content characteristic in dry leaves and stems exceeded the average interaction between the density of 400 plants. 1 m^2 and the variety Hawler2 significantly in the content of proline on the rest of the average overlap between the different densities and the rest of the varieties, where it gave the highest average in the content of proline and amounted to (205.08) while the lowest average in the content of proline amounted to (176.2) of the overlap between plant density (350) plants. 1 m^2 and the variety Hawler4. The reason for the existence of significant differences in the content of proline between varieties is due to the difference in the genetic structure among them, as these results agreed with the findings of (Johari-Pirevatlou et al. 2010) in their study of the wheat plant, where the synthesis of proline in wheat varieties varies according to the genetic structure of the variety.

3.4. Ascorbic Acid in Green Leaves

The results of the statistical analysis of the characteristic of ascorbic acid in green leaves indicate that there are significant differences between the two factors of the study and the overlap between them, as the results of Table (2) on the effect of the interaction between plant densities and varieties on the physiological characteristics of ascorbic acid trait in green leaves indicated that there are no significant differences between the average interaction between the density of 400 plants. 1 m^2 and the variety Hawler2 and the rest of the average overlap between the different densities and the rest of the varieties except for the overlap between the plant density (350) plants. 1 m^2 and the variety Hawler4, while the average overlap between the plant density did not differ (350) plants. 1 m^2 and the Hawler4 variety is significant with the rest of the interactions. The highest average ascorbic acid trait in green leaves was among the density of 400 plants. 1 m^2 and the variety Hawler2 reached (4.24) while the lowest average in the characteristic of ascorbic acid in green leaves reached (4.05) of the overlap between plant density (350) plants. 1 m^2 and the variety Hawler4.

3.5. Soluble Sugars

The results of the statistical analysis of the characteristic of soluble sugars confirmed the existence of significant differences between the two factors of the study and the overlap between them, as the results of Table (2) on the effect of the interaction between plant densities and varieties on the physiological characteristics of the soluble sugars content attribute exceeded the average interaction between the density of 400 plants. 1 m^2 and the variety Hawler2 significantly in the content of soluble sugars on the rest of the average interaction between the different densities and the rest of the varieties, where he gave the highest average in the content of soluble sugars and amounted to (42.77) while the lowest average in the content of soluble sugars amounted to (32.83) of the overlap between the plant density (450) plants. 1 m^2 and the variety Hawler4.

3.6. Carbohydrates

The results of the statistical analysis of the carbohydrate content characteristic indicate that there are significant differences between the two factors of the study and the overlap between them, as the results of Table (2) on the effect of the interaction between plant densities and varieties on the physiological characteristics of the carbohydrate content trait exceed the average overlap between the density of 400 plants. 1 m2 and the Hawler2 variety significantly in the carbohydrate content on the average overlap between plant density (450) plants. 1 m^2 and varieties Adana99 and Hawler4 and the overlap between plant density (350) plants. 1 m^2 and the variety Hawler4. There were no significant differences in the average overlap between plant density (400) plants. 1 m^2 and the Hawler2 variety with the rest of the average overlap between the different densities and the rest of the varieties Where the average overlap between plant density (400) plants. 1 m^2 and the variety Hawler2 has the highest average carbohydrate content and reached (80.73) while the lowest average in carbohydrate content reached (64.05) because of the overlap between plant density (450) plants. 1 m^2 and the variety Adana99. The reason for the significant differences in carbohydrate content between the varieties is due to the difference in the genetic makeup between them, as these results agree with the findings of (Veselinka et al. 2014).

3.7. Percentage of Phosphorus

Phosphorus is a very important component during flowering and has been positively associated with cereal wheat yield (Manske et al., 2001). Deficiency also causes a decrease in the number of branches in wheat and a decrease in plant length (Reuter et al., 1997). The results of the statistical analysis of the percentage characteristic of phosphorus showed that there are significant differences between the two factors of the study and the overlap between them, as the results of Table (2) on the effect of the interaction between plant densities and varieties on the physiological characteristics of the percentage characteristic of phosphorus exceeds the average overlap between the density of 400 plants. 1 m^2 and the variety Hawler2 significantly in the percentage of phosphorus on the rest of the average overlap between the different densities and the rest of the varieties, where it gave the highest average in the percentage of phosphorus and amounted to (4.99) while the lowest average in the percentage of phosphorus and reached (1.32) of the overlap between the plant density (450) plants. 1 m^2 and the variety Adana99.

