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Effect of N and P bio fertilizers on yield components of barley

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ABSTRACT: This experiment was laid out in order to evaluate the effects of different biofertilizers on yield components of barley. The experiment was a factorial design with three replications. Treatments were three nitrogen biofrtilizers (Nitroksin, Nitrokara and Supernitroplass) and three phosphate biofrtilizers (Phosphate barvar2, Biozarr and Superplass) with control for them and yield components were determined as standard. Results showed that, effect of Nitrogen bio fertilizer on number of grain per spike, 1000 grain weight, grain yield and biomass was significant. The effect of Phosphate bio fertilizer on grain yield and biomass was significant and the interaction between them on number of grain per spike, 1000 grain weight, grain yield and biomass was significant. Among the nitrogen biofertilizers, Nitroksin treatment has the highest grain yield and biomass and control treatment has the lowest of them. However, barley yield and it components was significantly higher in application of biofertilizers treatments. In final results of this study reviled that application nitrogen and phosphate biofertilizers increased yield and yield components of barley under Boroujerd environmental condition.

Key words: Barley, bio fertilizer and yield components

INTRODUCTION

Barley (*Hurdeum vulgar* L.) is the main rainfed crop and it grain yield is variable in response to the erratic rainfall (Austin et al., 1998a,b). However, barley is preferred by farmers under low rainfall conditions. In fact, data from the Agricultural Department of Catalonia (average from 1992 to 2000) indicated that of the total area sown to small cereals under rainfed conditions, c. 75% was sown to barley while only c. 19% was sown to bread wheat (Anonymous, 1999-2004a,b), and the proportion of area sown to barley increased with the reduction in average rainfall. Biofertilizer is a material containing microorganism(s) added to a soil to directly or indirectly make certain essential elements available to plants for their nutrition. Various sources of biofertilizers include nitrogen fixers, phytostimulators, phosphate solubilizing bacteria, plant growth promoting rhizobacteria, etc (Shekh, 2006). Application of biofertilizers became of great necessity

to get a yield of high quality and to avoid the environmental pollution (Shevananda, 2008). For give to highest seed yield in agriculture addition to both nitrogen and phosphate fertilizer is very important (Shaban, 2013a,b). For give the highest seed yield in barley should apply both nitrogen and phosphate bio fertilizers. Bio-fertilizer usually contains microorganisms having specific function such as Azospirillum to fix N2 and P solubilizing bacteria to solubilize P from the soil and fertilizer to be available to the plants (Saraswati & Sumarno, 2008). Several researchers had conducted the experiments to evaluate the responses of various plants such as young Robusta coffee (Junaedi et al., 1999), soybean (Noor, 2003; Totok & Rahayu, 2007), and turfgrass (Guntoro et al., 2007) to the biofertilizer application, but the results were still inconsistent. Increased root, shoot weight with dual inoculation in maize have been reported by (Chabot et al ., 1993), while grain yields of the different maize genotypes treated with Azospirillum spp. Seed inoculation with Rhizobium , phosphorus solubilizing bacteria, and organic amendment increased seed production of the crop(Panwar et al ., 2006). Increasing yield was attributed to the plant growth promoting substances by root colonizing bacteria more than the biological nitrogen fixation, (Lin et al ., 1983) stated that yield increased due to promoting root growth which in turn enhancing nutrients and water uptake from the soil. There were positive and synergistic interactions between factors like interactions between mycorrhizal inoculation and phosphate biofertilizer on N concentration and phosphate biofertilizer and vermicompost on P concentration (Darzi et al ., 2009).
This study was planned to study effect of N and P bio fertilizers on yield components of barley.

