Response of the growth and yield of local black barley to bio-fertilizer (Optimus-Plus) and Mow•.

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Abstract

Increase the growth characteristics and yield of all crops grown by humans is the goal of those interested in agriculture, so it is possible to increase the growth characteristics and yield in several ways. Perhaps simple and inexpensive methods are one of the major goals of those interested in agriculture, and from here came the idea of conducting the experiment during the 2022-2023 season., in the district of Rabia - Al-Kubar village, 160 km northwest of the Mosul city, this study aimed to determining the effect of spraying levels of bio-fertilizer (Optimus-Plus) [0, 50, 100, 150 ml. 100 L of water-1] and Mowing [without, and with Mowing at the tillering stage] in the growth traits and yield of the barley crop, as the results showed significant differences for the studied traits, where the level of spraying with the bio-fertilizer (Optimus-Plus) exceeded 150 ml. 100 L of water-1 in All studied traits (Plant height, Leaves Chlorophyll content, Spike length, No. of grains per spike, weight of 1000 grains, Grain yield per unit area, and Protein percentage) where the mentioned level was recorded (81.51 cm, 45.46 SPAD, 7.74 cm, 24.81 grains. spike-1, 45.71 gm, 477.27 gm-2, and 12.29%), respectively .

As for the mowing treatment, the level of [no mowing] was significantly superior to the studied traits (78.42 cm, 44.03 SPAD, 7.35 cm, 23.7 grains. spike-1, 44.53 g, 477.23 g.m-2, and 12.11%). While the interaction of spraying with bio-fertilizer at the level (150 ml. 100 L of water-1) with the no-mowing treatment recorded a significant and significant superiority for the studied traits, as the average of the traits reached, respectively, (86.74 cm, 47.46 SPAD, 8.26 cm, 25.89 grains. spike-1, 47.81 g, 567.28 g.m-2, and 12.89%.(

Keywords: Barley, Optimus-Plus, Mowing, Growth and Yield component.

Introduction

Barley (Hordeum spp.) is an important field crop. It is an annual cereal crop belonging to the Poaceae family. In Iraq, barley is the second cereal crop after wheat, as farmers grow it in the northern and central regions of Iraq. The cultivated area in the Nineveh Governorate reached about 4,528 thousand dunams [1]. The barley crop has great nutritional importance for humans and animals. Additionally, it ranks among the crops with the highest concentration of water-soluble plant fibers, a significant factor in cholesterol dissolution. Additionally, people use it in the manufacture of malt, and it has multiple medical applications. Its rapid growth and high resistance to salinity characterize it. It tolerates drought, so most areas of Iraq are considered suitable for its cultivation, and its productivity rate reached about 1.352 ha-1, with the cultivated area reaching about 0.9 per 100 dunams of area [2.[

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Iraq is still facing many problems in terms of its ability to produce and the quantity of consumption, as the significant decline in barley cultivation is because of its low prices compared to the prices of wheat (knowing that the majority of agricultural costs for the two crops are equal) and the amount of yield per unit area is small, which led to abandonment and reluctance. Many farmers stop growing it.

As everyone knows, farmers actively employ bio-fertilizers to enhance the properties of soil and plants, with the goal of ensuring a higher availability of elements and activating the action of fertilizers. The need to use safe methods to increase and improve production through sustainable agricultural processes will drive further development of the bio-fertilizer sector in the coming years, and the greatest expansion will be in the group of amino acids and beneficial organisms [3.[

Therefore, we must improve the reality of the barley crop by developing the local crop and using important bio-fertilizers such as Optimus Plus. Optimus Plus consists of organic materials and free plant amino acids that support the plant, according to the required fixed proportions used by the farmer that do not negatively affect the crop.

The aim of the current study was to determine the response of the barley crop to the nano-organic fertilizer Optimus-Plus after various mowing operations, as well as to determine the best level of the bio-fertilizer for the growth characteristics and yield of the barley crop, as well as to know whether mowing is feasible or not based on its effect on the amount of yield per unit area.

