Effect of the Biological Fertilizer, Azotobacter on Activity of Some Vegetative Traits and Grain Yield of Different Cultivars of Barley

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ABSTRACT

One of the most important agricultural problems especially in developing countries is the excessive use of chemical fertilizers to achieve more productivity. This not only can lead to huge economic spending, but also have environmental devastating effects and adverse impacts on human and animal health. Therefore, to reduce environmental and health hazards, use of biological fertilizers seems logical. In order to investigate the effect of biological fertilizers on eco-physiological characteristics and the yield of irrigated barley lines in the temperate regions of Kermanshah province, an experiment was performed in the form of split plots and randomized complete blocks in three replications in Sahneh City (Kermanshah Province) in 2013-2014. Azotobacter in three levels (100%, 50%, control) as the primary factor and secondary factor in 7 levels (MB-89-4, MB-89-9, MB-89-15 and D-10 and figures presented by Nosrat, Yousof and Nik) were considered. Analysis of variance showed that the effect of Azotobacter on some of the traits related to yield such asplant height, extrusion height, peduncle height at five-percent level, spike height and grain yield at one-percent level were significant and positive.

Keywords: Azotobacter, Barley, Vegetative traits, Yield

INTRODUCTION

Because the food needs of plants is various in different growth conditions, compliance of critical ranges and also introducing biological compounds as the supplier of some of the elements required by the plant, paying special attention to the points to achieve maximum yield, product quality, prevention of diseases, prevention toxicity and enhance and protect the living environment and environmental protection and many other important points, including increasing plant resistance, increase the level of harvest and reducing the import of unnecessary and chemical fertilizers and the content of pollutants such as cadmium, increase the water efficiency, achieve the early products, increase the resistance of plants to environmental stresses,optimal consumption of fertilizers all confirm the need for the optimal use fertilizers; and necessity to use biological fertilizers and other similar products have led to the reduction inquantitative and qualitative yield of products and irreparable economic and environmental damage to soil and water and product [1]. Biological fertilizers also play a vital role in the long-term maintenance of soil fertility and stability. Biological fertilizers have favorable effects on soil health. The use of bio-fertilizers in different agricultural

Research Article, Acta Biologica Indica 2015, 4(1):96-100

pISSN 2319-1244, eISSN 2279-0160

systems may save about 30-40 kg per hectare nitrogen fertilizer and 10-20 kg phosphoric acid per hectare per agricultural season. It is estimated that one ton of biological fertilizer Rhizobium is equivalent to 100 tone nitrogen fertilizer. Given these facts, it is expected that the use of biofertilizers in the next few years to increase several times [2].

MATERIALS AND METHODS

The present article mainly aims to investigate the effect of Azotobacter on eco-physiological characteristics and yield of irrigated barley lines in the temperate regions of Kermanshah province in the form of crushed split (split plot) and randomized complete blocks in three replications in Sahneh city (Kermanshah province) in 2013-2014. Azotobacter at three levels (100%, 50%, control) as the primary factor and genotype as secondary factor at 7 levels (MB-89-4, MB-89-9, MB-89-15 and D-10 and figures presented by Nosrat, Yousof and Nik) were considered. Each plot was considered in an area of 1.8 sq m (each stack 60 cm). The plant density was 400 grains per square meter, and planting depth was 4-5 cm. Sowingwas done by Winter Shniger experimental sower and irrigation in a plot form. The amount and type of consumed fertilizer in the form of sprayed solution was done in two steps. The first step in the 3-4 leaf stage at the beginning of March and the second phase at the beginning of tillering on the basis of recommendations prepared by the company was used. The traits which were studied and measured in this research include plant height, spike length, extrusion length, peduncle length and grain yield. Statistical analysis was performed using SPSS software.

RESULTS AND DISCUSSION

Plant Height

The results of analysis of variance showed that the effect of Azotobacter on plant height was significant at five-percent level. Also plant height affected by genotypeatone-percent level showed a significant statistical difference. In addition, the mutual interaction between genotype and Azotobacter fertilizer did not show a significant difference and had the same effect of plant height (Table 1). The results obtained from the comparison of the average effect of Azotobacter on plant height showed that Azotobacter 50% by an average of 91.76 cm and the control by an average of 86 cm had the highest and lowest plant height, respectively. Plant inoculation by viable bacteria stimulates plant growth and plant height (Table 2). Plant height is primarily a genetic trait and is partially stable. However environmental factors, particularly light, have a significant impact on it. Hossain et al. [3] reported the significant increase of nitrogen on wheat plant height. Barik and Goswami [4] also reported that wheat grain inoculation with Azospirillum had a positive effect on plant height and spike length. In general, it seems that use of Azotobacter leads to the ability to absorb more nutrients, and this is probably due to molecular nitrogen fixation or production of growth hormone. In general, Azotobacter increases plant height.

