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On the Effect of Biofertilizers on the Yield and Yield Components of Wheat (*Triticum aestivum*) under Eyvan Climate Condition

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ABSTRACT: In order to study the effect of Biofertilizers on Yield and Yield components of wheat, an experiment in the form of factorial design based on randomized complete blocks with three replications during 2011-2012 in Eyvan was conducted. Experimental factors included nitrogen and phosphorus biological treatments with three fertilizers and one control for each treatment. Nitroxin, Nitrocara, biofarm for nitrogen and Biosuper phosphate, phosphate fertilizer 2 and phosphate Behroshd for phosphorus fertilizers were used. Results indicated that nitrogen had a significant effect on all the studied traits under nitrogen treatment, the highest grain Yield 560.5 g.m^2 was achieved by biofarm fertilizer. Phosphorus biological fertilizers also had a significant effect on all traits. The highest grain yield under the effect of phosphor 545.3 g.m^2 belonged at phosphate fertilizer 2. Interactive effect of nitrogen and phosphorus biological fertilizers on the number of spikelets in spike, number of grain in spike, 1000 kernel weight, and grain yield was significant. The maximum and minimum grain yield with 624.5 and 325.9 g.m^2 belonged at treatment levels of biofarm + phosphate fertilizers 2 and control respectively. In general, separate and combined application of nitrogen and phosphorus biological fertilizers can improve yield and yield components of wheat.

Key words: Wheat, Nitrogen biofertilizer, Phosphorus biological fertilizer, Yield.

INTRODUCTION

Wheat is the most important agricultural plant that growth in a wide range of climate conditions. In fact, it is one of the most adaptable species among cereal (Noormohammadi *et al.,* 2007). Wheat cultivation and growth is possible in all parts of the world (Khosrvi, 2001). The best regions for Wheat cultivation in terms of soil are areas with high amount of homus, enough ventilation and complete nutrient (Khosravi, 1997). Nutritious elements and soil condition have a great importance in plant growth. Successive and irregular cultivations has caused reduction of nutrients in agricultural soils of the world and has necessitated application of fertilizers in farms (Ahmadian *et al.,* 2006). Researchers have estimated that 60 percent of land farms in the world lack nutrients that is the result of inaccessibility and poisonousness of some of the withal nutrients (Bukvic *et al.,* 2003). Improving soil fertility is one of the important strategies in increasing agricultural products (Castagno *et al.,* 2008). Nitrogen is effective in all components of plant yield including number and weight of grain. Lack of this element reduces economic output of crop and higher amount of it increases vulnerability of plant to load and diseases (Majidian *et al.,* 2008). In most of the agricultural systems, phosphor, shortage after nitrogen has been the main limiting factors of producing agricultural crops. phosphor`s uptake capability depends on factors such as soil PH, increasing contact between phosphor and soil solution, solubility degree and spreading solid phosphor, time length of reaction between phosphor and soil, content of organic materials, type of the soil and temperature (Mosali *et al.,* 2006). Phosphor has positive effects on roots, tailors, wheat resistance to the cool, stooping and immaturity. Having interactive effects increases nitrogen efficiency and effectiveness. Phosphor also increases wheat resistance to diseases and control negative effects of nitrogen abundance. (Noormohammadi *et al.,* 2007). Efficiency of phosphate fertilizers in common cultivation and only 5-20 percent of them in the first year are absorbed by plant. So, the plant is always faced with a lack of this element (Malakuti, 1996).

Fletcher *et al.,* 2008 consider the cultivation limit over 30 percent of world areas, as a result of phosphor shortage. On the one hand, green revolution caused increase of agricultural crops, on the other hand severely polluted the environment. Strong use of the chemical compositions for promoting production level and protecting plant, disturbs ecological balance of the soil and ventilates some nutrients (Sharma *et al.,* 2007). According to other researcher`s view, although chemical fertilizers had an important role in green revolution, their unstable application caused reduction of soil fertility and pollution of environment (Fankemo *et al.,* 2006). Stable agriculture based on using biofertilizers and with the aim of reducing or removing chemical problems of chemical fertilizers. Biofertilizer term doesn`t Just refer to organic material from livestock manure, plant remains, green fertilizer but fungous and bacterial micro organisms especially plant growth promoters and resulting material of their activities are among the most important biofertilizers (Hamidi *et al.,* 2006). Among nitrogen stabilizers, Azotobacter family has a great importance. The oldest and the most common microbic fertilizers made of Azotobacter is Azotobacterin. Nitrogen amount stabilized by this bacteria is 20 to 40 kg per hectar in year and need a large amount of organic material for stabilizing Nitrogen (Khosravi, 2001). Phosphate solvent bacteria help better growth of plant directly e.g. promoting plant growth with physiological and nutrient mechanisms such as herbaceous hormones, solving phosphate and accelerating mineralization process, indirectly by controlling disease factors through producing combinations such as syanid, sydro for, anti-fugi metabolites and antibiotics (Reihani Tabar *et al.,* 2002). Concerning biofertilizers significance in providing overused elements as Nitrogen, phosphor and reduction of environmental pollution and also their undeniable role in stable and low - input agriculture, current research was conducted to investigate the effects of nitrogen and phosphate biological fertilizers on yield and yield components of fall wheat in Evan climate condition.

