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Effect of perlite and nitrogen level on potassium availability in soil and yield of wheat (*Triticum aestivum* L.)

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Abstract

This study was conducted at Al Majd area in Al Muthanna Governorate (Away from the city center about 5 km to the north), to study the effect of perlite and nitrogen level on potassium availability in soil and the growth and yield of wheat (Triticum eastvum L.), during the agricultural season 2022-2021. A factorial field experiment, according to a Randomized Complete Block Design (RCBD) with three replicates. The experiment included two factors, the first factor is the addition of perlite with three levels (0, 1.5 and 3)% symbolized by B0, B1 and B2 respectively, while the second factor is nitrogen at five levels (0, 50, 100, 150 and 200) kg N ha-1 has the symbol N0, N1, N2, N3 and N4 respectively. The land was divided into plots, included 45 experimental units in three blocks, the area of the experimental unit (2 × 2) m2 The experimental unit included 8 lines with a length of 2 m, the distance between one line and another was 20 cm, leave a distance of 75 cm between one replicate and another. The seeds of wheat (Bohooth 22 cultivar) were sown on 11/11/2021. The results indicated the significant effect of adding perlite at a level of 3% by volume of the soil, by increasing of availability nitrogen and potassium in the soil when adding the first and second batch of nitrogen, and reducing the degree of soil reaction to the first and second batches of adding nitrogen to the soil, There was no significant difference between fertilizer to the soil at a level of 150 and 200 kg N ha-1 on the increase of availability nitrogen in the soil at the first and second batch of adding fertilizer and at harvest, increasing the availability potassium in the soil for the first and second batches of adding nitrogen fertilizer, with reducing the degree of soil reaction to the two batches of fertilizer added.

Key words: Perlite, nitrogen and potassium availability, soil, yield, wheat (*Triticum aestivum* L.).

Introduction

Potassium is one of the most important nutrients, for its important role in many vital processes in plants, the earth's crust contains large amounts of potassium, but it is not enough for the plant's need because it is not available, therefore, it is necessary to think about exploiting or benefiting from these quantities, for this purpose, many natural or chemical materials were used, which were added to the plant or soil and lead to an increase in the readiness of potassium, or maintain it directly or indirectly, within sufficient levels for the plant, among these substances, which are called preservatives for moisture and nutrients, such as perlite mineral (Evans, 2004).

Perlite is a material with small grains, about 1-5 mm in diameter, white in color, produced by heating silicon volcanic rocks up to 1000 m, leads to an increase in the size of its grains from 4 to 20 times of its original size (Nelson, 2012). Agricultural perlite is characterized by its high water absorption capacity, long term fertilizer retention, it separates the irrigation stages, as well as its high ability to exchange positive ions, pH Neutral (6.5 -7.5), it works to preserve the nutrients, including potassium in a available form and for a long time without fixing (Verdonck and Demeryer, 2004; Schmiewski, 2009).

Nitrogen is an important nutrient for plants in agricultural ecosystems, plants take nitrogen from the soil through the roots in the form of nitrate and ammonium, it is important for most of the vital processes in plants, its presence in the soil has an important and positive role in increasing the availability of many elements in the soil, including phosphorous and potassium (Qin et al., 2017).

The wheat crop (Triticum aestivum L.) is one of the most important cereal crops in the world, it is an essential source of human and animal nutrition. The wheat crop in Iraq suffers from a decrease in the agricultural yield unit, for reasons related to soil, irrigation water, crop variety and crop management methods, low nutrients in the growth stage of the crop due to reasons related to agricultural management, water scarcity, and lack of availability of other nutrients (Shafak and Al-Dababi, 2008).

This research aims to study the effect of perlite and nitrogen level on the availability and release of potassium in the soil and wheat yield.

Material and methods

The experiment site:

A field experiment was conducted during the agricultural season 2022-2021, at Al-Majd area in Al-Muthanna Governorate (about 5 km north of the city center), to determine the effect of perlite and nitrogen level on potassium availability at the soil and the growth and yield of wheat (Triticum aestivum L.).

Soil sample Collection:

Soil samples were taken from a depth of 0-30 cm and from different locations in the experimental ground, the samples were mixed together to homogenize them, air dried, softened and passed through a sieve with holes diameter of 2 mm, the chemical and physical analyzes were carried out (Table 1).