Spike Length

The analysis of variance showed that effect of Azotobacter on spike length was significant at one-percent level. Also, spike length under influence of genotype one-percent level showed a statistically significant difference. In addition, the interaction between genotype and Azotobacter fertilizer was significant at one-percent level. The results relevant to the mean effect of Azotobacter on the spike length showed that Azotobacter with 50 percent recommended by an average of 19.35 cm and the control treatment with an average of 17.08 cm had the highest and lowest spike length,

respectively (Table 2). Sharifi and Haqnia [5] stated that Nitroxinas a biological fertilizer was effective on yield and yield components of Sabalan Cultivar of wheat and increased spike length. In a study it was found that organic nitrogen fertilizer significantly affected all parameters of corn growth and maize length. In this study, biological nitrogen fertilizer played effective roles in increasingcorn shoot growth due to the increased uptake of nitrogen [6]. Ardekani [7] announced that Azospirilum increase the length of the spike in wheat. Based on the results of research by Kanani and Raei [8], spring barley spike length was significantly affected by the levels of biological nitrogen fertilizer. The reason may be due to increased levels of nutrients such as nitrogen established by Azotobacter.

Table 1. Analysis of variance of the measured traits after the use of biological fertilizer, Azotobacter.

Sources of Variations	Degree of Freedom	Plant Height (cm)	Extrusion Length (cm)	Peduncle Length (cm)	Spike Length (cm)	Grain Yield (kg/h)
Replication	2	21.397ns	3.949ns	2.084ns	.596ns	424745.635ns
Fertilizer	2	179.159*	62.830*	9.308*	35.814**	31930663.683**
Error 1	4	20.825	7.691	0.904	0.431	239249.33
Genotype	6	516.513**	183.757**	73.780**	24.250**	2599351.508**
Genotype*Fertilizer	12	9.307ns	15.220ns	2.931ns	2.193**	481994.794*
Error 2	36	44.368	13.692	2.309	0.744	210758.48
Variation Coefficient %		7.47%	12.52%	16.88	4.64%	5.77%

Comparison of the mean of various genotypes of harvest for the traits under study in Duncan method at 5%

Table 2. Means of recorded traits in different genotype.

Traits/ Genotype	Plant Height (cm)	Extrusion Length (cm)	Peduncle Length (cm)	Spike Length (cm)	Grain Yield (kg/h)
Yousef	84.4 D	25.60 B	7.022 D	18.27 B	7698 A
MB-89-4	95.7 B	34.46 A	13.59 A	18.61 B	7668 A
MB-89-15	84.3 D	23.66 B	5.756 D	16 C	7241 AB
MB-89-9	95.9 B	33.04 A	10.77 B	21.26 A	8343 A
Nik	82 D	28.5 B	6.222 D	18.44 B	8146 A
Nosrat	100.8 A	33.31 A	8.967 C	18.96 B	8877 A
D-10	88.3 C	31.47 A	10.69 B	18.94 B	7765 A

Extrusion Length

The analysis of variance showed that effect of Azotobacter on extrusion length was significant at five-percent level. Also, extrusion length under influence of genotype at one-percent level showed a statistically significant difference. In addition, the interaction between genotype and Azotobacter fertilizer was not significant and had the same effect on extrusion length. The results relevant to the mean effect of Azotobacter on the extrusion length showed that Azotobacter with 100 percent recommended by an average of 31.54 cm and the control treatment with an average of 28.47cm had the highest and lowest extrusion length, respectively (Table 2).

Peduncle Length

The analysis of variance showed that effect of Azotobacter on peduncle length was significant at five-percent level. Also, peduncle length under influence of genotype at one-percent level showed a statistically significant difference. In addition, the interaction between genotype and Azotobacter fertilizer was not significant and had the same effect on peduncle length. The results relevant to the mean effect of Azotobacter on peduncle length showed that Azotobacter with 100 percent recommended by an average of 9.41 cm and the control treatment with an average of 8.23 cm had the highest and lowest extrusion length, respectively (Table 2).

Grain Yield

The results of analysis of variance showed that effect of Azotobacter on the grain yield was significant at one-percent level. Also, the grain yield was under influence of genotype at one-percent level showed a statistically significant difference. In addition, the interaction between genotype and Azotobacter fertilizer was significant at five-percent level. The results relevant to the mean effect of Azotobacter on grain yield showed that Azotobacter with 100 percent of the recommended amount of fertilizer by an average of 9175 kg and control treatment (0%) by an average of 6686 kg had the highest and lowest yield, respectively (Table 2). The result obtained from the comparison of the average effect of genotype showed that Nosrat cultivar by an average yield of 8877 kg and MB89-15 line by an average of 7241 kg had the highest and lowest yield. Kanani and Raei [8] stated that based on the results of analysis of variance, the effect of different levels of biological nitrogen fertilizer and cultivar on barely grain yield per unit area was significant. In the experiment by Rai and Gaur [9], wheat grain yield was increased by 8.2, 9.1 and 1%, respectively. All the results of the experiments conducted by other researchers confirmed this fact as well. According to the results obtained by researchers, inoculation with Azotobacter increased on average about 10-70% in the yield of various plants, especially cereals. Due to the absorption of photosynthetic materials in the presence of amino acids and hormones that increase the amount of nitrogen available to plant, therefore, all the conditions are provided for increasing grain yield and grain yield will be increased.

CONCLUSION

In general, the significant impact of biological fertilizers on the qualitative and quantitative traits of barley indicates that to reduce environmental effects caused by excessive use of chemical fertilizers, the use of bio-fertilizers as an effective management strategy is suitable to agricultural crop production. Although the level of 50% of Azotobacter considerably increased plant height and spike length, 100% Azotobacter considerably increased biological and economic yield of grain in different cultivars of barely.

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