3.8. Percentage of Nitrogen

Nitrogen is one of the most important elements involved in the synthesis of amino acids, which is the cornerstone of protein construction (Heldt, 2005). The results of the statistical analysis of the percentage characteristic of nitrogen showed that there are significant differences between the two factors of the study and the interaction between them, as the results of Table (2) on the effect of interaction between plant densities and varieties on the physiological characteristics of the percentage characteristic of nitrogen percentage exceeds the average interaction between the density of 400 plants. 1 m^2 and the Hawler2 variety significantly in the percentage of nitrogen on the rest of the average overlap between the different densities and the rest of the varieties, where it gave the highest average in the percentage of nitrogen and reached (36.15) while the lowest average in the percentage of nitrogen amounted to (26.2) of the overlap between plant density (350) plants. 1 m^2 and the variety Hawler4. The reason for the existence of significant differences in carbohydrate content between varieties is due to the difference in genetic makeup among them, as these results agree with the findings of (Ahmed 2009), (Ottman et al. 2000), and (Noulas 2002). When observing the results of

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Table (2), we find a positive correlation between the percentage of nitrogen and the content of chlorophyll (A, B), and this is consistent with the study that indicated that the increase in nitrogen increases the concentration of chlorophyll pigment in the leaves, maintains their vitality and delays their aging (AL-Baddrani and AL-Romy, 2013).

3.9. Potassium Percentage

Potassium is one of the important elements of the plant for its important role in the growth and its relationship to many vital activities within the plant, most notably its importance for the process of photosynthesis, the transfer of its products, the formation of proteins and carbohydrates, the absorption of water, nutrients and many processes (Tisdale et al., 1997). The results of the statistical analysis of the percentage characteristic of potassium showed that there are significant differences between the two factors of the study and the interaction between them, as the results of Table (2) on the effect of the interaction between plant densities and varieties on the physiological characteristics of the percentage of potassium attribute exceeds the average interaction between the density of 400 plants. 1 m^2 and the variety Hawler2 significantly in the percentage of potassium on the rest of the average overlap between the different densities and the rest of the varieties, where it gave the highest average in the percentage of potassium and reached (15.61) while the lowest average in the percentage of potassium amounted to (8.07) of the overlap between the plant density (450) plants. 1 m^2 and the variety Hawler4.

3.10. Percentage of Calcium

The results of the statistical analysis of the percentage characteristic of calcium showed that there are significant differences between the two factors of the study and the overlap between them, as the results of Table (2) on the effect of the interaction between plant densities and varieties on the physiological characteristics of the percentage of calcium attribute exceeds the average interaction between the density 400 plants. 1 m^2 and the variety Hawler2 significantly in the percentage of calcium on the rest of the average overlap between the different densities and the rest of the varieties, where it gave the highest average in the percentage of calcium and reached (10.16) while the lowest average in the percentage of calcium and reached (5.15) of the overlap between the plant density (450) plants. 1 m^2 and the variety Hawler4.

3.11. Magnesium Percentage

The results of the statistical analysis of the percentage of magnesium characteristics showed that there are significant differences between the two factors of the study and the overlap between them, as the results of Table (2) on the effect of the interaction between plant densities and varieties on the physiological characteristics of the percentage of magnesium attribute exceeded the average overlap between the density of 400 plants. 1 m^2 and the Hawler2 variety significantly in the percentage of magnesium on the rest of the average overlap between the different densities and the rest of the varieties, where it gave the highest average in the percentage of magnesium and amounted to (3.26) while the lowest average in the percentage of magnesium amounted to (1.67) of the overlap between plant density (450) plants. 1 m^2 and the variety Hawler4.

Table 2. Effect of Overlap between Plant Densities and Wheat Varieties on Physiological Traits.

