Effect of planting date and bio fertilizer levels on growth and yield of bread wheat(*Triticum aestivum* L.)

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Abstract

A field experiment was carried out during the winter season 2022-2023 in the Field Crops Department College of Agriculture in order to improve the growth efficiency and yield of bread wheat by the influence of the planting date of bio fertilization. A complete randomized plot design was used with a split plot arrangement. The main factor included planting dates, while the secondary factor included levels of bio fertilizer. The results showed that the sowing dates did not differ between them in most of the studied traits, except for the characteristic of chlorophyll content, the length of the spike and the number of grains in the spike. The results also showed that there was a significant difference between the levels of bio fertilizer, as the level 6 kg ha^{-1}.excelled in giving the highest averages for the studied traits, as it gave the highest average grain yield of 2.71 ton ha^{-1}.and the highest biological yield reached 7087 ton ha^{-1}.. The results also showed that there was an overlap. Significant between sowing dates and bio fertilizer levels, as the overlap treatment of date 11-15 and 6 kg ha^{-1}.of manure achieved the highest mean of the number of tillers, spike length, weight of 1000 seeds and biological yield, which amounted to 7099 ton ha^{-1}., while the treatment of overlap date 10-12 with 6 kg ha^{-1}.has the highest average of plant height, flag leaf area, chlorophyll content, number of spikes, number of grains per ear, and grain yield which reached 2081 ton ha^{-1}.

Introduction

The wheat crop (*Triticum aestivum* L.) is one of the most important small grain crops in the world because of its strategic role in achieving food security. Which made the wheat crop occupy the first place in the list of consumer food commodities, as wheat grains provide the adult with more than 25% of the protein need and more than 50% of his energy need(3). The importance of wheat grains is due to wheat gluten, which is one of the most important grain proteins, which gives preference in quality bread (15). The process of seed formation includes a series of developmental stages beginning with fertilization and accumulation of nutrients and ending with seed desiccation and dormancy. Each of these stages includes a change in the morphological and physiological development of the seed, which can determine the vitality of the latent seed and its ability to perform and regrow again (10). The study of environmental factors and the control and management of soil and crop service processes has a major and essential role in understanding the performance of the seed under these influences, which leads to understanding the variation that can arise for seeds during plant growth to reach high vitality and quality seeds (17). The date of planting wheat varies according to its type; Where winter wheat is sown in the fall, it grows until early winter and then goes into hibernation, warm temperatures in spring stimulate new growth of wheat, while spring wheat is sown in spring, and it ripens in mid to late summer, and this type of wheat can To withstand dry weather more than winter wheat But it grows at a low altitude (5). Bio fertilizers are natural preparations that contain one or more types of beneficial

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microorganisms that are not genetically modified and that do not contain any pesticides or harmful chemicals. nutrients on an ongoing basis, which makes them somewhat safe if ideal conditions are provided for their growth to cover the needs of plants treated with them, and thus contribute to reducing environmental pollution and are relatively cheap food sources as alternatives to chemical fertilizers (6). Bio fertilizers are not just like mineral fertilizers that are added to the soil, but also help in the preparation of nutrients through various natural processes in the soil and increase the plant's ability to resist diseases. This study aims to know the effect of planting dates and bio fertilizers and the interaction between them on the growth and yield of wheat.

Mmaterials and methods

A field experiment was carried out during the winter season 2022_2023 in Field Crops Department College of Agriculture, with the aim of improving the growth efficiency and yield of bread wheat by the influence of planting date and levels of bio fertilizer, using complete randomized plot design according to split plot arrangement. The main factor included planting dates, while the secondary factor included Levels of bio-fertilizer were added at the germination stage.

Experimental design and factors.

The experiment designs used complete randomized plot design (RCBD) according to the split plot experiment with three replications. The study factors were the first factor: planting dates.

The first date is 15/11/2022 T1

The second date is 10/12/2022 T2

The second factor: bio fertilizer levels: (0, 3, 6 kg h^{-1})

Components of bio fertilizer: Bacteria and fungi 10%, humic acid 60%, seaweed 5%, soluble potassium 11%, organic matter 2%, moisture 10-12%.