Table (1) Some chemical and physical properties of field soil.

	Parameters	Unit	Value
	pH	--	7.80
	EC	dS m^{-1}	5.70
	Organic matter	gm kg^{-1}	1.10
Chemical properties	CEC	centimol kg^{-1}	10.00
	Nitrogen availability		23.00
	Phosphorous availability	mg kg^{-1}	17.20
	Potassium availability		170.00
	Ca^{+2}		25.52
	Na^{+1}	mmol. L^{-1}	11.83
	Cl^{-1}		37.51
	Sand		18.09
Physical properties	Silty	gm kg^{-1}	49.20
	Clay		32.71
	Texture	Clay loam	

Laboratory measurements of some chemical properties of soil

1. Available nitrogen in the soil (ammonium N-NH4 and nitrate N-NO3):

The available ammonium ion was estimated in the soil before planting and after adding the first and second batches of nitrogen and after harvesting by extraction method with potassium chloride solution (KCl 2M) and using magnesium oxide MgO, then distilled it after evaporation using a microcalcium device according to the method of Bremner and Edwrds (1965) mentioned in Page et al. (1982).

After the determination of the ammonium ion and in the same sample, the nitrate ion was reduced using a substance (Devarda alloy), then distilled with a microcalcium device according to the method of Bremner (1965) described in Page et al. (1982).

2. Available phosphorous (P):

The available soil phosphorous before planting was estimated using sodium bicarbonate (0.05M NaHCO3), pH = 8.5 according to Olsen's method, and the color was phased with ammonium molybdate and ascorbic acid, and it was estimated using a spectrophotometer at a wavelength of (882) nanometers, as mentioned in Page et al. (1982).

3. Available Potassium (K+):

It was extracted by ammonium acetate (1N NH4OAC) pH=7 and the available potassium was estimated before planting and after adding the first and second batches of nitrogen and after harvesting using the Flame Phtometer and according to the method mentioned in Richards (1954) and the available Mg was estimated by smearing with Na2EDTA according to the method contained in Jackson (1958).

4. pH Soil:

The pH soil in a soil extract: water (1:1) was estimated before planting, as well as it was measured in two batches during the growth of the first plant after ten days of plant germination and the second after a month and a half of adding the second batch of nitrogen levels using a pH meter According to the method given in Jackson (1958).

Experiment factors

The first factor:

Perlite mineral was added at levels 0, 1.5 and 3% by volume to the soil and its symbol B0, B1 and B2 respectively

The second factor:

Nitrogen was added at levels 0, 50, 100, 150 and 200 kg N ha-1 and symbolized by the symbol N0, N1, N2, N3 and N4 respectively.

A factorial experiment was conducted according to the Randomized Complete Block Design (RCBD), which included 15 treatments and with three replicates, so that the total number of units was 45 experimental units.

Table (2) Chemical and physical properties of perlite mineral.

Oxides	**Chemical symbol**	**Percent**
Silicon dioxide	SiO_2	72-75%
Aluminum oxide	AL_2O_3	11-14%
Potassium oxide	K_3O	2.8-4.3%
Water content	H_2O	3.2-4.5%
Properties	**Value**	**Unit**

Color	White	-
Density	100-80	Kg m^{-3}
Granule size	5-1	mm
pH	7.5-6.5	-

Agricultural operations:

The soil of the field was plowed with the cultivator plow, 30 cm deep and smoothed by disc combs, settled and then opened my main and subsidiary drivers, then it was divided into three sectors, one sector included 15 experimental units, the area of the experimental unit was 2×2 m2. The experimental unit included eight lines, the distance between one line and another was 20 cm, and a distance of 75 cm was left between one replicate and another. Nitrogen fertilizer at levels N0, N1, N2, N3 and N4 was added fertilizer (0,50, 100,150, 200) kg N.ha-1 in the form of urea (N 46%) in two batches, the first one week after germination and the second after a month From the first addition.