Materials and methods

During the 2022-2023 agricultural season, a team conducted a field experiment in the Nineveh Governorate to grow barley. The study took place in the Rabia district - Al-Kubar village, located (106) km northwest of the city center of Mosul. The researchers aimed to study the effect of the Optimus plus bio-fertilizer and mowing. Regarding the growth characteristics and yield of barley plants, as the site was within the areas of semi-guaranteed rain, the experiment planted on 3rd of Nov. 2022, and the harvest done on 17th of May 2023.

The experiment was implemented according to a factorial experiment system with a randomized complete block design (R.C.B.D.) with three replications. The distance between one experimental unit and another was 1 m. Local black barley, a variety approved by the Iraqi Ministry of Agriculture, it used in the study.

Planting was done with a seed rate of 120 kg. ha -1. The experiment included two factors as follows:

The first factor: nano-organic fertilizer (Optimus plus), which is of Turkish origin and is considered one of the unique fertilizers manufactured according to nanotechnology, as it consists of organic matter: 50%, free amino acids: 29%, organic carbon: 20%, total nitrogen: 2%, and pH (8-5) (Table 1), the fertilizer added with four levels as follows:

Without fertilizer (spray with water only1 .(

50ml. 100 L of water-1-2 .

100ml. 100 L of water-1-3 .

150ml. 100 L of water-1-4 .

The process of adding the bio-fertilizer (Optimus plus) was in two sprays, the first

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spraying done on 20th of Jan. 2023, and the second spraying done on 4th of March 2023 until complete wetness, using the backpack sprayer with a capacity of (16) liters.

Table (1): Components of the bio-fertilizer (Optimus-Plus) used in the study.

Substances	Percentage
Organic Matters	%50
Free Amino Acids	%29
Organic Carbon	%20
Total Nitrogen	%2
pH	8-5

The second factor: Mowing the plants of barley at two levels: (without, and with mowing.(

Studied characteristics:

Plant height (cm-1 .(

Leaves chlorophyll content-2 .

Spike length (cm-3 .(

Grains No. per spike-4 .

1000grains weight (g-5 .(

Grain yield per sq. Meter (g.m-2-6 (

Protein percentage-7 .

statistical analysis

The data analyzed using SAS (Statistical Analysis System) software, as reported by [4] as a factorial experiment within a randomized complete block design (R.C.B.D.), and the averages of the factorial coefficients compared according to the Duncan multiple range test (DMRT), regardless of the significance of the F test. According to what reported by [5], where the averages given letters, similar letters indicate that there are no significant differences between the averages, while different letters indicate of significant differences among the averages under the 5% probability level .

Results and discussion

The effect of the bio-fertilizer (Optimus plus) and mowing on the growth characteristics of the barley crop.

Plant Height (cm.1 :(

The results of table (2) showed that there were significant differences among the levels of the bio-fertilizer (Optimus plus) in the plant height characteristic, as it reached (81.51 cm) at the level of (150 ml. 100 L of water-1), while the no-spraying treatment gave the lowest average for the trait, which amounted to (63.9 cm). The reason for the increase in plant height may attributed to the fact that the amino acids present in the bio-fertilizer and the organic materials contributed to increasing cell expansion, which ultimately led to an increase in plant height. This result is in line with what reported by [6],[7] and [8.[

As for the effect of mowing, the non-mowing treatment gave the highest rate of the plant height trait, amounting to (78.42 cm), while

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the mowing treatment gave the lowest rate of the trait, reached to (71.85 cm). The reason for this may be because of the mowing process, which led to the plant heading toward basal branching, which was reflected in a decrease. In plant height, this result is consistent with the findings of [9], [10], and [11 .[

The interaction of the bio-fertilizer with the mowing treatment gave a significant effect on the plant height trait, as the interaction of the bio-fertilizer level (150 ml. 100 L of water-1) with the non-mowing treatment gave the highest rate of the trait, amounting to (86.74 cm), while the interaction of the bio-fertilizer (no spraying) recorded with the mowing and non-mowing treatments the lowest rate (63.46 and 64.33 cm), respectively .

Table (2) Effect of bio-fertilizer (Optimus plus) and mowing on plant height (cm).