Soil and crop service operations:

The land was plowed with two orthogonal plows, and divided into 4-square-meter planks for the experimental unit, after which the cultivar was sown in it, according to the approved dates, with a seeding rate of 120 kg ha-1, planting depth 5 cm, and ten lines for the experimental unit, and the distance between one line and another was 20 cm. The experiment was fertilized with urea fertilizer (46). % N) by 200 kg h^{-1} (14) Which was added in three equal batches, the first at planting (00: ZGS), the second at the appearance of the second node on the stem (32: ZGS), and the third batch at the end stage (40: ZGS), according to the scale (19.). Half of the triple superphosphate fertilizer was added at once before softening at a rate of 100 kg h^{-1}. The experimental land was irrigated immediately after planting, then the irrigation process continued according to the plant's need during the growing season, after which the studied traits were calculated according to the different stages of growth.

Studied traits:

Characteristics of vegetative growth:

The vegetative growth characteristics were measured by taking a random sample of ten plants and from the intermediate lines of each experimental unit and taking the mean for it:

Plant height cm:-

Ten plants were randomly measured after they reached 100% flowering using a graduated ruler. If done Measure the distance confined between the soil surface and the top of the spike of the main tiller without the apex.

The number of tillers per plant.

At the end of the tillers stage, the number of tillers per plant and ten plants was calculated manually from each experimental unit (19).

Leaves content of chlorophyll.

This characteristic was estimated using a 502—Model Spad Meter Chlorophyll) by taking Three readings for each flag leaf and for ten main stems after the completion of the flowering stage for each experimental unit.

Area of the flag leaf area cm2.

This characteristic was calculated according to the equation of(18).

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The area of the flag leaf is cm2 = length of the paper cm x maximum width at the middle of cm x 0.95

Spike length cm.

It was estimated randomly as an average of the length of ten spikes from the base of the spike to the end of the last terminal spike for each main stems using a ruler included.

Measurements of the characteristics of the yield and its components:

Number of spikes m ^{2}

It was estimated manually when it reached full maturity from the square meter area within the unit Experimental.

Number of grains per spike

The average number of grains was taken for ten ears randomly and they were sown manually to extract their averages.

Weight of 1000 seeds gm

1000 grains were taken at random from the final yield of each experimental unit, and then each sample was weighed

The moisture content of the grains was measured at a level of 14% moisture.

Biological yield

An estimate of all plants harvested from an area of 1 m2 per secondary experimental unit. As the whole plants were weighed (grain + straw) and then the weight was changed from a gram to a ton h^{-1}.

Grain yield, ton ha^{-1}

The harvested plants were manually studied from 1 m 2 from the center lines of each experimental unit. The straw was isolated from the grain and cleaned well. Then the grain was weighed, after adding the grain used to estimate the weight of 1000 grains for the same treatment. The weight was then converted into ton h^{-1}.

statistical analysis :-

The data were analyzed statistically using the computer within the Genstat Version 12 program according to the analysis of variance method for the design of randomized complete blocks (RCBD) in the order of the split plots at the level of probability 5%, and the averages were compared using the least significant difference (LSD).

Results and discussion:-

Growth traits:

plant height (cm)

The results shown in Table (1) that there were no significant differences between the sowing dates. While it is noted that the levels of bio fertilizer differed significantly among them in the average plant height, as the level of bio fertilizer 6 kg / ha^{-1} gave the highest average plant height of 79052 cm. While the lowest average for this trait in the comparison treatment was 71.09 cm. This may be due to the role of bio fertilizers, especially the growth-stimulating root bacteria, which led to increased utilization of inorganic nutrients and then reflected on plant growth (12).

The results also showed that there was a significant overlap between planting dates and bio fertilizer levels, as the overlap coefficient was 6 kg, and the planting date T2 had the highest average for this characteristic, which was 806.47 cm, and the lowest average was when the interaction treatment was 0 kg, and the time T1 was 69.68 cm.

Table (1) The effect of planting dates and bio fertilizer levels on plant height cm.