Phosphate fertilizer was added at the level of 100 kg P2O5 ha-1 in the form of triple superphosphate fertilizer TSP (P 21%) in one batch before planting, and potassium fertilizer was added at the level of 100 kg K. ha-1 in the form of potassium sulfate fertilizer (K 41.5%). (Ali et al., 2014). Perlite was added in volume by knowing the length and width of the experimental unit, the depth and density of the soil, making a box with known dimensions of length, width and height, and dimensions of length 40 cm, width 30 cm, and height 15 cm, the fund is added once for 1.5% transactions, and 2 funds are added for every 3% transactions, it was added with the soil a mixture that has chemical and physical properties (Table 2). All service operations were conducted equally for all experimental treatments in the study and whenever needed.

Experiment design and statistical analysis

The experiment was carried out using a two-factor factorial trial design of Randomized Complete Block Design (RCBD) with three replicates, and they were randomly distributed, with 15 experimental units.

Statistical analysis of all results was carried out on the basis of analysis of variance for the studied traits according to the factorial trials method of Randomized Complete Block Design (RCBD) using the statistical program (GENESTAT) and the comparison between the means of transactions was done using the Least Significant Difference (LSD) test at a probability level of 0.05.

Results and Discussion

Effect of perlite and nitrogen levels on pH soil:

Tables (3 and 4) indicate that the addition of perlite levels had a significant effect in decreasing the pH soil values. The levels B1 and B2 did not significant differ between them for the two batches, the average values for pH reached 7.45 and 7.43 after adding the first batch of nitrogen fertilizer (table 3), 7.31 and 7.18 when adding the second batch of nitrogen fertilizer (Table 4), the lowest pH soil was decreased at the B2 level to the addition of nitrogen fertilizer in the two batches, achieved a decrease rate of 2.87 and 13.4% for the two batches compared to the no-additive treatment B0, which achieved a pH soil of 7.83 and 7.77, respectively, for the two batches. The variance may be attributed to the lowering of the pH soil, to the positive role of the mineral in improving the chemical and fertility properties of the soil and its high water-holding capacity, which was reflected in the increase in hydrogen ion concentrations, thus, pH soil decreases, it agrees with what was found by Cabanilla et al., (2016) who showed that minerals are of great importance in chemical reactions, it was a catalyst for the reactions that occur in the internal cavities of the metal, including the possibility of the metal reducing pH soil added to it.

Tables (3 and 4) indicate that the addition of nitrogen fertilizer had a significant effect in decreasing the values of pH soil, the nitrogen level N4 achieved the lowest pH in the soil without significant difference with the level N3, amounted to (7.41 and 7.45) and (7.22 and 7.28), respectively, while the highest pH when the treatment did not add nitrogen fertilizer N0, and it reached 7.64 and 7.46, respectively, for the two batches, may be due to the acidic final effect of the added fertilizer, urea was characterized by an acidic final effect, as the concentrations of hydrogen ions in the soil solution increase, reflected on the pH as mentioned by Ali (2012).

Tables (3,4) showed that the interaction between the levels of the mineral and the nitrogen fertilizer achieved a decrease in the values of the pH soil, and for all the interaction treatments for the two batches. The interaction treatment B2N4 achieved the lowest decrease, which amounted to 7.30 compared to the comparison treatment B0N0, which reached a value pH of 7.83 (Table 3), with a decrease rate of 6.76%, aAs for the B2N3 treatment, it achieved a significant decrease in the interaction degree in the soil, which amounted to 7.13 (Table 4) compared to the comparison treatment B0N0, which reached 7.77 and a decrease of 8.23%. The reason for the low degree of pH soil may be due to the role that perlite plays in the retention in the compost, which is characterized by its acidic role for a long time in the soil, which increases the concentrations of the positively charged hydrogen ion in the solution and exchange surfaces, and this is consistent with (Silber et al., 2010).

Table (3) The effect of perlite and nitrogen levels on pH soil when adding the first batch of nitrogen

B	N					Mean
	N0	N1	N2	N3	N4	
B0	7.83	7.67	7.58	7.53	7.64	7.65
B1	7.44	7.48	7.56	7.48	7.32	7.45
B2	7.66	7.56	7.36	7.34	7.30	7.43
Mean	7.64	7.57	7.50	7.45	7.41	
$L.S.D_{0.05}$	N		B		N×B	
	0.076		0.059		0.130	

Table (4) The effect of perlite and nitrogen levels on pH soil when adding the second batch of nitrogen.