Optimus-Plus ml. 100 L of water	Without Mowing	With Mowing	Average of Optimus-Plus
0	64.33 e	63.47 e	**63.9 d**
50	80.03 b	72.63 d	**76.33 c**
100	82.58 b	75.03 cd	**78.81 b**
150	86.74 a	76.28 c	**81.51 a**
Average of Mowing	**78.42 a**	**71.85 b**	

Leaves Chlorophyll Content (SPAD.2 :(

The results of table (3) showed that there are significant differences among the levels of the Optimus plus in terms of chlorophyll content, as it reached (45.46 Spad) at the level of (150 ml.100 L of water-1), while the no-spraying treatment gave the lowest average for the trait, which amounted to (37.89 Spad). The reason for the increase in chlorophyll content attributed to improving the availability of nutrients and bio-fertilizers, which contain important nutrients such as nitrogen, iron, magnesium, zinc, and others, which contribute to improving the synthesis of chlorophyll and increasing its level. This result agreed with what reported by [12], [13], and [14.[

As for the effect of mowing, the non-mowing treatment gave the highest rate for the chlorophyll content trait, amounting to (44.03 Spad), while the mowing treatment gave the lowest rate for the trait, amounting to (40.87 Spad). The reason may attribute to preserving the young leaves. Non-mowing the leaves allows the survival of the young leaves that contain high levels of chlorophyll content. High in chlorophyll, new leaves are mainly photosynthetic, so preserving them can increase chlorophyll rate, and this result is consistent with the findings of [15] and [16.[

The interaction of the bio-fertilizer with the mowing treatment gave a significant effect on the chlorophyll content trait, as the interaction of the bio-fertilizer level (150 ml.100 L of water-1) with the non-mowing treatment gave the highest rate of the trait amounting to (51.36 Spad), while the interaction of the bio-fertilizer (no spraying) with the mowing treatment recorded. The mowing and non-mowing coefficients have the lowest rates (36.63 and 35.61 Spad), respectively.

ISSN 2072-3857

Table (3) Effect of bio-fertilizer (Optimus-plus) and mowing on leaves chlorophyll content.

Optimus-Plus ml. 100 L of water	Without Mowing	With Mowing	Average of Optimus-Plus
0	38.5 e	37.29 e	**37.89 d**
50	44.12 bc	40.82 d	**42.47 c**
100	45.76 b	42.21 cd	**43.98 b**
150	47.76 a	43.16 c	**45.46 a**
Average of Mowing	**44.03 a**	**40.87 b**	

Spike length (cm.3 (

The data in table (4) showed that there were significant differences among the levels of the Optimus-plus in the spike length trait, as it reached to (7.74 cm) at the level of (150 ml. 100 L of water-1), while the no-spraying treatment gave the lowest average for the trait, which amounted to (5.86 cm). The reason for the increase in spike length is that bio-fertilizers can enhance the tissue formation process in the stems, leading to increased strength and flexibility of the spikes and thus increasing their length. This result is in line with the results reported by [17], [6], and [18.[As for the effect of mowing, the non-mowing treatment gave the highest average for the trait of spike length, amounting to (7.35 cm), while the mowing treatment gave the lowest average for the trait, amounting to (6.48 cm). The reason for this result attributed to improving the balance of hormones. The balance of hormones in the plant plays an important role in regulating the growth of ears. Not mowing the leaves can maintain this hormonal balance, which helps stimulate the growth of the spikes and increases their length, and this result is consistent with the findings of [10] and [19.[The interaction of the bio-fertilizer with the mowing treatment gave a significant effect on the spike length trait, as the interaction of the bio-fertilizer level (150 ml.100 L of water-1) with the no-mowing treatment gave the highest trait rate of (8.29 cm), while the interaction of the bio-fertilizer (not spraying) with the mowing treatment recorded. The mow and without mow coefficients have the lowest rate (5.48 cm.(

Table (4) Effect of bio-fertilizer (Optimus-Plus) and mowing on spike length (cm).

