Response of Some Bread Wheat (*Triticum aestivum* L.) Cultivars to Nitrogen Levels

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Abstract:

A factorial experiment was conducted at the research field of College of Agriculture, University of Duhok, Summel, Kurdistan region/Iraq, during the season 2014 – 2015. The study aimed to investigate the response of growth and yield of five bread wheat cultivars namely: SHIF-7, NS733, QAF2AH-31, ALFAJER-1 and TAMUS to different nitrogen levels (0, 100, 120, 140 kg N ha\(^{-1}\)). Using randomized complete block design (RCBD) with three replications. The results showed significant differences among the tested wheat varieties for plant height, No. of days to %50 flowering, biological yield, 1000 - grain weight, grain yield Index, total chlorophyll and protein content. The majority of studied traits were maximum with wheat varieties SHIF-7 and ALFAJER-1. Nitrogen levels were also exhibited the significant effect on all studied traits except in few cases. It was found that the application of N up to 120 Kg N ha\(^{-1}\) significantly increased plant height, biological yield, no. of grain spike\(^{-1}\), grain yield, harvest index, total chlorophyll and protein content. The greatest grain yield 433g 1.2m\(^2\) (≈
3608.3 Kg ha\(^{-1}\)) was obtained with interaction between SHIF-7 × 120 Kg N ha\(^{-1}\). However, according to these study, it might be suggested that, rate of 120 Kg N ha\(^{-1}\) with varieties SHIF-7 and ALFAJER-1 could be recommended for appropriate wheat production under local environmental condition.

Keywords: Wheat (\textit{Triticum aestivum} L.), varieties, nitrogen levels, grain yield index, yield components.
Introduction:

Wheat (*Triticum aestivum* L.) is major cereal crop in the world and dominates the agronomic crops in term of production [1] and [23]. According to Shahzad et al., [23] “Wheat is a stable food for approximately one third of world population and occupies an important position in agriculture policies and farming”. However, the rapid growth of population has put a great pressure on the world food supply particularly grains. Therefore, appropriate grain production technology is highly important to be adopted to fulfill world food demands.

Management of nitrogen (N) gets ever harder. Regulations have become more stringent while fertilizer and wheat prices become more volatile. Growers must know how to maximize profit from N but minimize environmental impact in each field, therefore, dose of nitrogen fertilizer very important factor affecting the wheat yield and its quality. The production of wheat faces multiple challenges: it has to maximize grain yield with maintaining its protein content[26] to improve plant efficiency by using N fertilizer, adopt efficient production methods on N-deficient soils at the same time protecting the environment from N losses [17].

Nitrogen deficiency in low fertility soil is one of the major factors limiting wheat production [25]. According to Hussain et al.,[11] wheat varieties respond differently to the level of N fertilization. Rahman et al.,[20] stated that crop response to apply N fertilizer relies on soil type, soil fertility, soil and crop management practices, crop variety and methods of application. Thus, choice of genotype, which absorb N more efficiently, and N fertilization techniques (such as desired N fertilizer application) seem to give great influences on quality and grain yield production of wheat [27].

The Kurdistan region is located in semi-arid zone and nitrogen
Deficiency is widespread in most of soils of the area. Thus deficiency can be overcome by application of organic and inorganic fertilizers. Every year numerous new varieties of wheat being evolved and introduced by the breeder and grown in large part of the area, but the farmers are not fully aware about the economic, quality and grain yield potential of these new wheat varieties. It has been suggested that in order to assure maximum production and acceptable quality, cultural practices should be evaluated for each variety grown in the area[19]. This study was therefore aimed to evaluate the productivity of five bread wheat variety under different nitrogen levels and agro – climatic condition of Duhok.

**Material and Methods:**
A field experiment was conducted at the research field of the College of Agriculture, Summel, Duhok Governorate, Kurdistan region – Iraq, during growing season 2014-2015. The climate of the area is characterized by arid and semi-arid climate with mean annual precipitation (480mm) and means annual maximum and minimum temperature is (33.5°C) and (10.3°C) respectively. The soil of the area is classified as silty clay loam texture soil with organic matter content of 0.9% and available nitrogen 0.012%. The topography of the area is flat with an elevation of (475 meter above sea levels) and geographical location of the area is located between 36°,51',41"N longitude; and 42,51',67"E latitude. The area is well known for its extensive wheat production.