B	N					Mean
	N0	N1	N2	N3	N4	
B0	7.77	7.54	7.42	7.44	7.31	7.49
B1	7.41	7.31	7.33	7.27	7.24	7.31
B2	7.22	7.20	7.19	7.13	7.16	7.18
Mean	7.46	7.35	7.31	7.28	7.22	
$L.S.D_{0.05}$	N		B		N×B	
	0.026		0.20		0.046	

Available nitrogen in soil (mg N kg-1 soil):

Available nitrogen in the soil when adding the first batch of nitrogen**:**

Table (5) indicated the significant effect of adding perlite levels on the values of available nitrogen in the soil after adding the first batch of nitrogen fertilizer, increasing levels of perlite increased the values of available nitrogen, with averages of 29.76 and 32.15 mg N kg-1 soil for B1 and B2 addition levels, respectively, achieving an increase of 16.52 and 25.88% over the no-add (comparative) treatment B0, which gave the lowest mean of nitrogen available for the plant in the soil 25.54 mg N kg-1 soil. The reason may be due to the role of minerals with a high positive ionic exchange capacity, such as zeolite and perlite, in preserving moisture and nutrients, including nitrogen, without being exposed to known loss processes such as washing, volatilization and fixation for the longest possible period (Al-Dhalami, 2020) and (Kramar and Bindiganavile, 2011.(

Table 5) showed the significant effect of adding nitrogen levels on the values of available nitrogen in the soil when adding the first batch of nitrogen fertilizer, N3 level did not differ significantly with the N4 level, achieving the highest amount of available nitrogen in the soil, which amounted to 32.11 and 32.47 mg N kg-1 soil, respectively, and were significantly superior to the levels N2 and N1, the amount of prepared nitrogen was 29.30 and 28.54 mg N kg-1 soil, respectively. The lowest value was when the no addition treatment (comparison), which amounted to 23.65 mg N kg-1 soil. The reason for the increase of nitrogen in the soil may be due to the increase in the amount of nitrogen added to the soil, while the amount consumed in the early stages by the plant is close to all levels, we conclude that the controller is the amount of high addition at the last levels of nitrogen, this was confirmed by Musa, (2022), who mentioned the increase of available nitrogen in the soil by increasing the level of addition**.**

Table 5) shows that the interaction between mineral levels and nitrogen levels has a significant effect on increasing the amount of nitrogen in soil, the interaction coefficients B2N4 and B2N3 achieved the highest amount of nitrogen in the soil, which was 35.53 and 35.63 mg N kg-1 soil, respectively, thile the lowest value was reached when treating B1N0, which amounted to 22.36 mg N kg-1 soil, which did not differ in the significant aspect with treatment B0N0, which achieved 23.23 mg N kg-1 soil, while the rest of the transactions varied significantly between them, between rise and fall, perhaps the reason is due to the positive role and great ability of clay minerals in preserving the elements and for time periods in available form in the soil (Al-Dhalami, 2020).

Table (5) Effect of levels of perlite and nitrogen on the prepared nitrogen (mg N kg^{-1} soil) after adding the first batch of nitrogen.

B	**N**					**Mean**
	N0	**N1**	**N2**	**N3**	**N4**	

B0	23.23	24.66	24.43	26.53	28.86	25.54
B1	22.36	28.96	30.26	34.20	33.03	29.76
B2	25.36	32.00	33.23	35.63	35.53	32.15
Mean	23.65	28.54	29.30	32.11	32.47	
L.S.D$_{0.05}$	**N**		**B**		**N×B**	
	0.53		0.41		0.92	

Available nitrogen in the soil when the second batch of nitrogen was added.

Table (6) indicated that the addition of perlite had a significant effect on the values of available nitrogen in the soil after adding the second batch of nitrogen fertilizer, the average values were 26.29 and 27.91 mg N kg-1 soil for the level of addition B1 and B2, respectively, achieving increases of 17.78 and 25.04% compared to the treatment of no addition (comparison) B0, which gave the lowest average of 22.32 mg N kg-1 soil. Perhaps the reason was due to an important characteristic of minerals in raising available nitrogen in the soil by retaining nutrients, improving soil fertility when the mineral is mixed with chemical fertilizers and soil (Kavoosi and Rahimi, 2000).