Optimus-Plus ml. 100 L of water	Without Mowing	With Mowing	Average of Optimus-Plus
0	6.23 e	5.48 f	**5.86 d**
50	7.12 c	6.43 e	**6.78 c**
100	7.74 b	6.81 d	**7.28 b**
150	8.29 a	7.20 c	**7.74 a**
Average of Mowing	**7.35 a**	**6.48 b**	

Grains No. per spike (grain. spike -1.4 (

Table (5) showed that there were significant differences among the levels of the (Optimus-plus) bio-fertilizer in terms of the number of grains per spike, as it reached (24.81 grains. spike -1) at the level of (150 ml. 100 L of

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water-1), while the no-spraying treatment gave the lowest average for the trait, amounting to (21.08 grains. spike-1). The reason for this increase perhaps because of improving the availability of nutrients. Bio-fertilizers can increase the availability of basic nutrients in the soil, such as nitrogen, phosphorus, and potassium, which enhances the growth and development of the spike, which ultimately leads to an increase in the number of grains per ear. The result is in line with what reported by [20], [21], and [22.[

As for the effect of mowing, the non-mowing treatment gave the highest average for the number of grains per spike, which was (23.7 grains. spike-1), while the mowing treatment gave the lowest average for the trait, which was (22.7 grains. spike-1). The reason for this may be because of the mowing process, which may cause stress to the plants, which could negatively affect the plants. Grain development. Not mowing the leaves can reduce this stress and thus help promote grain development within the spikes. This result is consistent with the findings of [23], [9], and [24.[

The interaction of the bio-fertilizer with the mowing treatment gave a significant effect on the character of the number of grains per spike, as the interaction of the bio-fertilizer level (150 ml. 100 L of water-1) with the non-mowing treatment gave the highest rate of the trait amounting to (25.89 grains. spike-1), while the interaction of the bio-fertilizer (not spraying) recorded with the lowest treatment rate (20.63 grains. spike-1.(

Table (5) Effect of bio-fertilizer (Optimus-plus) and mowing on grains No. per spike.

Optimus-Plus ml. 100 L of water	Without Mowing	With Mowing	Average of Optimus-Plus
0	21.53 cd	20.63 d	**21.08 c**
50	23.37 b	22.71 bc	**23.04 b**
100	24.01 b	23.73 b	**23.87 b**
150	25.89 a	23.72 b	**24.81 a**
Average of Mowing	**23.7 a**	**22.7 b**	

Weight of 1000 grains (g.5 (

The results of table (6) showed that there were significant differences between the levels of the Optimus-plus in the weight of 1000 grains, as it reached (45.71 g) at the level of (150 ml. 100 L of water-1), while the no-spraying treatment gave the lowest average for the trait, amounting to (37.61 g). The reason for the increase in the weight of 1000 grains may be because of attribute to the fact that increasing the number of grains in spikes, the bio-fertilizers can increase the number of grains in each spike, which means increasing the number of grains that are calculated for the weight of 1000 grains. This result is in line with what was reported by [25], [7], and [26.[

As for the effect of mowing, the non-mowing treatment gave the highest average for the trait weight of 1000 grains, amounting to (44.53 g), while the mowing treatment gave the lowest average for the characteristic, amounting to (40.20 g). The reason for this may be because of the attribute to stimulating protein synthesis. The leaves contain the nutrients necessary for protein formation in the grains. Non-mowing the leaves can allow the protein

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synthesis process to be stimulated, which leads to an increase in the mass of the grain and thus an increase in the weight of 1000 grains. This result is consistent with the findings of [19], [9], and[24.[

The interaction of the bio-fertilizer with the mowing treatment gave a significant effect on the character of the weight of 1000 grains, as the interaction of the bio-fertilizer level (150 ml. 100 L of water-1) with the non-mowing treatment gave the highest rate of the trait, amounting to (47.81 g), while the interaction of the bio-fertilizer (no spraying) recorded with the treatment of mowing the lowest rate (35.83 g.(

Table (6) Effect of the bio-fertilizer (Optimus-plus) on the weight of 1000 grains (g).

Optimus-Plus ml. 100 L of water	Without Mowing	With Mowing	Average of Optimus-Plus
0	39.38 e	35.83 f	**37.61 c**
50	44.78 bc	39.83 e	**42.31 b**
100	46.13 ab	41.52 de	**43.83 b**
150	47.81 a	43.6 cd	**45.71 a**
Average of Mowing	**44.53 a**	**40.2 b**	

Grain yield per square meter (g.m-2.6 (

The results that showed in table (7) explained there were significant differences among the levels of the Optimus-plus in the grain yield trait, as it reached (477.27 g.m-2) at the level of (150 ml. 100 L of water-1), while the no-spraying treatment gave the lowest average for the trait, which amounted to (335.59 g.m-2). The reason for the increase in grain yield is that enhancing the formation of new ears. Bio-fertilizers may stimulate the formation of more new spikes, whether through increasing the number of flowers or improving the formation of existing spikes. Which ultimately led to an increase in grain yield, and this result is in line with what reported by [27], [28], and [12.[