The experiment have been laid out in the form of randomized complete block design (RCBD) and factorial arrangement with three replicates consisting of 60 treatments unites (plots) with 0.6 × 3m (1.8m²) size combined of five wheat varieties namely: SHLF-7, NS733, QAF2AH-31, ALFAJER – 1, TAMUS and four level of nitrogen fertilizer, i.e. (0, 100, 120, 140) kg N ha⁻¹. The seeds were drilled in rows by hand at rate of
120 kg ha\(^{-1}\). The N fertilizer were applied by surface broadcasting in the form of urea (46%) and in a split dose, i.e. half applied at sowing time and the remaining half was applied at the beginning of tillering. Similarly, each plot was received an equal amount (125 kg P\(_2\)O\(_5\) ha\(^{-1}\)) of phosphorus fertilizers in the form triple super phosphate (46% P\(_2\)O\(_5\)). All the other agronomic practices such as weeding and hoeing were carried out uniformly for the whole experiment as recommended.

For data collection, plant height measurement (cm) was performed at 50% flowering by selecting 10 tillers (main stem) randomly in each experimental units and measuring the length of plant from the base of plant to tip of spike excluding awns. The leaves area (cm\(^2\)) was also measured for 10 flag leaves by taking the length and width of the leaves and then multiplying by 0.74 as a correction factors [15]. At the same time, flag leaves were measured for their chlorophyll content using SPAD 502 Plus Chlorophyll Meter. No. of days to 50% flowering was determined by appearance of pollen in half of the plot.

At the time of harvesting (at maturity), 10 spikes were selected randomly for measuring: weight of grains per spike (g), No. of grains per spike. Crop samples were harvested at ground level from the two central rows (0.2m × 3m) of each plot for biological and grain yield measurement. The biological yield was recorded in g 1.2m\(^{-2}\). After measuring the biological yield, the spikes were threshed and the grain weighed separately to determine the grain yield for the experimental units and then the 1000 grain weight. Harvest index was calculated as the ratio of grain weight to dry biological yield using the following formula: (HI = grain weight/biological yield × 100). The grain protein content was determined though pre-measurement of nitrogen concentration in grain by micro-kjeldahl method after wet digesting ground samples of each plot by
H$_2$SO$_4$ and HClO$_4$, then calculating the content of protein by multiplying N value by 5.75 (protein content% = N% × 5.75) according to methods described by American Association Cereal Chemists (AACC) [4].

Data was analyzed using analysis of variance method (ANOVA) with GLM procedure to examine the significant effect (P < 0.05) of treatments on growth and yield attributes, using the Minitab software package 16. Subsequently, Tukey's HSD (Honestly Significant Difference) test was used to identify significant differences between treatment means.

**Results and discussion**

Plant height (cm)

The means table of plant height (Table 1) indicate that wheat cultivars significantly affected in this trait (P < 0.05); also the nitrogen levels significantly affected (P<0.05) plant height but the interaction between varieties and N levels were not significant (P > 0.05). Plant height for the five varieties average over dose of nitrogen showed that, variety SHLF – 7 had maximum plant height (114.6cm) and minimum plant height (91cm) was obtained with ALFAJER -1 (Table 2). This difference in plant height among plant genotypes is not surprising because physiological and biochemical mechanisms of plant are different and many of these process are under genetic control, but may be altered dramatically when plant are grown in different nutrition conditions[2 and 14]. Plant height increased with increasing nitrogen levels and the rate of 140 kg ha$^{-1}$, had a maximum plant height (105.4cm), which was at par with 100 and 120 kg N ha$^{-1}$ (Table,3).Table(4) exhibited the interaction between varieties and nitrogen levels, maximum plant height (123.4cm) was recorded for variety SH1F-7 when nitrogen level was 140kg ha$^{-1}$. These results supported the findings of Ishag [13]and [22] who reported that increasing the levels
of nitrogen increased the plant height.