Table (6) shows the significant effect of adding nitrogen levels on the values of available nitrogen in the soil when adding the second batch of nitrogen fertilizer, N4 level averaged 28.14 mg N kg-1 soil without significantly different with the N3 level, amounted to 27.86, achieving an increase rate of 29.91% and 28.62%, respectively, compared to the (comparison) treatment, which averaged 21.66 mg N kg-1 soil. The reason for the increase of nitrogen in the soil may be due to the increased levels of nitrogen fertilizer addition (Musa, 2022).

The interaction between perlite and nitrogen levels had a significant effect on increasing the amount of nitrogen in the soil. The B2N4 interaction treatment achieved the highest amount of nitrogen in the soil, which gave an average of 32.30 mg N kg-1 soil, while the lowest value was reached when treating B0N1, which amounted to 20.40 mg N kg-1 soil, did not differ significantly with the no addition treatment (comparison) which averaged 20.50 mg N kg-1 soil, as for the rest of the treatments, they varied significantly between them, between rise and fall, due to the positive role of the mineral to preserve nutrients, including nitrogen, added for a long time in the soil in availability form that can be absorbed by the plant.

Table (6) Effect of levels of perlite and nitrogen on the prepared nitrogen (mg N kg^{-1} soil) after adding the second batch of nitrogen.						
B	**N**					**Mean**
	N0	**N1**	**N2**	**N3**	**N4**	
B0	20.50	20.40	23.33	24.03	24.33	22.52
B1	22.50	25.43	26.40	29.36	27.76	26.29
B2	23.00	26.13	27.93	30.20	32.30	27.91
Mean	21.66	23.98	25.88	27.86	28.14	
$L.S.D_{0.05}$	**N**		**B**		**N×B**	
	0.37		0.29		0.65	

Available potassium in the soil (mg K kg-1 soil):

Available potassium in the soil when adding the first batch of nitrogen:

Table (7) indicated the significant effect of adding perlite levels on the values of available potassium in the soil after adding the first batch of nitrogen fertilizer, the levels B1 and B2 gave averages of 230.33 and 244 mg K kg-1 soil, respectively, achieving an increase of 26.60 and 34.11%, respectively, compared to the no addition treatment (comparative) B0, which gave the lowest average of 181.93 mg K kg-1 soil, tThe reason may be attributed to the mineral composition of the factors affecting the process of potassium liberation, one of the most important features of the shape of the metal installation is the availability of gaps at the surfaces and edges areas, the presence of these gaps affects the cation exchange capacity of the metal, by allowing and accelerating cations of the soil solution to the internal sites of the metal, this increases the rate of potassium displacement from these vacuoles, thus, increasing its readiness in the soil, and this is consistent with what was reached (Issa and Al-Sheikhly, 2001). Or it may be due to the effect of low soil reaction, as a result of the effect of adding perlite, which causes the dissolution and decomposition of minerals and the release of potassium ion (Table 3 and 4).

Table (7) shows the significant effect of adding nitrogen levels on the values of available potassium in the soil when adding the first batch of nitrogen fertilizer, it was noted from the table that the level of N3 did not differ significantly with the level of N4, achieving the highest value of available potassium in the soil, which amounted to 254.22 and 257.66 mg K kg-1 soil, respectively, were significantly superior to the levels N1 and N2 in which the amount of available potassium was 196.22 and 223.11 mg K kg-1 soil, respectively, while the lowest value was reached at the level of no addition (comparison), which amounted to 162.55 mg K kg-1 soil. The reason may be due to the effect of ammoniacal fertilizers on the availability of potassium from the soil, increasing the availability of potassium by adding urea, this was attributed to the effect of the ammonium ion resulting from the decomposition of this fertilizer and its replacement with potassium, and the latter was liberated from the exchanged layer to the available layer in the soil, and this is consistent with what was reached (Jawad, 2002).

Table (7) showed that the interaction between the levels of the mineral and the levels of nitrogen had a significant effect on increasing the amount of potassium in the soil, the B2N4 treatment achieved the highest amount of available potassium in the soil, which amounted to 293.33 mg K kg-1 soil, with an increase of 7.93% compared to the non-addition treatment (comparison), which gave the lowest average of 155.33 mg K kg-1 soil, as for the rest of the transactions only, they differed significantly among them, this may be due to the fixation of ammonium by specific regions in the perlite network, because it binds to perlite with the highest density of all cations, leads to the release of potassium from these areas, it increases its readiness in the soil, and these results were consistent with what was reached (Markoska, 2019).