MATERIALS AND METHOD

This study was conducted as a field trial in 2011 in Evan, Ilam province, Iran. This region is temperate. To determine soil characteristics, before conducting the experiment sampling at the depth of 0-30 cm of soil was done and its qualities were examined (Table 1).

Table 1: Physical and chemical properties of soil sample.

Depth (cm)	N (%)	P (ppm)	K (ppm)	PH	Clay (%)	Sand (%)	silt (%)
0-30	0.03	6.5	200	7.39	26	27	47

The experiment was run in a factorial design based on randomized complete blocks with three replications. Factors included three nitrogen biological fertilizers, Nitroxyen, Nitrocara, Biofarm and control and three phosphorus biological fertilizers, biosuper phosphate, phosphate fertilizers 2, phosphate behroshd and control. The used figure was a common number in that region. Data arrangement and analysis was done by Excel and SPSS and MSTATC software respectively Duncan Multiple Range Test (DMRT) was used for comparing trait means.

RESULTS

A. Number of spike per level

The results of variance analysis showed that various resources of biological Nitrogen and phosphorus fertilizer had a significant effect on the number of spike per level (Table 2). The highest mean of this trait 436.9 in meter square was obtained by biofarm application that had 31 percent increase than control treatment (Table 3).

In Phosphorus biofertilizer also the highest mean of this trait 410.8 in meter square belonged at phosphate fertilizer 2 that showed 17 percent increase than control (Table 4).

B. The number of spikelets per spike

The result of variance analysis of data indicated significant effect of Nitrogen biological fertilizers and phosphorus fertilizer on the number of spikelets per wheat spike (Table 2). The highest mean of this trait belonged at Nitrogen sources with Biofarm 12.97 in each square meter that was 17 percent greater than control (Table 3). Phosphorus biofertilizers also the highest mean of this tried was obtained by Behroshd phosphate fertilizer and was equal to 12.80 in square meter that was 10 percent greater than control (Table 4). According to Table 2, Intractive effect of Nitrogen and Phosphorus biofertilizers on the number of spikelets per spike was significant. In general, the maximum and minimum mean of this tried was obtained in Biofarm + Behroshd phosphate with 13.78 in each square meter and control with 9.4 in each square meter respectively.

C. The number of grain per spike

The results of variance analysis showed that Nitrogen biological fertilizer and Phosphorus biofertilizers had a significant effect on the number of grain per spike (Table 2). The highest mean of grain per spike was obtained under Nitrogen 38.91 and phosphate 35.55 treatment respectively by Biofarm and Phosphate fertilizer 2 which had 45 and 23 percent increase than control levels (Table 3,4). According to Table 2, Intractive effect of Nitrogen and Phosphorus biofertilizers on the number of grain per spike was significant. The maximum and minimum mean of this tried belonged at Biofarm + Biosuper phosphate with 42.07 in square meter treatment and control 24.7 in square meter respectively.

Table 2: Analysis of variance for studied traits of wheat in this experiment.

s.o.v	d.f	MS				
		Number of spike per level	Number of spikelets per spike	Number of grain per spike	1000 kernel weight	Grain yield
Rep	2	25510	6.45	13.8	17.44	9024
Nitrogen biofertilizer	3	23787**	10.40**	320.3**	41.98**	101710**
Phosphorus biofertilizer	3	8173*	3.68**	103.8**	92.46**	75416**
Nitrogen × Phosphorus	9	2988	2.01*	42.5**	28.57**	14831**
Error	30	2406	0.76	10.7	4.63	4456
CV (%)	-	12.65	6.99	9.9	6.12	14.19

* and * * were significant differences at 0.05 and 0.01 probability levels, respectively.