Flag leaf area (cm²)

Table (1) showed that there were no significant different in flag leaf area among the five wheat varieties, nitrogen levels treatments ($P > 0.05$) but the interaction between varieties and nitrogen levels exhibited a significant effect ($P < 0.05$) on flag leaf area. In spite of existence of few differences in means of both varieties and nitrogen levels treatments, these trends were statistically not significantly different. Concerning the interaction effects, interaction between applied N levels and wheat varieties on flag leaf area was found to be significant ($P < 0.05$) (Table 1). Applying 140 kg N ha$^{-1}$ resulted in a significant increase in flag leaf area for variety NS733, while variety QAF2H-31 and TAMUS showed significantly lower flag leaf area with application of 140 kg N ha$^{-1}$ (Table 4). Therefore, depending on these results it can be claimed that the response of flag leaf area to nitrogen levels relies on the wheat varieties. However, maximum flag leaf area (34.3 cm²) was recorded by variety NS733 at level 140 kg N ha$^{-1}$, while the minimum flag leaf area (23.4 cm²) was recorded in control treatments and SHLF-7. These findings are in accordance with results of Bhorgi [7] who reported that increasing nitrogen level, increased biomass. In another study Kumari,[14] reported that “Nitrogen availability had a systematic and large effect on leaf length and width displaying increased number of veins and stomata, indicating increased cell division and production of more cells”

No. of days to 50% flowering

Wheat varieties were highly and significantly affected ($P < 0.001$) on the number of days to 50% flowering but the nitrogen levels did not affected significantly ($P > 0.05$) this trait (Table 1). Table 2 showed the effect of varieties on number of days to 50% flowering, the variety ALFAJER-1 exceeded
other varieties and recorded 179 days, followed by variety QAF2H-31 which gave 176 days, while the variety TAMUS gave the lowest number of days to 50% flowering (161 days). This is not surprising because number of days to 50% flowering in wheat plant varies with stage of plant development due to genetic makeup [12]. On the other hand, no significant interaction ($P > 0.05$) between N fertilization and wheat varieties which was recorded on No of days to 50% flowering (Table 1). Meaning that the date of flowering of each of the studied varieties did not affect by the application of N fertilizer.

Biological yield (g 1.2m$^{-2}$)

Biological yield was also found to be highly and significantly varied ($P < 0.001$) among the studied wheat varieties (Table 1). Wheat variety SHLF-7 produced the maximum biological yield (1762 g 1.2m$^{-2}$) followed by variety QAF2H-31 (1652 g 1.2m$^{-2}$), while the variety ALFAJER -1 and TAMUS produced the lowest biological yield (1481 and 1462 g 1.2m$^{-2}$ respectively) (Table 2). The application of N fertilizer was also highly and significantly affected ($P<0.001$) biological yield (Table 1). The level 140 kg N ha$^{-1}$ gave the maximum biological yield (1685 g 1.2m$^{-2}$), while the control gave the lowest value (1504 g 1.2m$^{-2}$). this mean that the biological yield increase due to each increase in the amount of nitrogen applied. These results are agreed with those of Shahzad et. al.[23], who suggested that N shortage may contribute to growth suppression and reduction in biomass production. Thus, this increase in biological yield could be due to the increase of plant growth components of wheat plants. This is not surprising, because any increase in growth component will has a dramatic increase in biological yield of plant. The data in Table 1 illustrated that the effect of the interaction between varieties and nitrogen levels were significant in biological yield ($P < 0.05$).
Table (1): analysis of variance of wheat varieties, nitrogen levels and interaction between varieties and nitrogen levels on studied traits, growing season 2014 – 2015.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Varieties</th>
<th>N addition</th>
<th>Varieties × N addition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$F_{4,38}$</td>
<td>$P$</td>
<td>$F_{3,38}$</td>
</tr>
<tr>
<td>Plant height (cm)</td>
<td>24.2</td>
<td>0.0001</td>
<td>11.9</td>
</tr>
<tr>
<td>Flag leaf area (cm²)</td>
<td>2.22</td>
<td>0.085</td>
<td>2.17</td>
</tr>
<tr>
<td>No of Days to 50% flowering</td>
<td>388</td>
<td>&lt; 0.001</td>
<td>1.69</td>
</tr>
<tr>
<td>Biological yield (g 1.2m⁻²)</td>
<td>25.4</td>
<td>&lt; 0.001</td>
<td>15.8</td>
</tr>
<tr>
<td>Grain weight per spike (g spike⁻¹)</td>
<td>1.24</td>
<td>0.31</td>
<td>1.93</td>
</tr>
<tr>
<td>No. of grains per pike</td>
<td>2.29</td>
<td>0.077</td>
<td>8.06</td>
</tr>
<tr>
<td>1000 seed weight (g)</td>
<td>3.33</td>
<td>0.02</td>
<td>2.24</td>
</tr>
<tr>
<td>Grain yield (g 1.2m⁻²)</td>
<td>7.84</td>
<td>&lt; 0.001</td>
<td>3.51</td>
</tr>
<tr>
<td>Harvest Index (%)</td>
<td>13.45</td>
<td>&lt; 0.001</td>
<td>10.9</td>
</tr>
<tr>
<td>Total Chlorophyll (SPAD unit)</td>
<td>7.55</td>
<td>&lt; 0.001</td>
<td>3.78</td>
</tr>
<tr>
<td>Protein content%</td>
<td>3.35</td>
<td>0.019</td>
<td>3.0</td>
</tr>
</tbody>
</table>
This interaction indicates that both varieties SHLF-7 and TUMAS had a higher biological yield with applying 120 kg N ha$^{-1}$, thereafter, the trend declined. However, maximum biological yield (1907 g 1.2m$^{-2}$) was observed by the interaction 120kg N ha$^{-1} \times$ SHLF-7, while lowest biological yield (1218 g 1.2m$^{-2}$) was observed with interaction of control $\times$ TUMAS (Table 4). These results agreed with those obtained by Ishag[13] who concluded that increasing level of nitrogen increased biological yield.

