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Effect of different biofertilizers on Seed yield of barley (*Hurdeom vulgar* L.), Bahman cultivar

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ABSTRACT

A study was undertaken to determine the effects of different biofertilizers on growth and seed barley, Bahman cultivar in Iran. The trial was laid out in RCBD with split plot arrangement having three replications during 2011-12 and at Boroujerd, Iran. Treatments were three nitrogen biofrtilizers (Nitroksin, Nitrokara and Supernitroplass) and three phosphate biofrtilizers (Phosphate barvar2, Biozarr and Superplass) with control for them. Results shows that differences between application of different bofertilizers was significant. However, 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). For give the highest seed yield we should apply both nitrogen and phosphate biofertilizers.

Key words: barley, seed yield and biofertilizer

INTRODUCTION

Barley (Hordeum vulgare L.) ranks fifth among field crops in grain production in the world after maize, wheat, rice and soybean (FAO, 2008). It is the main rainfed crop and it grain yield is variable in response to the erratic rainfall (Austin et al., 1998a,b). In recent years, about two thirds of barley crop has been used for feed, one-third for malting and about 2% directly for food (Baik and Ullrich, 2008). However, barley is preferred by farmers under low rainfall conditions. In fact, data from the Agricultural Department of Catalonia (average from 1992 to 2000)

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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. Farmer preferences to assign barley to areas with higher frequency of severe drought are due to the general belief that it performs better than wheat under drought conditions. Therefore, monocultures of barley under more intense drought conditions are quite common in the region that as a result produces some difficulties in crop management, such as control of specific weeds and diseases. Seeding earlier increases chances of disease and insect problems. Seeding later reduces chance of survival, generally delays maturity, increases disease chances and reduces yield potential (El-Gizawyl, 2009). Grain yield of small grain cereals is determined by two main components, grain number per unit area (grains perm2) and mean grain weight. Environmental conditions around 20 days pre- and 10 days post-anthesis are considered critical for grain yield determination (Savin and Slafer, 1991). During pre-anthesis, the potential grain number per unit area (Fischer, 1985) and potential grain weight (Calderini et al., 2001) are defined. The final grain number per unit area is set immediately after anthesis, while grain filling occurs during the remaining postanthesis period (Ugarte et al., 2007). Grain yield is usually strongly associated with the number of grains per unit area (Fischer, 1985; Savin and Slafer, 1991). While this association has been extensively reported for a relatively wide range of environments. Nitrogen and phosphorus are known to be essential nutrients for plant growth and development. The global nitrogen cycle pollutes groundwater and increases risk of chemical spills. The production of chemical fertilizers is a highly energy-intensive process using large amounts of fossil energy. High- input farming practices achieving high yields have created environmental problems and degradation in natural resources. Large quantities of chemical fertilizes are used to replenish soil N and P, resulting in high costs and severe environmental contamination. Consequently, there has recently been a growing level of interest in sustainable agricultural practices to alleviate detrimental effects of intensive farming currently practiced. Increasing and extending the role of biofertilizers would reduce the need for chemical fertilizers and decrease adverse environmental effects. Microorganisms are important in agriculture in order to promote the circulation of plant nutrients and reduce the need for chemical fertilizers. In sustainable agriculture, grains are expected to have high nutritional value as well as ability to produce vigorous seedlings to compete weeds, leading to increase in yield. Grain mineral composition influences both nutritional quality and seed vigour. During seed development on the parent plant, nutrient concentration in seed is dependent on soil type, nutrient availability, crop species, weather condition, growing season as well as cultivar (Feil and Fossati, 1995; Rengel et al., 1999). Generally, in organic products, vitamin C, Fe, P, Mg, Zn concentrations were higher as compared with conventional products. However, protein, Mn, K, nitrate and heavy metal concentrations were less (Rengel et al., 1999; Woese et al., 1999; Zhang et al., 2001; Worthington, 2001; Ryan et al., 2004; Salo et al., 2007). Organic and inorganic fertilizers change the crop quality according to their different potential abilities. Inorganic fertilizers are generally more soluble and available at the high plant demand, but organic manure releases minerals slowly which may not be fully available during the critical period of plant demand (Worthington, 2001). There is a tendency in developed countries to reduce environmental risk and enhance food nutritional value by using more organic fertilizers, while in developing countries; low soil fertility limits the use of organic fertilizers (Kirchmann and Ryan, 2004). Thus it is important to apply the best fertilizing systems to overcome the widespread poverty and achieve the desired international grain food security.
Therefore this study was planned to examine effect of different biofertilizers on seed yield of barley, Bahman cultivar at the_Lorestan provience, Iran.

