Study on some morphological characteristics and phonological stages of sunflower (*Heliantus annuus* L.) under application of bio-fertilizers

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**Abstract**

A field experiment was laid out in order to study on effect of P and N Bio fertilizers on morphological traits and phonological stages of sunflower (*Heliantus annuus* L.) at Islamic Azad University, Boroujerd branch, Iran (Experimental farm: Songhor, Kermanshah province, Iran) at 2014. The experiment was laid out in a factorial design based on randomized block design with three replications. Treatments were Nitrogen bio-fertilizers in four levels (N₁=Supernitroplas, N₂=Nitrokara, N₃=Nitroxin and N₄=control) and phosphor biofertilizer in four levels (P₁=Bio-Zar, P₂=Phosphate Barbar 2, P₃=Superplas and P₄=control) with control for them. Analysis of variance results showed that effect of N biofertilizer was significant on number of grain per capitulum, day to bolling, day to flowering, day to maturity and grain yield. Also, effect of N biofertilizer was significant on Stem diameter, Capitulum diameter, number of grain per capitulum, day to bolling, day to flowering, day to maturity and grain yield. For morphological traits, interaction between them was significant on number of grain per capitulum and grain yield. Application of any N biofertilizers and among the P biofertilizers Phosphate barvar2 and biozar had the highest stem diameter. Also application of any P biofertilizers had the highest capitulum diameter. However, combined application of Nitroxin and Biozar biofertilizers had the highest number of grain per capitulum and application of Nitroxin with other P biofertilizers had the highest grain yield. For phonological stages application of Nitrokara biofertilizers had the highest day to bolling, flowering and maturity. This study shows that application of N and P biofertilizers improved morphological traits and longer phonological stages compared to non application of N biofertilizers and had a better effect on seed yield.

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**Introduction**

Sunflower (*Helianthus annuus* L.) is one indifferent towards the day but needs a lot of light. Ratio is relatively resistant to soil salinity. Forage legumes in crop rotation, usually after the first weeding the crop is planted with plants that have a common root diseases such as peas, sugar beets and potatoes, are not included in the frequency. With sunflower, soybean, canola, cottonseed and peanut oil a year, which is the most important crop plants, it has long been an important part of agriculture is formed Eastern countries (Alyaree and Shekari, 2000). Sunflower is a summer crop belonging to the Asteraceae family, and is used in Tunisia for its seeds as “dry fruit” (glibettes), oil crop, and cattle feed using seed meal.

Bio-fertilizers have a positive effect on growth, yield and yield component of many crops. Fertilizer management is one of the most important factors in successful cultivation of crops affecting yield quality and quantity (Tahmashi *et al.*, 2011). Although nitrogen is the key element in increasing productivity but large rates of fertilizer N loss to the environment could cause a serious environmental problem such as groundwater contamination. Nitrogen fertilizer application and seed biopriming with PGPR can increase quantitative and qualitative yield of Safflower (Seyed Sharifi, 2009). Beyranvand *et al.* (2013) reviled that application nitrogen and phosphate biofertilizers increased yield and yield components of maize under Boroujerd environmental condition. They suggested that effect of nitrogen and phosphate biofertilizers were evaluated positively, there were an increase in plant height, ear weight, number of grain per cob, grain yield and biomass yield. Also Azimi *et al.* (2013b) found that application nitrogen and phosphate biofertilizers increased yield and yield components of barley under Boroujerd environmental condition. They suggested that Grain yield and biomass yield increasing was reported with the biofertilizer application which account important benefit, causing decreasing in the inputs of production because of economizing much money to chemical fertilizers and increasing in yield and biological yield. Also, Azimi *et al.* (2013a) found that application of Supernitroplass biofertilizer with Phosphate barvar2 treatment has the highest seed yield (7.6 ton/ha) and non-application of biofertilizers treatment has the Pishtaz cultivar has the lowest seed yield (6.3 ton/ha). They told that for gave the highest seed yield we should apply both nitrogen and phosphate biofertilizers. Hence, alternative strategies to increasing P availability and crop yield are required. The application of soil microorganisms is regarded to be a promising approach in this context. Therefore the aim of this study is evaluation of effects of N and P Bio fertilizers on morphological traits and phonological stages of sunflower.

**Material and methods**

**Field material and experimental design**

This field experiment was laid out in order to study on effect of P and N Bio fertilizers on morphological traits and phonological stages of sunflower (*Helianthus annuus* L.) at Islamic Azad University, Boroujerd branch, Iran (Experimental farm: Songhor, Kermanshah provience, Iran) at 2014. The Songhor region has a continental semi-arid climate with annual precipitation of 450 mm.

**Treatments**

The experiment was laid out in a factorial design based on randomized block design with three replications. Treatments were Nitrogen bio-fertilizers in four levels (N1=Supernitroplas, N2=Nitrokara, N3=Nitroxin and N4=control) and phosphor biofertilizer in four levels ( P1=Bio-Zar, P2=Phosphate Barbar 2, P3=Superplas and P4=control) with control for them.