Grain weight per spike
The data presented in Table 1 revealed that there were not any significant effects ($P > 0.05$) of N fertilization, wheat varieties and their interaction on grain weight per spike. It has been observed that there was slight increment in grain spike$^{-1}$ as result of increasing levels of applied N fertilizer and higher mean was detected at 120 kg N ha$^{-1}$ comparing to other treatments but statistically these trend were not significantly different (Table 2). In addition, wheat variety SHLF-7 also showed higher grain weight spike$^{-1}$ than the rest varieties but again these values were not statistically significant (Table 3). The interaction between N levels and wheat varieties on grain weight$^{-1}$spike was also found to be non - significant ($P > 0.05$). Meaning that, grain weight spike$^{-1}$of all the studied wheat varieties were responded similarly to nitrogen (were not affected by the application of N levels). These results are in conformity with Hussain et. al.[11] regarding the effect of wheat varieties and the interaction between nitrogen levels and varieties on grain weight per spike.

No. of Grain per spike
It has been observed that there was a highly significant effect ($P < 0.0001$) of N fertilization on No. of grain per spike but the effect was non-significant ($P > 0.05$) in case of wheat varieties (Table,1). The Table(2) showed that the effect of varieties in this trait, the variety
ALFAJER-1 and TUMAS were produced the maximum number of grain per spike (58) and (57) respectively, while the variety SHLF-7 reported the minimum number of grain per spike but these differences were statistically not significant. Regarding the effect of nitrogen levels in the same trait, Table (3) showed that the rate of 120 and 140 kg N ha\(^{-1}\) produced the maximum number of grain per spike (59 and 58), while the minimum number of grain per spike (51) was recorded by control. On the other hand, the interaction effect between N fertilizer application and different wheat varieties was appeared to be significant \((P = 0.012)\). The interaction N fertilization \(\times\) wheat varieties indicated that wheat varieties responded differently to nitrogen levels. Table 4 showed that the variety TUMAS was superior in this trait and recorded a higher value (67) at level 120 kg N ha\(^{-1}\), while the lowest value (44) was recorded by variety SHLF-7 in the control treatment. These results conforming those of Rasmussen et. al[21] and Ashraf et. al. [5], who reported that the number of grain per spike increased due to increasing nitrogen. Probable reason for this is that different varieties have different genetic potential to use nitrogen efficiently.

1000 grain weight (g)

1000 grain weight is also considered as another important yield component parameters selected for studying the effect of nitrogen fertilization on plant yield because the same number of grains may vary in mass when subjected to different nitrogen levels and environmental conditions. Furthermore, another reason behind selecting this trait is that it is associated mostly with the grain yield and this has been confirmed by a positive correlation between this trait and grain yield in a study conducted by Aycicek, and Yildirim, [6]. However, 1000 grain weight was significantly affected by wheat varieties \((P < 0.05)\) but there was not any significant effect.
higher 1000 grain weight (47.2g) with the application of 100 kg N ha\(^{-1}\) but statistically this difference is very weak according analysis of variance ANOVA (Table 1 and 4).

