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# Effect of Row Spacing and Nitrogen Rate on Wheat Growth and Yield

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## Abstract

A field experiment was carried out at the research station of the College of Agriculture, university of Al-Muthanna in winter 2021-2022 to study the effect of four levels of nitrogen (250, 200, 150, 100) kg N $ha^{-1}$ and four Row Spacing (30, 25, 20, 15). (cm) on Wheat Growth and Yield. The results a significant superiority of the fertilizer rate 250 kg N ha-1 in plant height, leaf area, number of tillers, and nitrogen concentration, with means of 90.5 cm, 32.3 $cm^2$, 323.3 leaves $m^{-2}$, and 2.94%, respectively. The row spacing of 30 cm showed a significant superiority for the characteristic of the number of tillers, which reached to 319.5 tillers $m^{-2}$, while the The row spacing did not show any significant superiority in most of the studied traits plant height, number of days from planting to flowering, number of days from flowering to maturity, leaf area of the plant, nitrogen concentration).

.**Keywords:**

## Introduction

The wheat crop, *Triticum aestivum* L., which belongs to the Poacea family, is one of the most important food grain crops, as it comes first in terms of economic importance and cultivated area in Iraq and the world, as the total production for the winter season of 2021 is estimated at about 4234 thousand tons, as well The production of wheat straw was estimated at 10,463 thousand tons (Directorate of Agricultural Statistics 2021), and the nutritional importance of the wheat crop is due to the good balance in its grains between proteins and carbohydrates, in addition to containing quantities of fats, vitamins, some mineral salts, and essential amino acids that humans need (Ali, 2017). Despite this, the productivity of this crop is still below the level, so important scientific methods must be followed to raise its productivity to meet the actual need of it, and the most important of these methods is mineral nutrition, whether the addition is ground or sprayed on the plant (Sarhan et al., 2020).

The nitrogen element is one of the elements that plays a key role in improving the vegetative growth of the plant, which is reflected positively in increasing the yield and its components, in addition to raising the efficiency of the flag leaf in the

manufacture of amino acids, which are transferred to the grains, and thus increasing the percentage of protein per grain, which gives the dough the characteristic of excellent bakery (Ehsan, 2014), in addition to being the first element that leads to an increase in the amount of protein in cereals and flour, and leads to an increase in gluten and chelide (Al-Ani et al., 2017).

The geometry of the distribution of plants in the field with the selection of the variety has a major role in the performance of the crop, and the distance between the lines can affect the increase in the efficiency of the plant by producing a number of tillers and spikes, in addition to affecting the grain weight (Naresh et al., 2014). Therefore, it is necessary to determine the optimal number of plants per unit area and the spacing between plants to obtain high productivity. Rasool et al., (2013) Accordingly, this study aims to determine the best level of nitrogen fertilizer with the best distance between the lines and determine the best interaction between them to obtain the highest growth. and productivity of wheat crop per unit area within the study area.

## Materials and methods

A field experiment was carried out in Al-Muthanna Governorate, during the winter season 2021-2022 to study the effect of four levels of nitrogen (250, 200, 150, 100) kg N $ha^{-1}$ and four planting distances between lines (30,25, 20, 15) cm on the characteristics of growth and yield of wheat crop, using randomized complete block design (RCBD), with split plot arrangement and three replications, nitrogen levels occupied main plots, and the distance between lines occupied secondary plots.

The soil was analyzed and a composite sample was made from it, its chemical and physical characteristics were estimated in Table (1), and then plowing, smoothing and land division operations were carried out. The planting process took place on the ninth of December, and the irrigation process was carried out according to the plants need. Urea fertilizer was used as a source of nitrogen, and it was added according to the levels in four dose for each addition level after seedling, the second at tillers, the third at elongation, and the fourth during the booting stage. Phosphorus fertilizer was also added in an amount of 100 kg $P.ha^{-1}$ in the form of the triple superphosphate fertilizer P2O5, in one batch at planting (study 1995).

Table (1) some chemical and physical properties of agricultural soil

| Paragraph | %sand | %silt | %clay | soil texture | electrical conductivity Ecds.m)) | degree of interaction PH | Available nitrogen ppm | phosphorous Available ppm | potassium Available ppm | Organic Matter |
|---|---|---|---|---|---|---|---|---|---|---|
| the value | 18.3 | 45.01 | 36.80 | Silty Clay Loa | 8.90 | 7.82 | 52.00 | 11.20 | 132 | 1.13 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | m | | | | | | |

**Studied traits :**

1. Number of days from planting-100% flowering (day)
2. Number of days from 100%-physiological maturity (day)
3. Plant height (cm)
4. Leaf area (cm2)
5. No. of tillers per m2
6. Nitrogen concentration in leaves

**statistical analysis**

The data were analyzed statistically using the 20 Gen Stat program, and the means were tested according to L.s.d. to compare between the arithmetic means at the 5% probability level.