Bio fertilizer levels Kg ha^{-1}	Planting dates		Average bio fertilizer
	T1	T2	
0	69.68	72.50	71.09
3	74.67	76.80	75.73
6	78.57	80.47	79.52
Average planting dates	74.30	76.59	
LSD 5%	Planting dates	Bio fertilizer	Interaction
	N.S	2.75	9.56

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Number of plant tillers

It appeared from the results listed in Table (2) that there were no significant differences between the planting dates, while a variation in the levels of bio fertilizer showed a significant difference between them in the average number of tillers, as the level of bio fertilizer 6 kg h^{-1} gave the highest mean for this trait, which amounted to 4.66 ripples. plant, while the lowest mean for this trait when not adding bio-fertilizer was 3.35 plant stems.

The results showed that there was a significant overlap between planting dates and levels of bio fertilizer, as the overlap treatment (6 kg h^{-1}) and the first date T1 gave the highest mean for the mentioned trait of 4.80 plant shoots and the lowest mean when the overlapping treatment (0 kg h^{-1}) and the date T2 gave 3.20 plant shoots .

Table (2) The effect of planting dates and bio fertilizer levels on the number of plant tillers.

Bio fertilizer levels Kg ha^{-1}	Planting dates		Average bio fertilizer
	T1	T2	
0	3.50	3.20	3.35
3	4.10	3.93	4.01
6	4.80	4.53	4.66
Average planting dates	4.13	3.88	
LSD 5%	Planting dates	Bio fertilizer	Interaction
	N.S	0.30	0.65

Area of the flag leaf area cm^2.

The results of table (3) showed that there were no significant differences between the planting dates, while the levels of bio fertilizer showed that there were significant differences between them in the average area of the flag leaf, cm^2, as the level of bio fertilizer (6 kg h^{-1}) gave the highest average of 52.71 cm^2, while the lowest average For this characteristic at the fertilizer level (0 kg h^{-1}) 39.35 cm2

The results show that there is a significant overlap between the sowing dates and the levels of bio fertilizer, as the overlap treatment gave 6 kg $h^{-1}$and the second planting date the highest average for this trait amounted to 53.37 cm^2 , while the lowest average was when the interaction treatment was 0 kg and the first planting date amounted to 36.98 cm^2.

Table (3) The effect of planting dates and bio fertilizer levels on flag leaf area cm^2.

Bio fertilizer levels Kg ha^{-1}	Planting dates		Average bio fertilizer
	T1	T2	
0	36.98	41.71	39.35
3	45.72	45.70	45.71
6	52.04	53.37	52.71
Average planting dates	44.91	46.93	
LSD 5%	Planting dates	Bio fertilizer	Interaction
	N.S	5.21	8.74

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Chlorophyll content (Spad)

The results in Table (4) showed that there were significant differences between the sowing dates, as the highest average of chlorophyll content was 47.56 spad at the time T2, while the lowest average was 44.19 spad at the time T1. Difference in planting dates. The levels of bio fertilizer also differed significantly among themselves, as the highest average was 52.71 spad at level 6 kg of bio fertilizer, while the lowest average for this characteristic was 39.36 spad at level 0 kg of bio fertilizer.

The results showed that there was a significant interaction between the planting dates and the level of bio fertilizer, as the overlap treatment of 6 kg h^{-1} and the time T2 gave the highest mean for this trait amounted to 53.37 spad, and the lowest mean when the overlap treatment was 0 kg h^{-1} bio and the time T1 was 36.95 spad.

Table (4)Effect of planting dates and bio fertilizer levels on chlorophyll content Spad.

Bio fertilizer levels Kg ha^{-1}	Planting dates		Average bio fertilizer
	T1	T2	
0	36.95	41.76	39.36
3	43.56	47.55	45.55
6	52.06	53.37	52.71
Average planting dates	44.19	47.56	
LSD 5%	Planting dates	Bio fertilizer	Interaction
	3.25	3.69	4.51

Length of the spike is cm

The results shown in Table (5) showed that there were significant differences between the sowing dates, as the T2 date gave the highest mean for the characteristic of the spike length (cm) of 8.68 cm, while the lowest average was 8.17 cm for the T1 date. This is consistent with what was found by (13). There is a difference in the growth of the spike according to the different planting dates.