As for the effect of mowing, the non-mowing treatment gave the highest rate for the trait of grain yield, amounting to (477.231), while the .(mowing treatment gave the lowest rate for the trait, amounting to (336.916). This may be because of the improved use of resources. Not mowing the leaves allows full use of available resources such as light and water. And nutrients, which helps in enhancing the growth and development of ears and thus increasing grain yield. This result is consistent with the findings of), [9], [24], and [29.[

The interaction of the bio-fertilizer with the mowing treatment gave a significant effect on the grain yield trait, as the interaction of the bio-fertilizer level (150 ml.100 L of water-1) with the no-mowing treatment gave the highest trait rate of (567.28 g.m-2), while the interaction of the bio-fertilizer (no spraying) with the mowing treatment recorded the treatment rate of parts is the lowest (278.44 g.m-2

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Table (7) Effect of bio-fertilizer (Optimus-plus) and mowing on grain yield (g.m^{-2}).

Optimus-Plus ml. 100 L of water	Without Mowing	With Mowing	Average of Optimus-Plus
0	392.74 d	278.44 f	**335.59 d**
50	452.61 c	334.83 e	**393.72 c**
100	496.3 b	347.14 e	**421.72 b**
150	567.28 a	387.26 d	**477.27 a**
Average of Mowing	**477.23 a**	**336.92 b**	

Protein

Table (8) showed that there were significant differences among the levels of the (Optimus-plus) in terms of protein content, as it reached (12.29%) at the level of (150 ml. 100 L of water-1), while the no-spraying treatment gave the lowest average for the trait, which amounted to (10.9%), which may be due to the reason for the increase in the percentage of protein is that enhancing the formation of amino acids. As known the bio-fertilizers can enhance the formation of the amino acids necessary for protein formation, and this leads to an increase in the percentage of protein in the grains. This result is in line with what reported by [17], [30], and [31.[

As for the effect of mowing, the non-mowing treatment gave the highest rate for the protein percentage trait, which amounted to (12.11%), while the mowing treatment gave the lowest rate for the trait, which amounted to (11.25%). percentage.7(%)

The reason for this duo to attribute to improving the nutritional quality. Non-mowing the leaves can lead to improving the nutritional quality available for the grains, including nutrients needed for protein synthesis. This can increase protein accumulation in grains and thus increase the protein content of the crop, and this result is consistent with the findings of [10.[

The interaction of the bio-fertilizer with the mowing treatment gave a significant effect on the character of the protein percentage, as the interaction of the bio-fertilizer level (150 ml. 100 L of water-1) with the non-mowing treatment gave the highest rate of the trait amounting to (12.89%), while the interaction of the bio-fertilizer (no-spraying) with the mowing treatment recorded mowing treatment rate is the lowest (10.67%.(

Table (8) Effect of bio-fertilizer (Optimus-plus), mowing, on protein percentage.

Optimus-Plus ml. 100 L of water	Without Mowing	With Mowing	Average of Optimus-Plus
0	11.13 e	10.67 f	**10.9 d**
50	12.02 c	11.10 e	**11.56 c**
100	12.41 b	11.53 d	**11.97 b**
150	12.89 a	11.70 cd	**12.29 a**
Average of Mowing	**12.11 a**	**11.25 b**	

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Conclusions

Through the study, we conclude that spraying with the bio-fertilizer (Optimus-Plus) had a positive effect on all the traits studied, especially the level (150 ml. 100 L of water-1), as it was significantly superior to all traits. As for the plots, if the goal of cultivation was Obtaining fodder [green shoots] recommended, but if the goal is to obtain grains, it is not recommending performing the mowing process, especially at the tillering stage. The non-mowing treatment was significantly superior to all the studied traits. When studying the interaction between the levels of bio-fertilizer and mowing, the treatment (spraying with bio-fertilizer at a level of 150 ml. 100 L of water-1 with the non-mowing treatment) was significantly superior to all the traits studied, and we can recommend conducting further studies that deal with higher levels of bio-fertilizer (Optimus-Plus) it is possible to obtain a higher rate of the studied qualities .