Grain yield (g 1.2m\(^{-2}\))

Grain yield was found to be significantly affected (\(P < 0.05\)) by wheat varieties (Table 1). The variety SHLF-7 and NS733 are superior in this trait and produced grain yield with average values of 414.6 and 410.0 g 1.2m\(^{-1}\) respectively, while the variety QAF2H-31 had the lowest value (335.9 g 1.2m\(^{-1}\)) (Table 2). There was also a significant effect (\(P < 0.05\)) of N fertilization on grain yield and this effect indicated that there was an increase (although statistically insignificant) in grain yield due to each increase in N levels up to 120 kg N ha\(^{-1}\), then the trend was declined significantly (Table 3). Wheat grain yield resulting from nitrogen application 100, 120 kg N ha\(^{-1}\) did differ significantly over that of the control and this nitrogen levels reported the maximum yield (383.4
and 390.9 g 1.2m^2) respectively. Significant interaction effect (P < 0.05) between wheat varieties and N levels was also obtained on grain yield (Table 1). The interaction treatments wheat varieties × N levels showed significant increase in grain yield (477 g 1.2m^2) for variety TAMUS up to 120 kg N ha^-1, thereafter, the trend decline, while there was no significant increase in grain yield with increasing N levels for the rest of wheat varieties (Table 4). In a study conducted by Shahzad et al., [23] who found that, in variety Siran, grain yield increased with increase in nitrogen level up to 120 kg N ha^-1 while further increase in nitrogen level did not increase or decrease grain yield. So, this might be due to the fact that different varieties have different genetic make-up and hence respond differently to nitrogen application.

**Harvest Index**

Analysis of variance for yield index indicated that the highly significant differences (P < 0.05) were observed among wheat varieties and nitrogen levels (Table 1). The effect of varieties in yield index was presented in Table (2). The variety TAMUS gave the highest value 28.4%, followed by variety SHLF-7 which produced (23.7%), while the variety QAF2H-31 had the lowest value 20.5%. Thus, it can be reported that plant genotypes TAMUS and SHLF-7 have more physiological potential for converting total dry matter into economical yield. This might be probably, as it has been mentioned previously, due to difference of varieties genetic makeup.

Regarding the effect of nitrogen levels Table (3) showed that the levels 100 and 120 kg N ha^-1 and control appeared to have the similar effect, whereas the level 140 kg N ha^-1 gave significantly the lowest value (20.2%). Generally, it can be observed that the harvest index tended to decrease with increasing amount of nitrogen fertilizer, although there were no – significant differences in between control up to 120kg N ha^-1. Similar results have been
reported by other researchers Abedi et. al.[3] and Noureldin et. al. [17]. Bulman, and Hunt, [8] reported that harvest index fell with increasing biomass as a result of nitrogen application so that an increase in the proportion of grain yield came from a greater total biomass production rather than an increase in the proportion of grain dry matter. The interaction between varieties and nitrogen levels was also showed to have been significantly affected (P < 0.05) yield index. The interaction effect between applied N levels and wheat varieties revealed that increased N levels more than 140 kg N ha⁻¹ caused significant decrease in yield index in wheat varieties NS733, QAF2H-31 and TAMUS, while the yield index of wheat variety SHLF-7 and ALFAJER-1 did not significantly changed by increasing N levels (Table 4). However, higher yield index (33.1%) was recorded from the interaction of wheat variety QAF2H-31 × 140 kg N ha⁻¹.

Total Chlorophyll and protein content
Wheat varieties and nitrogen levels were found to differ significantly in total chlorophyll and protein content (Table 1). Highest chlorophyll content was observed with variety QAF2H-31 and TAMUS followed by variety ALFAJER-1, SHLF-7 and NS733, and the highest protein content was observed with variety QAF2H -31 and variety SHLF-3, indicating the difference in genetic backgrounds for the trait. On the other hand, the nitrogen levels increased both chlorophyll and protein content significantly over control but no significant increment was observed in chlorophyll and protein content between fertilization treatments (Table 3). Other authors Mueller et. al.[16] and Otteson et. al.[18] also reported an increase in grain protein concentration and chlorophyll content with N levels.
Table 2: effect of varieties on studied traits of wheat, growing season 2014–2015.