MATERIALS AND MHETODS

In order to study effect of different biofertilizers on seed yield of barley (*Hurdeom vulgar* L.) ,Bahman cultivar an experiments was conducted under temperate condition in station of agricultural farm in Lorestan provience (Boroujerd station), Iran during 20011–2012. 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. Each sample was oven dried at 80 ·C and grain yield measured. Then seed yield of cultivats was analyzed. Data were analyzed with Proc GLM procedure, SAS (SAS Inst., 1994) statistical software.

RESULTS

Results showed that effect of different biofertilizers on seed yield of Barley, Bahman cultivar were significant. (Table 1). The comparison of the mean values for seed yield shows that Nitroksin nitro-biofertilizer treatment of barley has the highest seed yield (7.6 ton/ha) and the control treat has the lowest (5.1 ton/ha) and the difference etween them was significant (Fig1). Some of the previous studies showed that mixture inoculations had no comparative advantage over single cultures in wheat (Han and New, 1998) and in other crops (Chiarini et al., 1998). In contrast to other studies suggesting that combined culture inoculants significantly increased grain and dry matter yields as compared with single inoculation of individual organisms in sorghum (Alagawadi and Gaur, 1992), and in sugar beet and barley (Çakmakçi et al., 1999). It has been shown that N fertilization (Kefyalew et al., 2007; Hamzei, 2011) and combination of N fertilizer and biological N2 fixation (Rawia et al., 2006; Kizilkaya, 2008) affected grain yield and biomass accumulation by crop at field condition which is in accordance to the results of this study.

Table1. Analysis of variance (mean squares) for seed yield of barley under application of different biofertilizers

Source	df	yield
R	2	3.27
Nitrogen biofertilizer (A)	3	3.79*
Phosphate biofertilizer (B)	3	3.7*
A*B	9	3.06*
Error	30	0.99
CV		15.38

ns: Non-significant, * and **: Significant at 5% and 1% probability levels, respectively

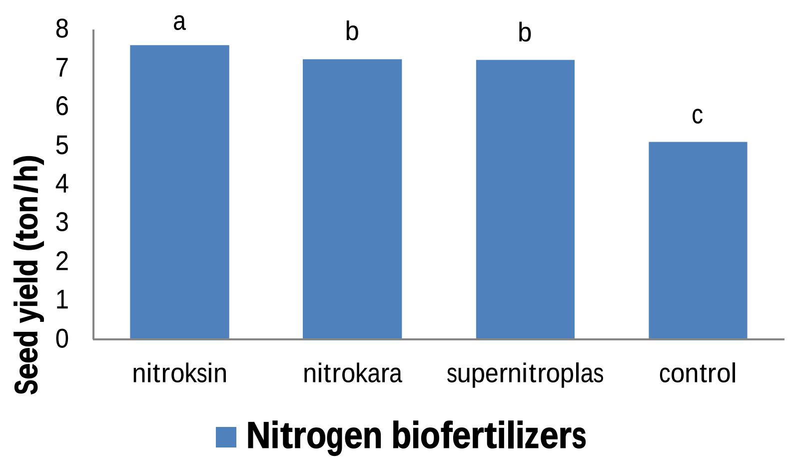

Fig 1. Simple mean comparisons for seed yield of barley under application of nitrogen biofertilizers

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

The analysis of variance shows that the effects of phosphate biofertilizers was not significant (Table 1). Simple mean comparisons for seed yield of barley shows that the highest seed yield (6.6 ton/ha) gave with application of Biozar phosphate biofertilizer and lowest (6.12 ton/ha) gave with application of Superplas phosphate biofertilizer and difference between them was not significant (Fig2). Biofertilizers are good tools to reduce environmental damages and enhance the yield (Lévai et al., 2006).

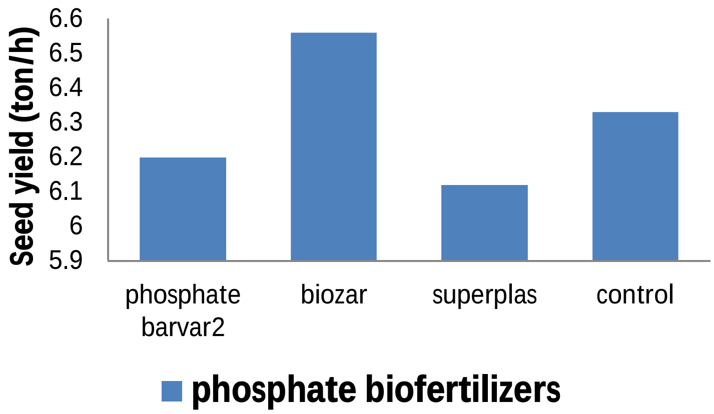

Fig 2. Simple mean comparisons for seed yield of barley under application of phosphate biofertilizers