Table 3: Mean comparisons traits under Nitrogen biofertilizer application.

Biofertilizer	Number of spike per level	Number of spikelets per spike	Number of grain per spike	1000 kernel weight	Grain yield
Nitroxyne	410.4 ab	12.9 a	35.1 b	36 ab	500.1 b
Nitrocara	375.2 b	12.6 a	33.8 c	35.6 b	485.3 b
Biofarm	436.9 a	12.97 a	38.91 a	36.23 a	560.5 a
Control	348.1 c	11.8 b	28.1 d	33.7 c	325.9 c

Means with the same letter(s) were not significantly differences at 0.05 probability level.

Table 4: Mean comparisons traits under Phosphorus biofertilizer application.

Biofertilizer	Number of spike per level	Number of spikelets per spike	Number of grain per spike	1000 kernel weight	Grain yield
Biosuper phosphate	398.5 ab	12.6 a	34.95 a	35.4 a	500.4 b
phosphate fertilizer 2	410.8 a	12.7 a	35.55 a	35.9 a	545.3 a
phosphate Behroshd	400.6 a	12.8 a	34.9 a	36.06 a	498.1 ab
Control	370.2 b	11.9 b	29.8 b	32.3 b	325.9 c

Means with the same letter(s) were not significantly differences at 0.05 probability level.

D. 1000 kernel weight

The results of variance analysis indicated the significant effect of Nitrogen biological fertilizer and Phosphorus biofertilizers on 1000 kernel weight (Table 2). Maximum mean of this trait obtained under Nitrogen treatment 36.23 g with Biofarm and Phosphor treatment 36.06 g with phosphate Behroshd that showed 11 and 16 percent increase than control (Table 3,4). Based on the results of mean comparison, Nitrocara + Phosphate fertilizer 2 and control + phosphate fertilizers 2 showed maximum and minimum 1000 kernel weight with 41.06 and 28.11 g respectively.

E. Grain Yield

According to the results, effect of Nitrogen biological fertilizer and Phosphorus biofertilizers on grain yield at 1 % were significant (Table 2). The highest grain yield mean was obtained under Nitrogen treatment 560.5 g per square meter with Biofarm fertilizer and under phosphor treatment 545.3 g per square meter with phosphate fertilizer 2 that had 63 and 52 percent increase than control treatment (Table 3,4). According to the results of mean comparison, Biofarm + phosphate fertilizer 2 with 624.5 g in square meter and control with 325.9 g in square meter had the highest and lowest mean of this trait respectively.

DISCUSSION

The number of spikes is one of the generative qualities of wheat. Results of this study indicated that Nitrogen biological fertilizers increased the number of spikes more than phosphorus Biofertilizers. According to Mozafari et al., 2021 in a study on wheat, nitrogen stabilizer bacteria including Azotobacter and Azospirillum had a significant effect on the number of spikes in plant. Madani *et al.*, 2011 reported that, the more transferable photosynthesis material, the more generative units of plants will be. Thus, biological fertilizer with their effect on leaf surface and photosynthesis, can increase the number of spikelets in plant. Increasing the number of spikelets cause increase of grain number in spike, accordingly, increasing grain number increases grain yield. probably, the reason for serious reduction of the number of grain in spike in this study has been reduction of the number of spikelets fertilizer. Noorgholipoor *et al.*, 2008 identified that Nitrogen caused the increase of the number of grain in wheat spike. They stated that lack of Nitrogen at the time of flower pollination cause lack of seeding. Therefore, Nitrogen biofertilizers, providing necessary Nitrogen of plants, can play an important role in grain filling and consequently the number of grains. Increasing the number of grain in spikes as a result of biofertilizers can result from their effects on spike`s length that somewhat increase their amount. Grain growth is supported by photosynthesis of plants and leaves and transfer of photosynthetic materials from other parts. Dry matter and accumulated Nitrogen before pollination is one of the important sources of photosynthesis and Nitrogen combinations for seed growth (Dordas and Sioulas, 2009). In a study on wheat, variety of Azotobacter increased performance in farm condition 84 percent and hose plant condition 95 percent than control treatment (Kizilikaya, 2008). Based on the results, it is obvious that using Nitrogen and Phosphate biofertilizers can provide parts of the phosphor and Nitrogen of wheat and reduce application of chemical fertilizers. In general, separate application of fertilizers or their combination can cause improvement of yield performance and finally wheat performance than unused mode of any one of them.

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