<table>
<thead>
<tr>
<th>Varieties</th>
<th>Plant height (cm)</th>
<th>Leaves area (cm²)</th>
<th>No. of days to 50% flowering</th>
<th>Biologica yield (g 1.2m⁻²)</th>
<th>Grain weight per spike (g)</th>
<th>No. of spike (spike⁻¹)</th>
<th>Total grain weight (g)</th>
<th>Harvest Index (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHLF</td>
<td>97.2±3.9 28.8±3.2</td>
<td>16±1.6 146±4.2</td>
<td>7±0.3 1.9±0.2</td>
<td>36.9±2.3 41.0±3.4</td>
<td>4.3±0.4 34.9±3.1</td>
<td>2.4±0.1 4.4±0.3</td>
<td>2.1±0.1 4.4±0.3</td>
<td>11.9±1.4 11.1±1.3</td>
</tr>
<tr>
<td>NS733</td>
<td>105.8±3.4 29.8±2.6</td>
<td>176±2.7 148±3.1</td>
<td>161±2.5 140±2.4</td>
<td>41.0±3.4 41.0±3.4</td>
<td>4.3±0.4 34.9±3.1</td>
<td>2.4±0.1 4.4±0.3</td>
<td>2.1±0.1 4.4±0.3</td>
<td>11.9±1.4 11.1±1.3</td>
</tr>
<tr>
<td>TAMUS</td>
<td>91.8±3.1 27.4±2.1</td>
<td>158±2.9 156±2.7</td>
<td>150±2.3 145±2.3</td>
<td>34.9±3.1 34.9±3.1</td>
<td>2.3±0.1 2.3±0.1</td>
<td>2.3±0.1 2.3±0.1</td>
<td>2.3±0.1 2.3±0.1</td>
<td>12.0±1.2 12.0±1.2</td>
</tr>
<tr>
<td>ALFAVER</td>
<td>91.8±3.1 27.4±2.1</td>
<td>158±2.9 156±2.7</td>
<td>150±2.3 145±2.3</td>
<td>34.9±3.1 34.9±3.1</td>
<td>2.3±0.1 2.3±0.1</td>
<td>2.3±0.1 2.3±0.1</td>
<td>2.3±0.1 2.3±0.1</td>
<td>12.0±1.2 12.0±1.2</td>
</tr>
</tbody>
</table>

Means having the same letters in the same column are not significantly different at p-value > 0.05.
Table 3: Effect of nitrogen levels on studied traits of wheat, growing season 2014–2015.

<table>
<thead>
<tr>
<th>Levels of nitrogen applied (kg ha⁻¹)</th>
<th>Plant height (cm)</th>
<th>Leaves area (cm²)</th>
<th>Leaves Plan</th>
<th>Leaves Total</th>
<th>Leaves of 2 leaves</th>
<th>Harvest Index (%)</th>
<th>Chlorophyll Total (SPAD unit)</th>
<th>Harvest Yield (g)</th>
<th>Harvest yield per ha (g)</th>
<th>Grain yield (g)</th>
<th>Grain yield per ha (g)</th>
<th>Biologic yield (g)</th>
<th>No. of grains per spike</th>
<th>Weight of 1000 grain (g)</th>
<th>No. of grains per ha</th>
<th>Protein content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>28.49</td>
<td>105.34</td>
<td>42.49</td>
<td>93.49</td>
<td>26.69</td>
<td>1714</td>
<td>11.44</td>
<td>10.50</td>
<td>11.80</td>
<td>120</td>
<td>100</td>
<td>120</td>
<td>102.00</td>
<td>27.50</td>
<td>42.49</td>
<td>11.80</td>
</tr>
<tr>
<td>10</td>
<td>29.34</td>
<td>104.74</td>
<td>42.19</td>
<td>94.10</td>
<td>26.69</td>
<td>1714</td>
<td>11.44</td>
<td>10.50</td>
<td>11.80</td>
<td>120</td>
<td>100</td>
<td>120</td>
<td>102.00</td>
<td>27.50</td>
<td>42.49</td>
<td>11.80</td>
</tr>
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<td>30.03</td>
<td>104.04</td>
<td>42.74</td>
<td>93.10</td>
<td>26.69</td>
<td>1714</td>
<td>11.44</td>
<td>10.50</td>
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<td>120</td>
<td>100</td>
<td>120</td>
<td>102.00</td>
<td>27.50</td>
<td>42.49</td>
<td>11.80</td>
</tr>
<tr>
<td>100</td>
<td>31.43</td>
<td>105.43</td>
<td>42.93</td>
<td>92.83</td>
<td>26.69</td>
<td>1714</td>
<td>11.44</td>
<td>10.50</td>
<td>11.80</td>
<td>120</td>
<td>100</td>
<td>120</td>
<td>102.00</td>
<td>27.50</td>
<td>42.49</td>
<td>11.80</td>
</tr>
<tr>
<td>120</td>
<td>31.82</td>
<td>105.62</td>
<td>42.93</td>
<td>92.83</td>
<td>26.69</td>
<td>1714</td>
<td>11.44</td>
<td>10.50</td>
<td>11.80</td>
<td>120</td>
<td>100</td>
<td>120</td>
<td>102.00</td>
<td>27.50</td>
<td>42.49</td>
<td>11.80</td>
</tr>
</tbody>
</table>