**Morphology and phenology**

There were 4 rows in each from 16 plot with 0.5 m row spacing. Phenological stages was record. At maturity stage morphological traits was determined. Also, at maturity, two outer rows for each plot, 50 cm from each end of the plots, were left as borders and the middle 1 m² of the tow central rows were harvested. Then grain yield was calculated as standard method. To determine grain yield, we
removed and cleaned all the seeds produced within two central rows in the field. Then grain yield recorded on a dry weight basis. Yield was defined in terms of grams per square meter and quintals per hectare.

**Statistical analysis**

The statistical analyses to determine the individual and interactive effects of treatments were conducted using JMP 5.0.1.2 (SAS Institute Inc., 2002). Statistical significance was declared at \( P \leq 0.05 \) and \( P \leq 0.01 \). Treatment effects from the two runs of experiments followed a similar trend, and thus the data from the two independent runs were combined in the analysis (SAS, 2002).

**Results**

**Number of branches per plant**

The results of analysis of variance showed that, the effect of any treatment was not significant on number of branches per plant (table 1).

**Table 1.** Simple mean comparison for phonological stages and morphological traits under application of N and P bio-fertilizer.

<table>
<thead>
<tr>
<th></th>
<th>Stem diameter(cm)</th>
<th>Capitulum diameter(cm)</th>
<th>day to bolling</th>
<th>day to flowering</th>
<th>day to maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N biofertilizers</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitroxin</td>
<td>2.3</td>
<td>14.5</td>
<td>65b</td>
<td>77a</td>
<td>124a</td>
</tr>
<tr>
<td>Super nitroplas</td>
<td>2.3</td>
<td>14.5</td>
<td>65b</td>
<td>76a</td>
<td>123a</td>
</tr>
<tr>
<td>Nitrokara</td>
<td>2.3</td>
<td>14.5</td>
<td>66a</td>
<td>77a</td>
<td>124a</td>
</tr>
<tr>
<td>Control</td>
<td>2.2</td>
<td>14.5</td>
<td>64c</td>
<td>75b</td>
<td>122b</td>
</tr>
<tr>
<td><strong>P biofertilizers</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phosphate barvar2</td>
<td>2.3</td>
<td>14.5a</td>
<td>65b</td>
<td>76b</td>
<td>123b</td>
</tr>
<tr>
<td>Biozar</td>
<td>2.3</td>
<td>14.5a</td>
<td>66a</td>
<td>77a</td>
<td>124a</td>
</tr>
<tr>
<td>Superplas</td>
<td>2.2</td>
<td>14.2a</td>
<td>65b</td>
<td>76b</td>
<td>123b</td>
</tr>
<tr>
<td>Control</td>
<td>2.2</td>
<td>13.3b</td>
<td>65b</td>
<td>76b</td>
<td>123b</td>
</tr>
</tbody>
</table>

Means by the uncommon letter in each column are significantly different \( (p < 0.05) \).

\( (N_1=\text{Super nitroplas}, N_2=\text{Nitrokara}, N_3=\text{Nitroxin}, N_4=\text{control, P_1=\text{Biozar, P_2=Phosphate Barvar 2, P_3=Superplas and P_4=control}}) \).

**Stem diameter**

The results showed that, the effect of P bio-fertilizers on stem diameter was significant at 1% (table 1). The comparison of the mean values of the stem diameter showed that application of any N biofertilizers had the highest (2.3 cm) and the control treatments had the lowest stem diameter (2.2 cm) (table 2). Among the P biofertilizers Phosphate barvar2 and biozar had the highest (2.3 cm) and the superplas and control treatments had the lowest stem diameter (2.2 cm) (table 2).

**Capitulum diameter**

The results showed that, the effect of P bio-fertilizers on capitulum diameter was significant at 1% (table 1). The comparison of the mean values of the capitulum diameter showed that application of any P biofertilizers had the highest (14.5 cm) and the control treatments had the lowest capitulum diameter (13.3 cm) (table 2) and differences was significant.

**Number of grain per capitulum**

The results showed that, the effect of N and P bio-fertilizers and interaction between them on number of grain per capitulum were significant (table 1). The comparison of the mean values of the number of grain per capitulum showed that combined application of Nitroxin and Biozar biofertilizers had the highest (500) and the control treatment for N and P biofertilizers had the lowest number of grain per capitulum (430) (figure 1) and differences was significant.

**Day to bolling**

The results showed that, the effect of N and P bio-fertilizers was significant on day to bolling (table 1).
The comparison of the mean values of day to bolling showed that application of Nitrokara biofertilizers had the highest (66) and the control treatments had the lowest day to bolling (64) (table 2). Among the P biofertilizers Biozar had the highest (66) and the other treatments had the lowest day to bolling (65) (table 2) and differences were significant.

Day to flowering
The results showed that, the effect of N and P biofertilizers was significant on day to flowering (table 1). The comparison of the mean values of day to flowering showed that application of Nitroxin and Nitrokara biofertilizers had the highest (77) and the control treatments had the lowest day to flowering (75) (table 2). Among the P biofertilizers Biozar had the highest (77) and the other treatments had the lowest day to flowering (76) (table 2) and differences were significant.