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References

[1] CSO, Central Statistical Organization, 2020. Estimation of Wheat and Barley production, Ministry of Planning, Central Statistical Organization – Iraq.

[2]Al-Baldawi, M. H. K., Abdul-Razzaq, M., Hamza, J. H., Muhammad, K. I., Hashem, K. I., & Karim, H. M. 2014. Controls and standards for cultivation and study of field crops. College of Agriculture-University of Baghdad, 285-295.

[3]Rouphael, Y., & Colla, G. 2018. Synergistic biostimulatory action: Designing the next generation of plant biostimulants for sustainable agriculture. Frontiers in plant science, 9, 1655.

[4]Peng, C. J. 2008. Data analysis using SAS. Sage Publications.

[5]Al-Rawi, K. M., & Khalaf Allah, A. M. 2000. Design and analysis of agricultural experiments. El Mousel Univ., Iraq, 19, 487.

[6]Kumar, P., Singh, S., Shukla, R. D., & Singh, V. 2017. Effect of NPK and biofertilizer on growth and yield of barley (Hordium vulgare L.) In western uttar Pradesh. Progressive Research–An International Journal, 12(IV), 2434-2437.

[7]El-Sheshtawy, A. A., Hager, M. A., & Shawer, S. S. 2019. Effect of bio-fertilizer, Phosphorus source and humic substances on yield, yield components and nutrients uptake by barley plant. J. Biol. Chem. Environ. Sci, 14(1), 279-300.

[8]Jasim, T. S., & Hamid, B. A. 2023. Effect of Organic and Biofertilization on some

Qualitative and Productive Traits of Barley Plant. In IOP Conference Series: Earth and Environmental Science (Vol. 1259, No. 1, p. 012031). IOP Publishing.

[9]Al-freeh, L. M., & AL-zergawy, M. A. 2015. Effect of seeding rates and number of cutting on growth and yield of Barley (Hordeum vulgare L.) in Basrah. Thi-Qar University Journal for Agricultural Researches, 4(2.(

[10]Manohar Lal, Saini KS. 2017. Productivity, quality and profitability of dual-purpose barley (Hordeum vulgare L.) under various planting techniques and cutting practices in Indo-Gangetic Plains of India. International Journal of Current Microbiology and Applied Sciences.; 6(9):648-654.

[11]Hussein, A. A. 2022. EFFECT OF FOLIAR NITROGEN AND NUMBER OF CUTTING ON YIELD OF GREEN FORAGE AND QUALITY OF BARLEY. IRAQ JOURNAL OF AGRICULTURAL RESEARCH, 26(1.(

[12]Niazi Ardakani, M., Barati, V., Bijanzadeh, E., & Behpoori, A. 2020. Effects of different nitrogen fertilizer sources and crop residues on yield and yield components of barley (Hordeum vulgare L.) under late season water stress. Journal of Agroecology, 12(1), 107-126.

[13]Raffi, M. M., & Charyulu, P. B. B. N. 2021. Azospirillum-biofertilizer for sustainable cereal crop production: Current status. In Recent developments in applied microbiology and biochemistry (pp. 193-209). Academic Press.

[14]Aghaei, F. A. T. E. M. E. H., Sharifi, R., & Narimani, H. 2022. Effects of uniconazole and biofertilizers on yield, chlorophyll fluorescence indices and some physiological traits of wheat under salinity soil conditions. Journal of Plant Research (Iranian Journal of Biology), 35(1), 112-124.

[15]Lal, M., & Saini, K. S. 2017. Productivity, quality and profitability of dual-purpose barley (Hordeum vulgare L.) under various planting techniques and cutting practices in Indo-Gangetic plains of India. Int. J. Curr. Microbiol. App. Sci, 6(9), 648-654.

[16]Dhillon, B. S., & Uppal, R. S. 2018. Growth, productivity and nutrient uptake of barley (Hordeum vulgare) as influenced by different varieties and clipping management. Wheat and Barley Research, 10(2), 89-92.

[17]Rahuma, M. A. A., Radwan, F. I., Gomaa, M., & Fathallah Rehab, I. 2016. Effect of Potassium, Phosphorus and Bio-fertilization on Barley Productivity. Journal of the Advances in Agricultural Researches, 22(1), 136-147.