Means having the same letters in the same column are not significantly different at P - value > 0.05.
Table 4: Interaction effect between wheat varieties and nitrogen levels on studied traits, growing season 2014-2015.

<table>
<thead>
<tr>
<th>Varieties</th>
<th>control</th>
<th>100 kg N ha⁻¹</th>
<th>120 kg N ha⁻¹</th>
<th>140 kg N ha⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant height (cm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TAMU</td>
<td>104.9</td>
<td>112.7</td>
<td>117.2</td>
<td>123.4</td>
</tr>
<tr>
<td>ALFAER</td>
<td>92.2</td>
<td>97.9</td>
<td>100.0</td>
<td>101.8</td>
</tr>
<tr>
<td>SHLF</td>
<td>86.8</td>
<td>94.3</td>
<td>93.1</td>
<td>93.1</td>
</tr>
<tr>
<td>NS33</td>
<td>91.1</td>
<td>97.9</td>
<td>100.0</td>
<td>101.8</td>
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<td>112.7</td>
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<td>97.9</td>
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<td>94.3</td>
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<tr>
<td>NS33</td>
<td>91.1</td>
<td>97.9</td>
<td>100.0</td>
<td>101.8</td>
</tr>
</tbody>
</table>

| Biological yield (g m⁻²) | | | | |
| TAMU | 6.9 | 6.9 | 6.9 | 6.9 | |
| ALFAER | 6.9 | 6.9 | 6.9 | 6.9 | |
| SHLF | 6.9 | 6.9 | 6.9 | 6.9 | |
| NS33 | 6.9 | 6.9 | 6.9 | 6.9 | |

| Grain weight per spike (g spike⁻¹) | | | | |
| TAMU | 2.6 | 2.6 | 2.6 | 2.6 | |
| ALFAER | 2.6 | 2.6 | 2.6 | 2.6 | |
| SHLF | 2.6 | 2.6 | 2.6 | 2.6 | |
| NS33 | 2.6 | 2.6 | 2.6 | 2.6 | |

| No. of grain per spike (g spike⁻¹) | | | | |
| TAMU | 2.6 | 2.6 | 2.6 | 2.6 | |
| ALFAER | 2.6 | 2.6 | 2.6 | 2.6 | |
| SHLF | 2.6 | 2.6 | 2.6 | 2.6 | |
| NS33 | 2.6 | 2.6 | 2.6 | 2.6 | |
| Means having the same letters in same rows and columns are not significantly different at P-value > 0.05.

<table>
<thead>
<tr>
<th>ALFAJER</th>
<th>TAMUS</th>
<th>QAF2H</th>
<th>SHLF - 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1218</td>
<td>1462e</td>
<td>1428d</td>
</tr>
<tr>
<td>II</td>
<td>1395e</td>
<td>1490e</td>
<td>1428d</td>
</tr>
<tr>
<td>III</td>
<td>1630d</td>
<td>1590d</td>
<td>1428d</td>
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<tr>
<td>IV</td>
<td>1530d</td>
<td>1790d</td>
<td>1428d</td>
</tr>
<tr>
<td>V</td>
<td>1640d</td>
<td>1790d</td>
<td>1428d</td>
</tr>
</tbody>
</table>

Means having the same letters in the same rows and columns are not significantly different at P-value > 0.05.
<table>
<thead>
<tr>
<th>Varieties</th>
<th>Control</th>
<th>100 kg N ha&lt;sup&gt;-1&lt;/sup&gt;</th>
<th>120 kg N ha&lt;sup&gt;-1&lt;/sup&gt;</th>
<th>140 kg N ha&lt;sup&gt;-1&lt;/sup&gt;</th>
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</thead>
<tbody>
<tr>
<td>TAMUS</td>
<td>e</td>
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<td>37.24</td>
<td>36.18</td>
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<tr>
<td>ARALIE - 1</td>
<td>f</td>
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<td>35.64</td>
<td>34.86</td>
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<tr>
<td>NS733</td>
<td>g</td>
<td>34.62</td>
<td>33.46</td>
<td>32.84</td>
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<tr>
<td>SHLF - 7</td>
<td>de</td>
<td>32.58</td>
<td>31.44</td>
<td>30.28</td>
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</table>