Day to maturity
The effect of N and P bio-fertilizers was significant on day to maturity only (table 1). The comparison of the mean values of day to maturity showed that application of Nitroxin and Nitrokara biofertilizers had the highest (124) and the control treatments had the lowest day to maturity (122) (table 2). Among the P biofertilizers Biozar had the highest (124) and the other treatments had the lowest day to maturity (123) (table 2).

Grain yield
The results showed that, the effect of N and P biofertilizers, and interaction between them on grain yield were significant at 1% (table 1). The comparison of the mean values of grain yield for interaction between P and N bio-fertilizer showed that application of Nitroxin with other P biofertilizers had the highest (6900 kg/ha) and differences between this treatment with other combined application of biofertilizers were significant as well (figure 3).

Discussion
The results indicated that application of biological fertilizers increase stem and capitulum diameter compared to non-application treatment. Application of any N and P biofertilizers had the highest and the control treatments had the lowest stem and capitulum diameter respectively (table 2). Karnataka and Agrik (2009) reported that application of bio fertilizer yielded the greatest thickness in disc diameter while control treatment caused the least thickness in disc diameter. A survey conducted by Emam and Eikaee (2000) showed that application of biologic Nitroxin fertilizer, compared to non-application case, resulted in thickness disc diameters in sunflower plant.

In the present study N and P biofertilizers has strong influence on the crop phenology stages and morphological traits in sunflower. Plant phenology is dependent upon environmental factors too. Single application of Nitrokara biofertilizers had the highest day to bolling compaled to control. (table 2). Among the P biofertilizers Biozar had the highest day to bolling (table 2) and differences were significant. Application of these biofertilizers are very useful for vegetative and reproductive of growth stages. Reproductive phase of crop is more sensitive to than vegetative phase, which results in floral abortion, poor seed set, infertile pollens and empty seeds with reduced seed size that limit the production potential of the crop (Goyne et al., 1989; Kaleem et al., 2009). Also application of Nitroxin and Nitrokara
biofertilizers had the highest and the control treatments had the lowest day to flowering (table 2). However, Among the P biofertilizers Biozar had the highest and the other treatments had the lowest day to flowering (table 2). The results of this study showed that, application of Nitroxin and Nitrokara biofertilizers had the highest and the control treatments had the lowest day to maturity. Among the P biofertilizers Biozar had the highest and the other treatments had the lowest day to maturity (table 2).

Fig. 2. Interaction effect of N and P bio-fertilizers on grain yield in sunflower. Means by the uncommon letter in each column are significantly different (p<0.05). (N1=Supernitroplas, N2=Nitrokara, N3=Nitroxin, N4=control, P1=Bio-Zar, P2=Phosphate Barbar 2, P3=Superplas and P4=control).

The positive effect of mycorrhizal inoculation decreased with increasing P levels due to decreased percent root colonization at higher P levels. According to the results of this experiment, application of N and P biofertilizers recommended had an appropriate performance and could increase seed yield to an acceptable level, so it could be considered as a suitable substitute for chemical phosphorus fertilizer in organic agricultural systems (Soleimanzadeh, 2010). Seed weight in sunflower has been reported to have the highest direct positive effect on seed yield (Marinkovic, 1992) along with the number of seeds per head and the head diameter (Yasin and Singh, 2010). In the present study combined application of Nitroxin and Biozar biofertilizers had the highest and the control treatment for N and P biofertilizers had the lowest number of grain per capitulum (figure 1).

Application of Nitroxin with other P biofertilizer was more useful for yield, although application of Superplas with Nitroxin had a better effect (figure 2). Gholinejad et al (2009) stated that in higher quantities of nitrogen, investing photosynthesis materials in part of leaf and stem increased and thereby concentrated materials in seeds tends to rise. Bahamin et al (2014) showed that when seeds were in inculcation by Nitroxin biologic fertilizer seed yield reached 3840kg per hectare, showing 28% increase compared to non-inculcation treatment. Also Ahmad et al (2010) showed that higher yield under the effects of biologic fertilizers might be because of the increase in metabolic activities of biologic fertilizers and production of growth stimulating hormones by bacteria. In the present study non application of biofertilizers had the lowest grain yield (figure 2). In higher quantities of nitrogen, investing photosynthesis materials in part of leaf and stem increased and thereby concentrated materials in seeds tends to rise (Hoseynabadi et al, 2006). Positive effect of biofertilizer may resulted from its ability to increase the availability of phosphorus and other nutrients especially under the specialty of the calcareous nature of the soil which cause decreasing on the nutrients availability, results agree with (Kucey et al, 1989). The positive effect of biofertilizers on sunflower plants observed in the present study was due to the increase of the yield. Also, Hassanzade and Ghalavand (2005) stated that by combinational nutrition we can not only increase seed yield per unit of surface but also reduce application of Nitrogen fertilizers.

Conclusion

The present study shows that application of N and P biofertilizers improved morphological traits and longer phonological stages compared to non application of N biofertilizers and had a better effect on seed yield. Thus we can use this biofertilizers instead of chemical fertilizers for production of health food for human nutrition.

References


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