Influence of different levels of nitrogen and phosphorus on some traits of wheat (*Triticum aestivum* L.)

Maryam Molla-Ali-Akbari*, Mohammad-Agha Lotfollahi

*Department of Soil Science, Karaj Branch, Islamic Azad University, Karaj, Iran*

**Key words:** Nitrogen, Phosphorus, Protein, Wheat.

http://dx.doi.org/10.12692/ijb/6.5.147-151 Article published on March 09, 2015

**Abstract**

In order to study the effect of nitrogen and phosphorus fertilizers on some traits of wheat, a factorial based on completely randomized design (CRD) with three replications was conducted at greenhouse research in 2014. Factors were three levels of nitrogen (N1=0, N2=0.2 and N3=0.4 g/pot) and three levels of phosphorus (P1=0, P2=0.2 and P3=0.4 g/pot). In each replication there were 10 pots for each treatment. At maturity, total dry weight, seed weight, Straw weight and percentage of phosphorus, nitrogen and protein of seed were determined. Analysis of variance showed that different levels of N and P had significant effects on seed nitrogen and protein percentage, whereas their interaction (N × P) not had any effect on measured traits. The highest seed nitrogen (4.27%) and protein percentage (24.35%) were obtained with 0.4 g/pot, whereas the lowest (3.28% and 18.71%, respectively) were obtained in control treatment. Among the P levels, used of 0.2 g/pot P had the highest seed nitrogen and protein percentage (4.27% and 24.33%, respectively) and the lowest (3.44% and 19.60%, respectively) were obtained from zero level.

*Corresponding Author: Maryam Molla-Ali-Akbari maryam.mollaaliakbari2000@gmail.com*
Introduction
Wheat is one of the most important foods in the world. It is a major source of energy and protein in human nutrition (Pomeranz, 1988). It provides approximately one-fifth of the total calorific input of the world’s population (FAO, 2011). Iran has been ranked 14th in the world with 13.5 million tons of wheat production in 2011 that shows increasing trend compared to previous years (FAO, 2011).

Nitrogen and phosphorus are two of the most important nutrients related to cereal production in the world. Not only does their availability strongly determine the rate of crop growth and thereby its final grain yield, but also their relative contribution to the grain dry matter largely determines the grain quality (Calderini et al., 1995). Nitrogen is the most expensive fertilizer used to raise crop plants (Spiertz, 2010). A reliable portion of the applied N is lost through leaching and denitrification (Jamieson and Semenov, 2000). Increased demand for N fertilizers also raises farm input costs. Therefore, farmers need to develop used of nitrogen level that can uptake it more efficiently from the soil and partition most of it into the grain.

The effect of N on seed yield may be a consequence of N influence on photosynthesis, on the amount of photo-assimilates that are produced by the plant, on dry matter partitioning, and on organ development (Dordas and Sioulas, 2008, 2009; Dordas et al., 2008). The effect of N on photosynthesis may also affect the yield components (Dordas and Sioulas, 2008, 2009). Phosphorus is one of the essential nutrients for plant growth and crop production. Higher P levels increased the yield and nitrogen use efficiency (Zubillaga et al., 2002). Studies on the effects of combined nitrogen and phosphorus fertilization on yield and other wheat characters are scanty. The aim of present study was influence of different levels of nitrogen and phosphorus fertilization on yield and other wheat characters.

Materials and methods
Factors and measured treatments

The experiment was designed as factorial based on completely randomized design (CRD) with three replications, in a greenhouse research. Factors were three levels of nitrogen (N1=0, N2=0.2 and N3=0.4 g/pot) and three levels of phosphorus (P1=0, P2=0.2 and P3=0.4 g/pot). In each replication there were 10 pots for each treatment. The pots were filled with the media mixtures and seeds of Triticum aestivum (Pishtaz variety) were planted and watered immediately. The soil texture was determined with the hygrometer method (Dewis and Freitas, 1970). The physiochemical characteristics are presented in Table 1. The available phosphorous was determined from saturated paste extract (Olsen and Sommers, 1982). The ammonium was estimated by acid digested material (Bremner and Mulvaney, 1982) and organic matter through sulphuric acid using the Walkley–Black method (Sahrawat, 1982). At maturity, total dry weight, seed weight, Straw Weight and percentage of phosphorus, nitrogen and protein of seed were determined.