Den per 1m²	**Var**	**C_A**	**C_B**	**Caroten**	**protein in dry leaf and stem**	**proline in green leaves**	**Ascorbic acid in green leaves**	**sugar**	**Carbohydrate**	**P %**	**N %**	**K %**	**CA %**	**Mn %**
450 a	A99	9.65 d	2.23 cd	3.73 cde	170.25 e	192.32 d	4.15 ab	36.09 d	64.05 d	2.64 d	29.87 e	11.91 d	7.11 de	2.03 cd
	H2	10.5 b	2.57 b	4.17 b	196.13 b	203.01 ab	4.2 ab	41.11 b	78.76 ab	4.08 b	34.41 b	14.66 b	9.33 b	2.95 b
	H4	8.63	1.9	3.68	153.5	178.0	4.25	32.8	69.7	1.74	26.9	8.07	5.76	1.89

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Den per 1m^2	Var	C_A	C_B	Caro ten	protein in dry leaf and stem	proline in green leaves	Ascor bic acid in green	sugar	Carbo hydrate	P %	N %	K %	CA %	Mn %
		e	3 ef	de	h	2 fg	a	3 e	4 bcd	f	3 h	h	f	de
400 b	A99	9.92 c	2.46 bc	4.21 b	177.15 d	199.29 c	4.17 ab	38.26 c	76.68 ab	3.26 c	31.08 d	13.13 c	8.49 c	2.25 c
	H2	11.36 a	3.23 a	5.22 a	206.05 a	205.08 a	4.24 a	42.77 a	80.73 a	4.99 a	36.15 a	15.61 a	10.16 a	3.26 a
	H4	9.75 cd	2.21 de	4.1 bc	161.19 g	179.25 f	4.1 ab	35.54 d	73.28 abcd	2.14 e	28.28 g	10.05 f	6.52 e	1.87 de
350 c	A99	8.44 ef	1.95 ef	3.53 e	165.87 f	187.29 e	4.12 ab	36.14 d	72.02 abcd	2.86 d	29.1 f	11.03 e	7.58 d	1.89 de
	H2	9.79 cd	2.37 bc	3.96 bcd	189.63 c	202.25 b	4.19 ab	39.62 c	77.87 ab	3.77 b	33.27 c	14.38 b	8.9 bc	2.75 b
	H4	8.26 f	1.84 f	3.44 e	149.34 i	176.2 g	4.05 b	33.37 e	67.63 cd	1.32 g	26.2 i	8.95 g	5.15 g	1.67 e

Table 3. Correlation values for the studied traits by the effect of overlap between plant densities and varieties.

	Ch a	Ch b	Carotene	protein in dry leaf and stem	proline in green leaves	acid in green	Soluble sugars	Carbo hydrate	P %	N %	K %	Ca %	Mn %
Ch a	1												
Ch b	.936**	1											
Carotene	.898**	.917**	1										
protein in dry leaf and stem	.89**	.887**	.786**	1									
proline in green leaves	.803**	.797**	.656**	.951**	1								
Ascorbic acid in green leaves gm	.348	.3	.306	.345	.332	1							
Soluble sugars	.886**	.872**	.795**	.984**	.934**	.339	1						
Carbo hydrate	.548**	.507**	.635**	.605**	.552**	.228	.649**	1					
P %	.856**	.879**	.793**	.985**	.942**	.336	.971**	.608**	1				

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	Ch a	Ch b	Carotene	protein in dry leaf and stem	proline in green leaves	acid in green	Soluble sugars	Carbo hydrate	P %	N %	K %	Ca %	Mn %
N %	.89**	.887**	.786**	1.0**	.951**	.345	.984**	.605**	.985**	1			
K %	.845**	.837**	.71**	.971**	.937**	.277	.972**	.565**	.956**	.971**	1		
Ca %	.839**	.853**	.757**	.972**	.958**	.335	.97**	.622**	.986**	.972**	.963**	1	
Mn %	.871**	.873**	.793**	.976**	.897**	.347	.96**	.611**	.949**	.976**	.925**	.925**	1

Conclusion

We conclude that the (400) plants. m^2 density gave the best results when interfered with different wheat varieties. The variety Hawler2 outperformed the rest of the varieties in most of the studied qualities by overlapping with all levels of density.

Therefore, we recommend adopting the density (400) plants. m^2 and variety Hawler2 and the overlap between them.

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