Table 4 (continued) Interaction effect between wheat varieties and nitrogen levels on studied traits, growing season 2014–2015.
<table>
<thead>
<tr>
<th>Varieties</th>
<th>Protein content %</th>
<th>CHLOROPHYLL (SPAD unit)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>control</td>
<td>120</td>
</tr>
<tr>
<td></td>
<td>150</td>
<td>140</td>
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<tr>
<td></td>
<td>300</td>
<td>140</td>
</tr>
</tbody>
</table>

Means having the same letters in same rows and columns are not significantly different at P-value > 0.05.
Concerning the interaction between wheat varieties and nitrogen levels, the results in the Table (1) showed no significant effect on both traits ($P > 0.05$). Concerning the interaction effect between wheat varieties and N levels found to be insignificant ($P > 0.05$) for both chlorophyll and protein content (Table 1). Meaning that all studied wheat varieties responded similarly to nitrogen application. The results are agreed to some earlier finding [3] and [24]. However, maximum chlorophyll (47.1 SPAD unit) and protein content (12.8%) was obtained from the interaction QAF2H-31 × 120 kg N ha$^{-1}$, while minimum chlorophyll (38.3 SPAD unit) was obtained from the interaction between NS733× control, and minimum protein content (9%) was recorded with TAMUS at control treatment.

**Conclusion:**
Depending on the results obtained in current study, it can be concluded that yield and its components, evaluated in this experiment, responded variably to nitrogen fertilization. However, the varieties SHLF-3 and ALFAJER-1 greatly responded to nitrogen fertilization and had maximum grain yield under experimental site conditions. It was also observed that the application of N at 120 Kg ha$^{-1}$ resulted in an enhancement in wheat production compared to other N treatments. Therefore, for higher wheat yield production, the recommendation of N at the rate of 120 Kg ha$^{-1}$ as the two equal splits are the appropriate application strategy for improving wheat production under local environmental conditions of this study.

**References**


and potassium levels on kenaf  


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استجابة بعض اصناف حنطة الخبز لمستويات النيتروجين

استجابة بعض اصناف حنطة الخبز لمستويات النيتروجين

المستخلص:

طبقت تجربة عاملية في حقل كلية الزراعة، جامعة دهوك، قضاء سميل، اقليم كردستان العراق خلال

الموسم الزراعي 2014-2015 لدراسة حاصل خمسة اصناف من حنطة الخبز (7-NS733, QAF2AH, TAMUS, ALFAJER-1, SHIF-7) تحت تأثير مستويات مختلفة من

الناتروجين (معدل 0, 100, 120, 140 كغم N). استخدمت تصميم القطاعات العشوائية الكاملة

و ثلاثية مكررات. أظهرت النتائج اختلافات معنوية في أصناف الحنطة ومستويات النباتية المختلفة

في ارتفاع النباتات وعدد الأيام التي 50% من التزهر و الحاصل البيولوجي و وزن 1000 بذرة و

دليل حاصل الحبوب و الكلوروفيل الكلسي و محتوى البروتين. تفوق الصنف SHIF-7 و

ALFAJER-1 و SHIF-7 على بقية الأصناف في معظم الصفات المدروسة. كما أظهر المستوى 120 كغم

N Hكارت كأثر معنوي في ارتفاع النباتات و الحاصل البيولوجي و عدد البذور في السنة و حاصل

الحبوب و دليل الحصاد و الكلوروفيل الكلسي و محتوى البروتين. وظهر الصنف SHIF-7 و

المستوى السمدي 120 كغم N Hكارت كأعلى حاصل الحبوب بلغ 433 كغم N Hكارت 1 مع ALFAJER-1

و SHIF-7، هكارت 1/4 للوصول إلى أفضل حاصل للحنطة تحت الظروف المحلية

كلمات مفتاحية: الحنطة، أصناف، مستويات التثؤجين. دليل حاصل البذور. مكونات الحاصل.