It was also noted that there were significant differences between the levels of bio fertilizer for this characteristic, the highest mean was 9.18 cm at the level of bio fertilizer 6 kg/ha, while the lowest average was 7.96 cm at the level of bio fertilizer 0 kg ha^{-1}.

The results showed that there was a significant interaction between planting dates and bio fertilizer levels, as the overlap treatment of 6 kg h and the T1 date gave the highest mean of 9.33 cm and the lowest mean when the overlap treatment of 0 kg ha^{-1}. and the same date was 7.60 cm.

Table (5) Effect of planting dates and bio fertilizer levels on the spike length cm.

Bio fertilizer levels Kg ha^{-1}	Planting dates		Average bio fertilizer
	T1	T2	
0	7.60	8.33	7.96
3	7.60	8.70	8.15
6	9.33	9.03	9.18
Average planting dates	8.17	8.68	
LSD 5%	Planting dates	Bio fertilizer	Interaction
	0.43	0.32	0.54

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Number of spikes m ^{2}

It is clear from the results of Table (6) that there were no significant differences between the planting dates, while the levels of bio fertilizer gave significant differences in the average number of spikes m 2, the highest average was 387.7 spikes m 2 at the level of bio fertilizer 6 kg ha^{-1}., while the lowest average for the aforementioned trait was 272. 5 spike m2 at the level of bio fertilizer 0 kg ha^{-1}.. This is consistent with what was found by (1 and 6), that bio fertilizer affected yield components.

The results also showed that there was a significant overlap between planting dates and levels of bio fertilizer, as the overlap treatment gave 6 kg ha^{-1}. of bio fertilizer and time T2 the highest average for the characteristic of the number of spikes amounted to 393.0 spike m ^{2}, while the lowest average for this characteristic when the intervention treatment did not add biological fertilizer and time T2 was 252 3. M2 spike.

Table (6) Effect of planting dates and bio fertilizer levels on the number of spikes m ^{2}

Bio fertilizer levels Kg ha^{-1}	Planting dates		Average bio fertilizer
	T1	T2	
0	292.7	252.3	272.5
3	357.7	342.3	350.0
6	387.3	393.0	387.7
Average planting dates	345.9	329.2	
LSD 5%	Planting dates	Bio fertilizer	Interaction
	N.S	38.59	46.56

Number of grains per spike

The results of Table (7) showed that there were significant differences between the sowing dates, as the highest average number of grains per spike was 34.37 grains a spike at time T2, while the lowest average for this trait was 32.92 grains a spike at time T1, due to the superiority of date T2 in spike length, which It was reflected on the number of grains. As for the levels of bio fertilizer, there were also significant differences, as the level of bio fertilizer 6 kg ha^{-1} achieved the highest mean of 35.50 grain spikes, while the lowest mean reached 31.73 grains of spike at the level of bio fertilizer 0 kg ha^{-1}.

The results also showed that there were significant differences between the overlap between the planting dates and the levels of bio fertilizer, where the combination of the overlap 6 kg ha^{-1}. and the time T2 gave the highest average of 36017 grains of spike, while the lowest average of the overlap combination of 0 kg ha^{-1} of bio fertilizer and the time T1 was 30.63 grains of spike.

Table (7) Effect of planting dates and bio fertilizer levels on the number of grains per spike.

Bio fertilizer levels Kg ha^{-1}	Planting dates		Average bio fertilizer
	T1	T2	
0	30.63	32.83	31.73
3	33.70	34.10	33.70
6	35.83	36.17	35.50
Average planting dates	32.92	34.37	
LSD 5%	Planting dates	Bio fertilizer	Interaction
	1.05	0.61	1.90

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Weight of 1000 graine

The results shown in Table (8) showed that there were significant differences between the sowing dates, as the T1 date achieved the highest average for the weight of 1000 grains of 25.72 g and the lowest average reached 24.46 g for the T2 date. A higher number of dry matter, which caused an increase in grain weight, is consistent with what was found by (4 , 8, and 9). As for the levels of bio fertilizer, they differed significantly, as the highest average for this characteristic was achieved 26.29 gm at the level of bio fertilizer 6. kg e, while the lowest average was 23.12 g at the level of bio fertilizer 0 kg ha^{-1}..