**3- Results and Discussion:**

**1- Number of days from planting-100% flowering (day).**

The results of the analysis of variance table(2) indicated that there was no significant effect of nitrogen levels, agricultural distances and the interaction between them in the mean number of days from planting to flowering.

The results in the table(2) showed a non-significant superiority of level N4 over the rest of the levels.

The results in the table(2) showed a non-significant superiority of the distances.

Table (2) Effect of nitrogen levels and planting distances and the interaction between them on the number of days from planting-100% flowering (day)

| nitrogen levels(N)<br>Spaces<br>Agriculture(S) | 100<br>(Kg) | 150<br>(Kg) | 200<br>(Kg) | 300<br>(Kg) | mean distances |
|---|---|---|---|---|---|
| 15cm | 92.67 | 92.67 | 101.0 | 97.33 | 95.92 |
| 20cm | 90.67 | 95.67 | 96.00 | 96.67 | 94.75 |
| 25cm | 93.00 | 97.00 | 95.33 | 98.00 | 95.83 |
| 30cm | 92.00 | 89.33 | 91.67 | 97.33 | 92.58 |

| | | | | | |
|---|---|---|---|---|---|
| nitrogen means | 92.08 | 93.67 | 96.00 | 97.33 | |
| L.S.D 0.05)) | N | S | N x S | | |
| | N.S | N.S | N.S | | |

**Number of days from 100% flowering to physiological maturity (day)**

The results of the analysis of variance table (3) indicated that there was no significant effect of nitrogen levels, agricultural distances and the interaction between them on the mean number of days from flowering-physiological maturity.

The results showed in Table (3) a non-significant superiority of the 100 kg N $ha^{-1}$ level in the number of days from flowering to maturity.

The results of Table (3) indicated a non-significant superiority for the distances.

Table (2) Effect of nitrogen levels and planting distances and the interaction between them on the number of days from planting-100% flowering (day)

| nitrogen levels (N)<br>spaces<br>Agricultur(S) | 100<br>(Kg) | 150<br>(Kg) | 200<br>(Kg) | 300<br>(Kg) | Mean<br>Distances |
|---|---|---|---|---|---|
| 15cm | 35.33 | 37.33 | 28.67 | 34 | 33.83 |
| 20cm | 37 | 32.67 | 34.67 | 33 | 34.33 |
| 25cm | 36 | 31 | 35.67 | 30.67 | 33.33 |
| 30cm | 37 | 41.67 | 36.67 | 28.33 | 35.91 |
| nitrogen means | 36.33 | 35.67 | 33.92 | 31.5 | |

| | | | |
|---|---|---|---|
| L.S.D 0.05)) | N | S | N x S |
| | N.S | N.S | N.S |

**plant height (cm)**

The results of the analysis of variance table, indicated that there was a significant effect of nitrogen fertilization levels on the mean plant height, the agricultural distances and the interaction between fertilization and distances had no - significant effect on the rate of this trait.

The results of the table showed a significant superiority of the fertilizer level of 250 kg N $ha^{-1}$ with the highest mean plant height of 90.5 cm, which did not differ significantly from the level of (200 kg N $ha^{-1}$), which gave an mean of 85.64 cm, while the levels (150 , 100 kg N $ha^{-1}$). Two means of 78.125 and 73.71 cm, respectively. The reason for the higher level of (250 kg N $ha^{-1}$) is due to the role of nitrogen in cell division and elongation, which increased plant height. The important role of nitrogen in building the chlorophyll molecule and building enzymes, proteins, hormones, and amino acids that are involved in cell division and elongation, and then increasing plant height, Al-Jabri, (2020), this result agreed with (Hussein et al., 2013, Al-Anbari and Al-Rafi'i, 2013, and Al-Abdullah , 2015, Hussain et al., 2017, Sarhan and Abdel Ghafour, 2020), all of whom indicated that there were significant differences between the levels of nitrogen fertilizer in the rate of plant height.