Table (7) Effect of levels of perlite and nitrogen on prepared potassium (mg N kg^{-1} soil) after adding the first batch of nitrogen.

B	**N**					**Mean**
	N0	**N1**	**N2**	**N3**	**N4**	
B0	155.33	170.00	182.33	202.33	209.66	181.93
B1	167.66	207.33	226.00	280.66	270.00	230.33
B2	174.66	211.33	261.00	279.66	293.33	244.00
Mean	162.55	196.22	223.11	254.22	257.66	
L.S.D$_{0.05}$	**N**		**B**		**N×B**	
	8.07		6.37		11.31	

Available potassium in the soil when adding the second batch of nitrogen:

Table (8) indicated that the addition of perlite levels had a significant effect on the values of available potassium in the soil after adding the second batch of nitrogen fertilizer, increasing the levels of perlite led to an increase in the values of available potassium in the soil with averages of 241.96 and 272.82 mg K kg-1 soil for the levels of addition B1 and B2, respectively, achieving an increase of 31.00 and 47.70% over the non-addition treatment (comparison) B0, which gave the lowest average amount of potassium available in the soil 184.7 mg K kg-1 soil, because the exchangeable cations in perlite, potassium and calcium, are trapped inside cavities in the perlite structure, these cations can be replaced by ammonium and other metal cations depending on the pH value and its concentration. This was agreed with the results of Mazeikiene (2010).

Table (8) showed that the addition of nitrogen levels was significant in the values of available potassium in the soil, N3 did not differ significantly with the level of N4, achieving the highest amount of potassium available in the soil, which amounted to 261.16 and 266.08 mg K kg-1 soil, respectively, significantly superior to the levels N1 and N2 in which the amount of available potassium reached 224.36 and 241.88 mg K kg-1 soil, respectively, while the lowest amount was when the treatment of no addition (comparison), which amounted to 169.16 mg K kg-1 soil. The reason may be due to the displacement of the potassium ion from the exchange complex and the layers of clay minerals in the high concentrations of ammonium resulting from the added urea due to the convergence of their sizes, it was also due to the oxidation of ammonium by the nitrification process and the formation of nitrates, which reduces the degree of reaction and thus increases the solubility of some compounds and minerals containing potassium, reflected on its readiness in the soil and this agrees with (Khairo, 2003; BarTal, 2011; Al Yassari, 2012).

Table (8) showed that the interaction between the levels of the mineral and the levels of nitrogen had a significant effect on increasing the amount of potassium in the soil, B2N3 treatment achieved the highest amount of potassium in the soil, which amounted to 310.66 mg K kg-1 soil, with an increase of 53.54%, while it did not achieve a significant difference with the treatments B1N4 and B2N4, in which the amount of potassium was 291.00 and 295.33 mg K kg-1 soil, respectively, the lowest value when the non-additive (comparative) treatment was B0N0, which amounted to 146.16 mg K kg-1 soil, the rest of the treatments differed significantly in the amount of potassium available, perhaps the reason is that mixing perlite with chemical fertilizers added to the structure of perlite mineral, contains large cavities, retain nutrients, including ammonium, it increases the chemical and fertility properties of the soil (Wang and Peng, 2010).

Table (8) Effect of perlite and nitrogen levels on prepared potassium (mg N kg-1 soil) after adding the second batch of nitrogen.

B	N					Mean
	N0	N1	N2	N3	N4	
B0	146.16	184.33	195.33	202.33	212.33	184.7
B1	182.66	223.33	242.33	270.50	291.00	241.96
B2	195.66	265.43	288.00	310.66	295.33	272.82
Mean	169.16	224.36	241.88	261.16	266.08	
L.S.D$_{0.05}$	N		B		N×B	
	6.05		5.59		9.56	

Biological yield (microgram ha-1):

Table (9) shows that there is an increase in the biological yield with the increase in the levels of added perlite, tThe levels B1 and B2 gave averages of 16.74 and 19.21 mcg ha-1, respectively, with an increase of 24.09 and 42.40%, respectively, than the no-addition treatment (comparison), which gave the lowest average of 13.49 mcg ha-1, B2 was significantly superior to level B1, this increase may be due to the positive role of the mineral in improving the fertile soil properties, especially the nitrogen and potassium elements, as it had a significant effect in increasing plant height, this was natural, accompanied by a high vegetative growth of leaves, stems and ears, which was reflected in the increase in the biological yield (Abdul Hassan, 2018).