It is also noted that there is a significant overlap between planting dates and levels of bio fertilizer, as the overlap treatment gave 6 kg h and time T1 the highest mean of 27.11 g, and the lowest mean when the nesting treatment was 0 kg h bio fertilizer and time T2 was 22.54 g.

Table (8) Effect of sowing dates and bio fertilizer levels on the weight of 1000 grains

Bio fertilizer levels Kg ha^{-1}	Planting dates		Average bio fertilizer
	T1	T2	
0	23.70	22.54	23.12
3	26.36	25.37	25.87
6	27.11	25.37	26.29
Average planting dates	25.72	24.46	
LSD 5%	Planting dates	Bio fertilizer	Interaction
	1.01	0.92	1.59

Biological yield is ton ha^{-1}.

The results shown in Table (9) showed that there were no significant differences between the sowing dates, while significant differences were observed between the levels of bio fertilizer, as the level of bio fertilizer 6 kg ha^{-1}. gave the highest average of the biological yield characteristic of 7.87 tons ha^{-1} in Khin The lowest average for this trait at the compost level of 0 kg ha reached 6.78 tons ha^{-1}. This is due to the superiority of this level in most of the growth traits and yield components, which were reflected on the biological yield, and this is consistent with the results of (16).

The results also showed that there was a significant overlap between planting dates and levels of bio fertilizer, as the overlap treatment of 6 kg h at the time T1 achieved the highest average of 7.99 ton ha^{-1}, while the lowest average when the overlap treatment of 0 kg and the first of cultivation amounted to 6.64 ton h^{-1}.

Table (9) Effect of planting dates and bio fertilizer levels on the biological yield, ton ha^{-1}

Bio fertilizer levels Kg ha^{-1}	Planting dates		Average bio fertilizer
	T1	T2	
0	6.64	6.91	6.78
3	7.83	7.66	7.74
6	7.99	7.75	7.87
Average planting dates	7.49	7.44	
LSD 5%	Planting dates	Bio fertilizer	Interaction
	N.S	0.434	1.017

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Grain yield, ton ha^{-1}.

The results shown in Table (10) showed that there were no significant differences between the sowing dates in terms of grain yield. While it is noted that the levels of bio fertilizer differed significantly among themselves in the average of this characteristic, as the level of bio fertilizer 6 kg ha^{-1}. gave the highest average of 2.71 tons ha^{-1}, while the lowest average for this characteristic at the level of bio fertilizer 0 kg ha^{-1}. was 1.69. ton ha^{-1}.. The superiority of this treatment is attributed to its superiority in the average number of grains per spike, which was reflected in the grain yield, and this is consistent with what was found by(1 and 6), who showed that the levels of bio fertilizers led to a difference in the yield of wheat grains. The results also showed that there was a significant overlap between planting dates and levels of bio fertilizer, as the overlap coefficient of 6 kg h of bio fertilizer and date T2 gave the highest average for this characteristic amounted to 2.81 tons h^{-1} and the lowest average was when the overlap coefficient was 0 kg h and date T1 was 1.16 tons ha^{-1}..

Table (10) Effect of planting dates and bio fertilizer levels on grain yield, ton ha^{-1}

Bio fertilizer levels Kg ha^{-1}	Planting dates		Average bio fertilizer
	T1	T2	
0	1.61	1.77	1.69
3	2.37	2.54	2.45
6	2.60	2.81	2.71
Average planting dates	2.19	2.38	
LSD 5%	Planting dates	Bio fertilizer	interaction
	N.S	0.486	0.618

conclusions

We conclude from this study that the planting dates did not differ among them in most of the studied traits. The levels of bio fertilizer differed in characteristics, as the highest grain yield and biological yield were achieved at the fertilizer level of 6 kg ha^{-1}.1, and the best grain yield was achieved when adding 6 kg h of bio fertilizer at the planting date 10/12/2022.

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