Table (4) The effect of nitrogen levels, planting distances, and the interaction between them on plant height (cm)

| nitrogen levels (N)<br>spaces<br>Agriculture | 100<br>(Kg) | 150<br>(Kg) | 200<br>(Kg) | 300<br>(Kg) | distance means |
|---|---|---|---|---|---|
| 15cm | 74.18 | 80.17 | 84.82 | 92.58 | 82.94 |
| 20cm | 76.65 | 75.15 | 83.86 | 89.74 | 81.35 |
| 25cm | 72.13 | 76.63 | 87.28 | 90.00 | 81.51 |

| | | | | | |
|---|---|---|---|---|---|
| 30cm | 71.87 | 80.55 | 86.58 | 89.76 | 82.19 |
| nitrogen means | 73.71 | 78.12 | 85.63 | 90.50 | |
| L.S.D | N | S | N x S | | |
| | 8.53 | N.S | N .S | | |

**leaf area ($cm^2$)**

The results of the analysis of variance table indicated that there were significant differences between the arithmetic mean of the leaf area according to the different nitrogen fertilizer levels, while the distances between the lines and the Interaction between the fertilization and the distances had no significant effect on this characteristic.

The results, showed in Table (5) that there was a significant effect of the levels of nitrogen fertilizer on the mean leaf area cm2, while the mean level of (150 kg N ha-1) was 28.25 cm, while the level of (100 kg NH-1) gave the lowest mean for this characteristic reached to 21.34 cm. As a result of the important role of nitrogen in the different growth stages, which reflected positively on increasing the leafy area of the crop, the positive correlation of nitrogen concentration for this characteristic, as the correlation value reached 0.329, in addition to the basic role of nitrogen in stimulating vegetative growth as it affects the Cell division and elongation and works to increase the concentration of chlorophyll in the leaves, which leads to an increase in the process of photosynthesis, which reflects positively on the leafy area of the plant (Isa, 1990). This result agreed with the findings of Al-Lami (2009) and Abra. Heim (2018) and Abo El Ezz and Haffez (2019), who all proved that a significant increase in leaf area occurred with an increase in the level of nitrogen fertilizer.

Table (5) the effect of nitrogen levels and planting distances and the interaction between them on the leaf area of the plant (cm)2

| nitrogen levels (N)<br>Spaces Agriculture(S) | 100 (Kg) | 150 (Kg) | 200 (Kg) | 300 (Kg) | distance means |
|---|---|---|---|---|---|
| 15cm | 21.38 | 25.59 | 30.52 | 30.68 | 27.04 |

| | | | | | |
|---|---|---|---|---|---|
| 20cm | 22.04 | 29.08 | 30.17 | 29.73 | 27.76 |
| 25cm | 21.47 | 27.94 | 30.57 | 32.34 | 28.08 |
| 30cm | 20.46 | 30.4 | 30.6 | 35.37 | 29.20 |
| nitrogen means | 21.34 | 28.25 | 30.47 | 32.03 | |
| (L.S.D 0.05) | N | | S | N x S | |
| | 3.13 | | N.S | N.S | |

**No of tillers per m2.**

The results of the analysis of variance table indicated that there were significant differences between nitrogen fertilizer levels and planting distances, and the Interaction between them in the mean number of tillers.

The results showed in Table (6) that there were significant differences in the number of streaks with different levels of nitrogen fertilizer, as the level exceeded 250 kg N ha-1 with the highest mean for this characteristic reached to 323.3 tillers M-2 without a significant difference from the level of (150 kg N ha-1), which gave an mean of (150 kg N ha-1) 323.0 tillers m-2, while the levels (200 and 100 kg N ha-1 )gave the lowest mean for this characteristic reached to (259.3 and 267.3) tillers m-2, and the reason for this may be attributed to the fact that the availability of sufficient quantities of nitrogen for the plant encourages the growth of primary shoots And the secondary one also supports the growth of tillering buds and prolongs the period for their production, in addition to the availability of nitrogen during the different stages of the plant leads to a decrease in the percentage of death of some tillers and thus an increase in the number of tillers. ) who all indicated that there were significant differences between the levels of nitrogen fertilizer in terms of the number of tillers.

The results confirmed in Table (6) that there are significant differences in the number of tillers with the different planting distances between the lines, as the distance of 30 cm, was significantly superior by giving it the highest mean number of tillers, which reached to 319.5 m, without a significant difference for the two distances of 15 and 20 cm, as it gave a number of tillers of 294.4 and 289.2 m2 tiller, respectively, while the distance of 25 cm, gave the lowest mean number of pruning, which was 269.8 m2. The result is in agreement with the findings of Alzubaidy and Aljubory (2018) who confirmed that the number of overgrafts increased with the increase in the distance between the

planting lines, while this result differed with Al Anbari et al. while reducing the distance between planting lines.