Table (9) showed that the addition of nitrogen fertilizer at different levels had a significant effect on the biological yield, the levels N1, N2, N3, and N4 gave averages of 15.68, 17.09, 17.85 and 18.65 mcg ha-1, respectively, with an increase of 37.62 and 43.79%, respectively, for levels N3 and N4 over the level of no addition (comparison), which gave the lowest average of 12.97 mg ha-1, N4 level did not differ significantly with the N3 level, but it was significantly superior to the rest of the other levels. The reason was that adding nitrogen fertilizer increases the plant's ability to grow and produce straws, improving the performance of biological processes within the plant, most of the nitrogen absorbed from the roots is exploited to increase the size of the vegetative group and grains, and these results are consistent with what was found

(Al-Waeli, 2002; Al-Murjani, 2005; Faraj and Jadoua, 2015).

Table (9) indicates that the interaction between the levels of the mineral and the levels of nitrogen fertilizer has led to a significant increase in this trait, the interaction treatment B2N4 outperformed and gave the highest value of 21.88 mcg ha-1 with an increase of 90.75% over the no addition treatment (comparison) B0N0 which gave an average of 11.47 mcg ha-1, while the rest of the transactions varied significantly between them, between rise and fall, this increase is due to the fact that the mineral reduces the loss of urea by washing, to trap them in the vacuoles of the metal and release them slowly, which provides available nitrogen to the plant on a continuous basis, led to an increase in the biological yield of the cultivated crops (Latifah et al., 2011). Adding minerals with chemical fertilizers gave a high production in the plant, also, when treating the soil with metal, a high yield of wheat is obtained, for its adsorption of macronutrients, including nitrogen, phosphorous and potassium, which have a significant impact on the growth and productivity of the crop (Wiedenfeld, 2003).

Table (9) Effect of perlite and nitrogen levels on the biological yield of wheat (mcg ha^{-1}).

B	**N**					**Mean**
	N0	**N1**	**N2**	**N3**	**N4**	
B0	11.47	12.40	13.83	14.48	15.25	13.49
B1	12.87	15.81	17.89	18.32	18.83	16.74
B2	14.57	18.85	19.56	20.74	21.88	19.21
Mean	12.97	15.68	17.09	17.85	18.65	
L.S.D$_{0.05}$	**N**		**B**		**N×B**	
	0.11		0.08		0.19	

References

Abdul Hassan, S.N. 2018. Using zeolite mineral to improve the physical properties of soils of different textures and the growth of wheat plants. Al-Muthanna University - College of Agriculture.

Al-Dhalami, G.R.H. 2020. The effect of adding zeolite, phosphorous and sulfur on the release of phosphorous in soil and wheat productivity, Al-Muthanna University- College of Agriculture.

Ali, N.S. 2012. Fertilizer Technologies and Their Uses. University House for printing, publishing and translation. Ministry of Higher Education, Research and Scientific. faculty of Agriculture. Baghdad University. Iraq. 202

Al-Murjani, A.H.F. 2005. Effect of the level of ground application of NP K and its spraying on the growth and yield of wheat Triticum aestivum L. Master Thesis - College of Agriculture - University of Baghdad.

Al-Waeli, A.Ta.M. 2002. Effect of adding nitrogen and potassium to the soil and spraying on the accumulation of dry matter and nitrogen concentrations in the shoots of wheat Triticum aestivum L. Journal of the College of Basic Education. Number (52): 468-455.

Al-Yassari, M.N.H. 2012. Effect of batches and levels of nitrogen fertilizer on the readiness and release of ammonium and potassium in the soil, growth and yield of wheat (Triticum aestivum L.). Master's Thesis, Faculty of Agriculture. Baghdad University

Bar Tal, A. 2011. the Effect of Nitrogen form on interaction with potassium .Inter. Pot. I.(29): 3-11.