MATERIALS AND METHODS

A field experiment was laid out in the Faculty of agronomy and plant breeding, Islamic Azad University, Boroujerd Branch, Boroujerd, Iran during the growing seasons 2011-2012. The experiment was laid out in order to evaluate the effects of nitrogen and phosphate bio fertilizers on yield components of barley. The soil type was a clay loam, pH of 7.9 and EC = 0.40 d s m^{-1}. The Boroujerd region has a continental semi-arid climate with annual precipitation of 369 mm. About 50% of this falls during the wheat and barley growing period. The experimental design was a RCBD with three replications. There were twelve rows in each plot; rows were 1 m long with 0.2 m row spacing. Treatments Treatments were three nitrogen biofrtilizers (Nitroksin, Nitrokara and Supernitroplass) and three phosphate biofrtilizers (Phosphate barvar2, Biozarr and Superplass) with control for them. At maturity, two outer rows for each plot, 25 cm from each end of the plots, were left as borders and the middle 1 m^2 of the two central rows were harvested. Then yield components were calculated as standard methods. To determine grain yield, biomass yield and harvest index, we removed and cleaned all the seeds produced within two central rows in the field. Then grain yield and biomass yield recorded on a dry weight basis. Yield was defined in terms of grams per square meter and quintals per hectare. Replicated samples of clean seed (broken grain and foreign material removed) were sampled randomly and 1000-grain were counted and weighed. The harvest index was accounted with follow:

$$HI = (\text{Economical yield} / \text{Biological yield}) \times 100$$

The statistical analyses to determine the individual and interactive effects of time cultivation and weeds control methods were conducted using JMP 5.0.1.2 (SAS Institute

Inc., 2002). Statistical significance was declared at P≤0.05 and P≤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.

RESULTS AND DISCUSSION

The results showed that, effect of Nitrogen bio fertilizer on number of grain per spike, 1000 grain weight, grain yield and biomass was significant (Table 1). The effect of Phosphate bio fertilizer on grain yield and biomass was significant and the interaction between them on number of grain per spike, 1000 grain weight, grain yield and biomass was significant (Table 1).

The comparison of the mean values of the number of spike per plant showed that among the nitrogen biofertilizers, Super notroplas treatment has the highest (71) number of spike per plant and control treatment has the lowest number of spike per plant (65) and the differences were significant (Table 2). Among the phosphate biofertilizers treatments, the highest number of spike per plant (68.2) was belonged at application of Superplas and the lowest number of spike per plant (65) was belonged at application of Phosphat barvar2 (Table 2).

Among the nitrogen biofertilizers, Nitroksin treatment has the highest (28g) 1000 grain weight and Nitrokara treatment has the lowest 1000 grain weight (24g) and the differences were significant (Table 2). Differences between Phosphate biofertilizers treatments for 1000 grain weight was not significant (Table 2). The comparison of the mean values of the grain yield showed that among the nitrogen biofertilizers, Nitroksin treatment has the highest (7.6 ton/ha) grain yield and control treatment has the lowest grain yield (5.1 ton/ha) and the differences were significant (Table 2). Differences between Phosphate biofertilizers treatments for grain yield was not significant (Table 2).

The comparison of the mean values of the biomass yield showed that among the nitrogen biofertilizers, Nitroksin treatment has the highest (23 ton/ha) biomass yield and control treatment has the lowest biomass yield (17.1 ton/ha) and the differences were significant (Table 2). Differences between Phosphate biofertilizers treatments for biomass was not significant (Table 2).

Table1. Analysis of variance (mean squares) for effects of different bio fertilizers on yield components of barley

source	df	Number of tillers	Number of spike	number of grain per spike	1000 grain weight	grain yield	biomass yield	harvest index
R	2	0.14	0.24	9.33	3.49	3.27	5.64	24.41
N biofertilizer(N)	3	0.05	0.15	35.41*	20.5**	3.7*	7.7*	6.3
P biofertilizer(P)	3	0.11	0.13	17.7	4.14	3.7*	5.2*	40.4
N*P	9	0.9	0.69	28.5*	10.7*	3.06*	5.04*	23.1
E	24	0.45	0.42	11.42	4.22	0.99	2.65	18.6
CV		11.4	12.4	4.9	5.3	15.3	15.4	7.03