As for the effect of the interaction between nitrogen fertilizer levels-planting distances, the interaction (250 kg N ha - 1 x 15 cm) gave the highest mean of 411.0 shrew m - 2 without a significant difference from the interference (150 kg N ha - 1 x 30 cm) which gave an mean It reached 410.4 rips m-2, while the Interactionping (100 kg N e - 1 x 15 cm) gave the lowest mean number of strokes reached to 235.8 rips m-2, and the reason for this may be attributed to the fact that increasing the percentage of nitrogen in narrow spaces reduced competition between plants and thus increased the number of Erasing.

Table (6) The effect of nitrogen levels, planting distances and the interaction between them on the number of tillers (m)2

| nitrogen levels (N) Spaces Agriculture(S) | 100 (Kg) | 150 (Kg) | 200 (Kg) | 300 (Kg) | means distances |
|---|---|---|---|---|---|
| 15cm | 235.8 | 268.0 | 262.8 | 411.0 | 294.4 |
| 20cm | 276.7 | 299.3 | 256.7 | 324.2 | 289.2 |
| 25cm | 248.7 | 314.2 | 255.7 | 260.7 | 269.8 |
| 30cm | 308.1 | 410.4 | 262.0 | 297.4 | 319.5 |
| means nitrogen | 267.3 | 323.0 | 259.3 | 323.3 | |
| L.S.D 0.05)) | N | S | N x S | | |
| | 36.13 | 31.43 | 61.75 | | |

**The nitrogen concentration in the shoot system**

The results indicated in the analysis of variance table to the significant effect of levels of nitrogen fertilization and the

Interaction between fertilization and distances between lines on the concentration of nitrogen in the flag leaf, while planting distances had no significant effect on this trait.

the result showed from Table (7) that there was a significant effect of the levels of nitrogen fertilizer on the mean nitrogen concentration, as it exceeded the level of (250 kg N $ha^{-1}$) by giving it the highest mean of 2.94% compared to the mean levels,( 200, 150, 100 kg N H-1), which did not differ significantly between them, as It gave means of (2.24, 2.42 and 2.3)%, respectively, and the reason may be attributed to the fact that the increase in added nitrogen led to an increase in its absorption by the plant and thus an increase in its concentration in the leaves. This result agreed with (Deriak and Abdel-Kader, 2015) and (Turki and Abd AL Kader, 2017) and (Abo El Ezz and Haffez, 2019), who all indicated an increase in nitrogen concentration by increasing the level of nitrogen fertilizer.

As for the interaction between nitrogen fertilizer levels and planting distances, the results of the table indicated that the interaction between the level of 250 kg NH-1 and the distance of 30 cm was significant, as it gave the highest mean nitrogen concentration of 3.57%, which did not differ significantly with the combination (200 kg NH-1 20). x cm), as it gave an mean of 3.01%, while the mixture (100 kg N x H-1 30 cm) gave the lowest mean for this characteristic, amounting to 1.47%. The reason for the superiority of this combination may be due to the increase in nitrogen added with the increase in the distance between the lines, which reduced competition between plants, thus increasing the uptake of nitrogen, which led to an increase in its concentration inside the leaves.

Table (7) The effect of nitrogen levels, planting distances, and the interaction between them on the nitrogen concentration in the leaves. %

| nitrogen levels<br>) N)<br>spaces<br>Agriculture(S) | 100<br>(Kg) | 150<br>(Kg) | 200<br>(Kg) | 300<br>(Kg) | means<br>distances |
|---|---|---|---|---|---|
| 15cm | 2.87 | 2.66 | 1.61 | 2.66 | 2.45 |
| 20cm | 2.59 | 2.73 | 3.01 | 2.8 | 2.78 |
| 25cm | 2.03 | 2.38 | 1.89 | 2.73 | 2.25 |
| 30cm | 1.47 | 1.89 | 2.73 | 3.57 | 2.41 |

| | | | | | |
|---|---|---|---|---|---|
| means<br>nitrogen | 2.24 | 2.41 | 2.31 | 2.94 | |
| L.S.D 0.05)) | N | S | N x S | | |
| | 0.30 | N.S | 0.74 | | |

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