Bremner, J.M. and A. P. Edwards.1965. Determination and isotope ratio analysis of different forms of nitrogen in soils:1.Apparatus and procedure for distillation and determination of ammonium. Soil. Sci.Soc.Amer.Proc.,29:504- 507

Cabanilla, C.C.; Canillas, N.C.; Molinos, J.A. and Palmes, L.J.K.S. 2016. Effects of PH, Initial Nitrate Concentration And ZeoliteLoading on The Removal of Nitrates From Synthetic WastewaterUsing Rice Husk-Derived Zeolite.

Evans, M.R. 2004. Ground bovine bone as a perlite alternative in horticultural substrates. Hort Technology 14:171-175.

Faraj, J.T. and K.A. Jadoua 2015. . Effect of Nitroen Levels and Its Addition Fraction on Barley Grain Yield (Hordeum Vulgare. L). Journal of Iraqi Agricultural Sciences 46 (6) 942-943

Issa, S.K. and R.A. Al-Sheikhly 2001. Shape features of mica minerals and their relationship to potassium liberation in some sedimentary plain soils. Iraqi Agricultural Science Journal, Volume (32), Issue Four, pp.: 22-9.

Jackson, M. L. 1958. Soil chemical analysis prentice Hall. Inc. Englewood Cliffs, NJ, 498, 183-204.

Jawad, K.S. 2002. Effect of adding urea and ammonium sulfate on the rate of potassium release in a sedimentary soil. Iraqi Journal of Agricultural Sciences.33(5): 65.72.

Kavoosi, M; Rahimi, M. 2000. The effect of zeolite application on rice yield in both light and heavy soils. Ministry of Agriculture. AgriculturalEducation Research Organization. National Rice Research Institute .

Khairo, A.M. 2003. Effect of spraying with nitrogen and potassium on the growth of maize yield. Master's Thesis - College of Agriculture, University of Baghdad.

Kramar, D., Bindiganavile, V. 2011. Mechanical properties and size effects in lightweight mortars containing expanded perlite aggregate .Article. Materials and Structures 44(4):735-748.

Latifah, O.; Ahmed, O.H.; and Muhamad, A.N. 2011. Reducing ammonia Loss from urea and improving soil exchangeable ammonium and available nitrate in nonwater logged soils through mixing zeolite and sago (Metroxylon sagu) waste water.

Markoska, V. 2019. structural , pHysical and chemical characterization of perlite as a substarte for improving the soil properties . University "Goce Delcher " in shtip. Faculty of Agriculture – shtip . Doctoral dissertation , pp. 1-222.

Mazeikiene, A., M. Valentukeviciene, M. Rimeika, A. B. Matuzevicius, and R. Dauknys. 2010. Removal of nitrates and ammonium ions from water using natural sorbent zeolite (clinoptilolite). J Environ Eng Landscape Manage 16: 38-44

Musa, L.A. 2022. Effect of some chemical compounds and aqueous plant extracts added to urea on the nitrification process, ammonia volatilization in the soil and the growth and yield of barley. Master's Thesis, College of Agriculture, Al-Muthanna University.

Nelson, P. V. 2012. Greenhouse operation and management. 7th ed. Pearson, Upper Saddle River, NJ.

Page, A. L., Miller, R. H. and D. R. Keeney .1982. Methods of soil analysis. Part (2). 2nd. ed. Madison, Wisconson, USA; PP: 1159.

Richards, L.A .1954. Diagnosis and Improvement of Saline and Alkali soils. USDA hand book No (60) roseus (L.) G. Don and Gazania rigens var. rigens (L.) Gaertn. roseus (L.) G. Don and Gazania rigens var. rigens (L.) Gaertn.

Schmilewski, G. 2009. Growing medium constituents used in the EU. Acta Hortic. 819(1):33-46.

Shafak, S.E.A. and A.E. Al-Dababi. 2008. Field crop production. First edition. Arab Thought House. p.594.

Silber, A., B. Yosef, Z. Levkovitich and S. soryano .2010. pH – dependent surface properties of perlite : Effect of plant growth. J. Geoderma,158 : 275-281.

Verdonck, O. and P. Demeyer. 2004. The influence of the particle size on pHysical properties of growing media. Acta Hort. 644: 99-101.

Wang, S, Peng Y .2010. Natural zeolites as effective adsorbents in water and wastewater treatment. Chem Eng J 156: 11–24.

Wiedenfeld, B. 2003. Zeolite as a soil amendment for vegetable production in the lower Rio Grande valley. Subtropical Plant Sci, 55,7-10.