* and **: Significant at 5% and 1% probability levels, respectively

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,Tiwari *et al* ., 1989,Afzal *et al* ., 2005, and Ozuturk *et al* ., 2003). According to the data of table 2, the effect of nitrogen and phosphate biofertilizers were evaluated positively, there were an increase in number of grain per spike, 1000 grain weight, grain yield and biomass. Some researchers determined that enhanced phosphorus release increases evaluations for the trait of grain yield, biomass and 100-seed weight (Rovira and Ridge, 1979; Khaliq and Sanderz, 2000). It has also been reported that photosynthetic material exchange activity is stimulated through symbiosis with microorganisms in inoculated plants that increases the efficiency of photosynthetic phosphorus. Therefore, it may be concluded that photosynthetic capacity of plants treated with phosphors-solving microorganisms increases due to increased supply of phosphors nutrition. Therefore, reduced production of photosynthetic substances due to a smaller green surface area, decreased the conservation content of photosynthetic substances due to having short internodes or high levels of absysic acid during the above–mentioned critical period, restrict the 100-seed variance analysis, the effects biological fertilizers. Results were similar to previous research(Shekh, 2006, El-kholy et al ., 2005 and Sarig et al ., 1990).

Table2. Mean comparisons for effects of different bio fertilizers on yield components of barley

treatments	Number of tiller	Number of spike	number of grain per spike	1000 grain weight(g)	grain yield(ton/ha)	biomass yield(ton/ha)	harvest index(%)
N biofertilizer(N)							
Nitroksin (N_1)	6.2^{a}	6^{a}	67^{b}	28^{a}	7.6^{a}	23^{a}	27^{b}
Nitrokara (N_2)	6^{a}	5^{b}	68^{b}	24^{b}	6.2^{b}	20^{b}	31^{a}
Super notroplas(N_3)	5.2^{ab}	6.2^{a}	71^{a}	24^{b}	6.2^{b}	19^{b}	25^{a}
Control(N_4)	4.9^{b}	5^{b}	65^{b}	26^{b}	5.1^{c}	17.2^{c}	23^{b}
P biofertilizer(N)							
Phosphat barvar2(P_1)	6^{a}	6^{a}	65^{b}	25	6.2	21	25^{b}
Biozar(P_2)	5^{b}	5.1^{a}	68^{a}	24	6.5	20	29^{a}
Super plas(P_3)	5.7^{ab}	5.3^{b}	68.2^{a}	25	6.12	20	24^{b}
Control(P_4)	5.1^{b}	6.2^{a}	67^{a}	26	6.3	19	29^{a}

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

1000 grain weight increase may under the effect of the phosphorus biofertilizer which induced the uptake ability of the roots to nutrients and positive increase in the yield parameters because of improving the root system as a source-sink relationship to the reproductive part (shoot), that agree with (Mohammed et al ., 2001), (Ozturk et al ., 2003) and (Panwar et al ., 2006). 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. Biomass yield was increased under application of biofertilizers, which positively influenced the plant photosynthesis and dry matter accumulation more actively that agree with (Lin et al ., 1983, Salmone and Dobereiner, 2004, Shevananda, 2008, and Darzi et al ., 2009). Long term field studies showed a significant contribution of biofertilizers for the yield increase of the field crops, which

vary in range from 8–30% of control value depending on crop and soil fertility. The rhizosphere competence of native bacteria for C sources was major determinant for the success of inoculants (Gyaneshwar et al., 2002). As free living, non-photosynthetic bacteria depend on soil organic matter as a food source, enhanced bacterial populations in the mixtures possibly increased competition for energy sources in the soil. Mixed microbial cultures allow their components to interact with each other synergistically, thus, stimulating each other through physical or biochemical activities.

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