Statistical analysis
Analysis of variance of the data from each attribute was computed using the statistical analysis software (SAS). The Duncan’s new multiple range test at 5% level of probability was used to test the differences among mean values (Steel and Torrie, 1980).

Results and discussion
Analysis of variance showed that different levels of N and P had significant effects on sees nitrogen and protein percentage, whereas their interaction (N × P) not had any effect on measured traits.

The highest seed nitrogen percentage (4.27%) was obtained with 0.4 g/pot, whereas the lowest (3.28%) was obtained in control (Table 3). Among the P levels, used of 0.2 g/pot P had the highest seed nitrogen percentage (4.27%) and the lowest (3.44%) was obtained from zero level (control) (Table 3).

Mousavizadeh et al. (2011) studied effect of different levels of nitrogen and phosphorus on seed yield of Azarshahr red onion. Authors reported that nitrogen
and phosphorus not had affected on seed nitrogen percentage, which is contrast with our result in wheat. Nouriyan et al. (2012) reported that increase in nitrogen levels in wheat caused the decline of the nitrogen use efficiency (NUE), nitrogen uptake efficiency (NUpE) and nitrogen utilization efficiency (NUtE).

Table 1. Soil properties of the experimental pots.

<table>
<thead>
<tr>
<th>Texture</th>
<th>pH</th>
<th>Ex dS m⁻¹</th>
<th>N (%)</th>
<th>Organic matter (%)</th>
<th>P (mg kg⁻¹)</th>
<th>K (mg kg⁻¹)</th>
<th>Sand (%)</th>
<th>Silt (%)</th>
<th>Clay (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>clay/loam</td>
<td>7.2</td>
<td>3.23</td>
<td>0.13</td>
<td>1.87</td>
<td>12.6</td>
<td>247</td>
<td>24</td>
<td>45</td>
<td>31</td>
</tr>
</tbody>
</table>

Protein content and grain yield of wheat (Pishtaz cv.) significantly increased with increasing nitrogen fertilizer (Nasri et al., 2014). Changes in protein content with application of fertilizer N differ with cultivar (Clarke et al. 1989; Fowler et al. 1990). Semidwarf wheat cultivars show a smaller increase in grain protein with small applications of N fertilizer than do cultivars of conventional height due to greater yield potential of semidwarf wheat (Campbell et al. 1977; Clarke et al. 1989).

Table 2. ANOVA of some traits that were measured in this study.

<table>
<thead>
<tr>
<th>MS</th>
<th>Total dry weight (g)</th>
<th>Seed weight (g)</th>
<th>Straw weight (g)</th>
<th>Seed Nitrogen (%)</th>
<th>Seed phosphorus (%)</th>
<th>Seed protein (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOV</td>
<td></td>
<td>N 2 4.87</td>
<td>0.78</td>
<td>0.97</td>
<td>2.48*</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P 2 0.62</td>
<td>0.75</td>
<td>0.97</td>
<td>1.56*</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N*P 4 0.34</td>
<td>0.17</td>
<td>0.97</td>
<td>0.2</td>
<td>0.00</td>
</tr>
<tr>
<td>Error</td>
<td>18</td>
<td>7.29</td>
<td>1.17</td>
<td>3.11</td>
<td>0.11</td>
<td>0.02</td>
</tr>
</tbody>
</table>

*: significant at 1% probability level.

The effect of nitrogen (N), phosphorus (P) and potassium (K) fertilization on leaf and grain protein has been studied by Mosolov and Volliedt (1962). Authors reported high N:P fertilizer ratios decreased leaf protein and leaf nitrogen concentrations. With N:P ratios slightly greater than 1.0, both leaf protein and carbohydrate concentrations were high. With low N:P ratios, both leaf protein and carbohydrate concentrations were low. Grain protein percentages, in the same experiments, decreased as P fertilization increased except at the highest P treatment. Our result revealed with application of P, seed protein percentage increased whereas in most experiments P application had no effect on grain protein (Leikem et al., 1978; Murphy and Gallagher, 1976; Murphy et al., 1977).