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

The analysis of variance shows that the effects of nitrogen biofertilizer × phosphate biofertilizer application was significant at 5% level (Table 1). Interaction effect of nitrogen biofertilizer × phosphate biofertilizer application on seed yield of barley shows that the highest seed yield (6.5 ton/ha) gave with application of phosphate barvar2 for Nitroksin biofertilizer and difference of it with other nitrogen biofertilizers was significant for Bahman cultivar. The lowest seed yield (6.19 ton/ha) for Nitroksin biofertilizer gave in the control treat and diffrence of it with Superplas and Biozar was not significant (Fig3). However for Nitrokara biofertilizer highest seed yield (7.1 ton/ha) gave with application of Superplas and lowest seed yield (6.2 ton/ha) gave with application of Biozar. For Supernitroplas biofertilizer highest seed yield (7.9 ton/ha) gave with application of phosphate barvar2 and lowest seed yield (6 ton/ha) gave with application of Biozar and difference between them was significant for Bahman cultivar. With application of any nitrogen biofertilizer highest seed yield (7 ton/ha) gave with application of phosphate barvar2 and lowest seed yield (6 ton/ha) gave with application any phosphste biofertilizer. According of this study for achieve highest yield in barley cultivation we should apply supernitroplas with phosphste barvar2 biofertilizers (Fig 3). Non opplication of them laid to lowest Barley yield. The efficiency of Azotobacter, Azospirillium and phosphate soloubilizing bacteria on growth and essential oil of marjoram (Majorana hortensis L.) plants were studied by Fatma et al. (2006). They suggested that the mineral N and P fertilizers can be replaced by bio-fertilizers, which can reduce both the production costs and the damages to the environment, particularly the nitrate form of nitrogen. Sharifi and Haghnia (2006) showed that the application of Nitroxin biofertilizer increased grain yield of wheat (cv Sabalan). Rasipour and Asgharzadeh (2006) also obtained similar results in Soybean. Fallahi et al. (2008) studied the effects of Nitroxin biofertilizer, phosphate suloblizing bacteria and Nitroxin biofertilizer+phosphate suloblizing bacteria on quantity and quality yield of Chamomile. Their results showed that the treatments had significant effects on seed yield. The Highest seed yield was observed when Nitroxin and phosphate suloblizing bacteria were applied together. They concluded that this biofertilizers can be considered as a replacement for chemical fertilizers in chamomile medicinal plant production.

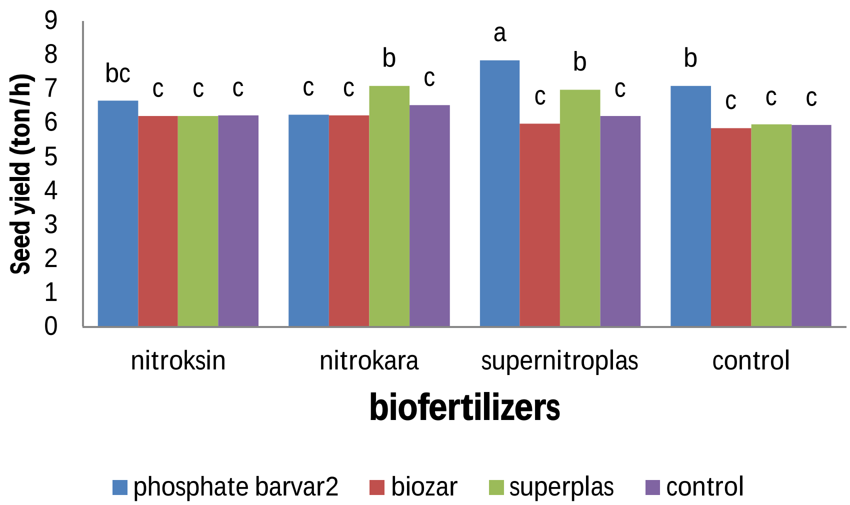

Fig 3. Interaction effect of sowing date and cultivars on seed yield of wheat

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

CONCLUSION

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. Plant growth promoting activity was partially independent of bacterial population size on roots (Chiarini et al., 1998). The nutrient competition between plant and high bacteria population probably limited plant growth (Oliveira et al., 2002). Mixed microbial cultures allow their components to interact with each other synergistically, thus, stimulating each other through physical or biochemical activities (Vassilev et al., 2001). The interaction of N2-fixing bacteria with other bacteria could also inhibit their diazotrophic activity (Rojas et al., 2001). Soil microbial cultures with similar or different functions might express beneficial actions in a soil or rhizosphere (Bashan, 1998). In the present work, significant differences were observed among nitrogen and phosphate biofertilizers treatments regarding the average seed yield was more affected. Application of supernitroplas with phosphate barvar2 biofertilizers in the same time on its own increased seed yield of barley significantly.

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