[18]Tiwari, A. K., Mishra, A., Mishra, U. S., Sirothia, P., Singh, O. K., & Jendre, A. 2023. Substitution of Nitrogen and Phosphorous by Bio-Inoculants and Their Effect on Growth Parameters, Yield Attributes and Yield of Barley. International Journal of Environment and Climate Change, 13(10), 4499-4505 .

[19]ALkinani, A. H., Jassem, K. A., & Jabail, W. A. 2019. Effect of Nitrogen Fertilization and Number of Cutting on Yield, Components of Barley (Hordeum vulgare L.). Jornal of Al-Muthanna for Agricultural Sciences, 7(1.(

[20]Qostal, S., Kribel, S., Chliyeh, M., Mouden, N., Selmaoui, K., Touhami, A. O., & Douira, A. 2020. Biostimulant Effect of Trichodermaon the Development of Wheat and Barley Plants and Its Survival Aptitudes on The Roots. Plant Archives J., 20(2), 7829-7834.

[21]Singh, R. 2023. Influence of Biofertilizers and Zinc on Growth and Yield of Barley. International Journal of Plant & Soil Science, 35(16), 40-45.

ISSN 2072-3857

[22]Singh,R. & Vishal, 2023. Influence of Biofertilizers and Nitrogen on the Growth and Yield of Barley (Hordeum vulgare L.). International Journal of Environment and Climate Change Volume 13, Issue 8, Page 312-317, 2023.

[23]Al-Seedi, S. N. N. 2010. The effect of salinity on the growth, soluble sugar and mineral ions content of barley plant (Hordeum vulgare L.) and soil properties. JOURNAL OF THI-QAR SCIENCE, 2(2.(

[24]Hussein, A. O., Mansoor, H. N., & Jaber, A. A. 2021. Influence Of Levels Of Nitrogen And Mowing On Grain Yield And Its Components For Barley Crop (Hordeum vulgare L.). Plant Archives J., 21(1), 66-70.

[25]Neelam, B. S., & Khippal, A. (2018). Mukesh and Satpal. 2018. Effect of different Nitrogen levels and Bio-fertilizers on yield and economics of feed barley. Wheat and Barley Research, 10(3), 214-218.

[26]Makenova, M., Nauanova, A., Aidarkhanova, G., Ospanova, S., Bostubayeva, M., Sultangazina, G., & Turgut, B. 2023. Organic and biofertilizers effects on the rhizosphere microbiome and spring barley productivity in Northern Kazakhstan. SABRAO J. Breed. Genet, 55(3), 972-983.

[27]Azimi, S. M., Farnia, A., Shaban, M., & Lak, M. 2013. Effect of different biofertilizers on Seed yield of barley (Hurdeom vulgar L.), Bahman cultivar. International journal of Advanced Biological and Biomedical Research, 1(5), 538-546.

[28]Islas-Valdez, S., Lucho-Constantino, C. A., Beltrán-Hernández, R. I., Gómez-Mercado, R., Vázquez-Rodríguez, G. A., Herrera, J. M., & Jiménez-González, A. 2017. Effectiveness of rabbit manure biofertilizer in barley crop yield. Environmental Science and Pollution Research, 24, 25731-25740.

[29]Talib, M. S., Mansoor, H. N., & Abbas Al-Khafaji, H. H. 2021. The Effect Of Mowing Dates And Different Nitrogen Levels On Yield Characteristics Of Barley (Hordeum vulgare L.). Plant Archives J., 21(1), 104-108.

[30]Hasanabadi, T., Khalaj, H., Ardakani, M. R., & Delfani, M. 2019. Assess effect of nitrogen fertilizer and phosphorous biofertilizers (Azospirillum and Pseudomonas) on barley crop production and seed protein content. Journal of Crop Nutrition Science, 5(4), 32-41.

[31]Çağlar, Ö., Bulut, S., Öztürk, A. 2023. Determination of Yield Parameters of Barley (Hordeum vulgare L.) Inoculated with Phosphorous-Solubilizing and Nitrogen-Fixing Bacteria. Polish Journal of Environmental Studies.https://doi.org/10.15244/pjoes/172036