Table 3. Effect of nitrogen and phosphorus levels on studied traits.

<table>
<thead>
<tr>
<th>Levels</th>
<th>Total dry weight (g)</th>
<th>Seed weight (g)</th>
<th>Straw weight (g)</th>
<th>Seed Nitrogen (%)</th>
<th>Seed phosphorus (%)</th>
<th>Seed protein (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N1</td>
<td>10.78A</td>
<td>2.55A</td>
<td>8.56A</td>
<td>3.28B</td>
<td>0.73A</td>
<td>18.71B</td>
</tr>
<tr>
<td>N2</td>
<td>11.50A</td>
<td>2.95A</td>
<td>8.55A</td>
<td>4.08A</td>
<td>0.83A</td>
<td>23.30A</td>
</tr>
<tr>
<td>N3</td>
<td>12.25A</td>
<td>3.12A</td>
<td>9.12A</td>
<td>4.27A</td>
<td>0.81A</td>
<td>24.35A</td>
</tr>
<tr>
<td>P1</td>
<td>11.41A</td>
<td>3.02A</td>
<td>8.72A</td>
<td>3.44B</td>
<td>0.75A</td>
<td>19.60B</td>
</tr>
<tr>
<td>P2</td>
<td>11.80A</td>
<td>3.05A</td>
<td>8.77A</td>
<td>4.27A</td>
<td>0.79A</td>
<td>24.33A</td>
</tr>
<tr>
<td>P3</td>
<td>11.30A</td>
<td>2.54A</td>
<td>8.73A</td>
<td>3.93A</td>
<td>0.82A</td>
<td>22.41A</td>
</tr>
</tbody>
</table>

Means in the same column by the same letter do not differ significantly according to the Duncan test (P = 0.05).
With increasing N level seed weight was increased, although statistically not significant. The highest seed weight (3.12 per pot) was obtained with 0.4 g/pot, whereas the lowest (2.55 per pot) was obtained in control (Table 3). Nasri et al. (2014) studied different levels of nitrogen on wheat yield and reported that application of N had a significantly effect on seed weight that is contrast with our result. In flax seed weight was affected by phosphorus fertilization (Parhizkar-khajani et al., 2012).

The effect of N on seed yield may be a consequence of N influence on photosynthesis, on the amount of photo-assimilates that are produced by the plant, on dry matter partitioning, and on organ development. The effect of N on photosynthesis may also affect the yield components (Dordas and Sioulas, 2009).

Nitrogen and phosphorus are two of the most important nutrients related to cereal production in the world. Not only does their availability strongly determine the rate of crop growth and thereby its final grain yield, but also their relative contribution to the grain dry matter largely determines the grain quality (Calderini et al., 1995).

**Abbreviation:** N: Nitrogen; P: Phosphorus.

**Conclusion**
Combined applications of N and P not had effect on wheat measured traits. The seed nitrogen and protein percentage were affected by N and P applications, which were increased.

**References**


**Campbell CA, Cameron DR, Nicholaichuk W, Davidson HR.** 1977. Effect of fertilizer N and soil moisture on growth, N content, and moisture use by spring wheat. Can J Soil Sci **57**, 289-310. [http://dx.doi.org/10.4141/cjss77-03.5](http://dx.doi.org/10.4141/cjss77-03.5)


**Fataneh PK, Hamid I, Majid M, Hussein O.** 2012. Influence of different levels of nitrogen, phosphorus and potassium on yield and yield
components of flax seed oil (Linum usitatissimum L.)
variety Lirina. Journal of Medicinal Plants Research 6(6), 1050-1054.
http://dx.doi.org/10.5897/jmpr11.11.94

http://dx.doi.org/10.2134/agronj1990.0002196200820004000.2x

http://dx.doi.org/10.1016/s0378-4290(00)00103-9


http://dx.doi.org/10.12692/ijb/5.2.157-16.6


http://dx.doi.org/10.1007/bf02185.705

http://dx.doi.org/10.1051/agro:2008.064


http://dx.doi.org/10.1046/j.1439037x.2002.00570x