The 1st International Conference on New Ideas in Agriculture
Islamic Azad University Khorasgan Branch
26-27 Jan. 2014, Isfahan, Iran

APPLICATION METHODS OF FULZYME$_{PLUS}$ BIOFERTILIZER ON MORPHOLOGICAL, PHYSIOLOGICAL CHARACTERISTICS AND YIELD COMPONENTS IN WHEAT (*TRITICUM AESTIVUM* L.) CULTIVARS

Ali eslami[*1], Reza Sadrabadi haghighi[2]
MSc agroecology student, Mashhad Branch Islamic Azad University, Mashhad, Iran,
E-mail: alislami46@yahoo.com
[2] *Associate Professor, Mashhad Branch Islamic Azad University,*

1. Introduction

In recent years the use of chemical inputs in agriculture creates too many environmental problems such as water pollution, loss of soil fertility and decrease the quality of products have been (Nain et al, 2010). Based agricultural biofertilizers, with the goal of reducing and eliminating chemical inputs in an optimal way to overcome these problems is considered. As regards the limited researchs on the impact of these biofertilizers on growth characteristics and yield of wheat in Iran, especially Khorasan, This study was based. Biological fertilizers containing micro-organisms that are plant hormones, biological nitrogen fixation, and facilitate nutrient uptake from the soil and the biological control of plant pathogens, plant growth is affected (Vessey, 2003). There are Clear evidence of improvement or plant's quality and quantity by using bio-fertilizers but that reason is complex and it can be due to interactions of plants and microorganisms, microorganisms and signal transduction in plant defense responses attributed (Karthikeyan et al, 2008). The results of most studies on the growth of cereals and grasses, especially wheat inoculated with Azospirillum showed an increase in growth parameters such as plant height (Amir et al, 1991). Kizilkay (2008) showed that Azotobacter can be up to 84% yield increase. Halajnia et al (2009) showed that several varieties of wheat seed inoculation with Azospirillum increased the yield was 18-9%. Several studies have shown that Azotobacter inoculation in cereals lead to increase in nitrogen uptake and grain yield (Kumar et al, 2005). One kind of Commercial biofertilizers containing the bacteria Bacillus subtilis, is Fulzaym (Fulzyme $_{plus}$) which is contained the name of the bacteria and organic material and some enzymes protease, amylase, lipase and chitinase. According to the manufacturer, the use of fertilizers dissolve elements such as phosphorus, magnesium, calcium, potassium and lead to better position elements available for plant roots, is helping to break down crop residues and organic matter and prevent the spread of pathogens .

2.Materials and Methods

This study was conducted in Mazrae Nemouneh Astan Quds Razavi in 2011- 2012. The experiment performed as split plot based on randomized complete block design with three replications. Four wheat cultivars Falat, Pishtaz, Bahar and Toos were in main plots and four application methods as follows application on seed, using in irrigation water, using on seed and irrigation and control were in sub plots. Seed treating was done before planting with Fulzyme $_{plus}$ that (containg Bacillus subtilis (not less than 1x1010/ml), amino acid and organic materials. For this work seeds were sprayed by amount of 2.3 grams per liter and seeds were planted immediately. For irrigation factor applied like amount by irrigation after planting, exactly. And in combination of seed treat and irrigation factor used both of reminded methods. To calculate the chlorophyll content, chlorophyll meter SPAD-502, Soil-Plant Analysis Development (SPAD) Section, Minolta Camera Co. Ltd., Japan] was used. Spad index was measured three times on May 15, May 26 and June 4. At physiological maturity, in order to determine the harvest index used the following formula:HI = (EY / BY) × 100 HI: harvest index, EY: economic performance and BY: the biomass. Also yield and yield components were measured in square meters. Analysis of variance and analysis of experimental data using MS-Excel and MSTAT-C software and the means were compared by Duncan's multiple range tests.

3. Results

PlantHeight

The results showed that in among of wheat varieties, Falat with 61.5 cm height had less height than the other cultivars so that Toos and Pishtaz had about 14.5 cm more heighter than Falat (table 1). Of course Falat between common wheat cultivars in short height are classified and this is a definite genetic characteristic for it.

Table 1. Some morphological traits and chlorophyll meter values of wheat cultivars

Wheat cultivar	Plant height	Ear length	Chlorophyll meter values (stage I)	Chlorophyll meter values (stage 2)	Chlorophyll meter values (stage 3)	Harvest index (%)
Falat	61.50b	8.569b	66.94a	54.17a	56.06 a	27.67a
Pishtaz	70.33a	8.610b	50.97b	41.17b	36.43b	25.23a
Bahar	67.58a	10.07a	48.57b	41.83b	41.41b	28.22a
Toos	70.42a	8.583b	69.74a	63.54a	63.29a	29.34a

Similar letters in each column show non-significant differences according to Duncan's Multiple Range Test at 5% level.

Earlength

ear length in Bahar cultivar (10.07) was the heighest (table 1). This may lead to an increased number of spikelet per ear and number of flowers on ear and will ultimately increase the number of grains per ear that the results of the data on the number of grains per ear confirmed it. Also Falat had a high number of grains per ear that according to ear length, it can be concluded that the The density of spikelets on the ear in this cultivar (spikelets are attached close together) while other varieties may have a more open ear. Reported that spike length in wheat is controlled by varieties genetic characteristics and climatic conditions during the growing season (Dahiya et al, 2007).

Chlorophyllmetervalue

Chlorophyll meter value readings during at growth season showed that Falat and Toos have more Chlorophyll meter values and demonstrated priority than Pishtaz and Bahar, significantly. Chlorophyll meter value readings in the third stage leading 45.9% than Pishtaz, and 52.8% increase than Bahar. High number of Chlorophyll meter value positively correlated with iron and chlorophylla.

Harvestindex

The harvest index is the result of economic yield portion on biological yield, had the minimum value in control and had maximum values in seed treat and combination of seed treat and irrigation (Table 1).

Numberofearpersquaremeter

In this study interaction between cultivar and application methods of biofertilizer had significant effect on number of ear per square meter per So that in most varieties, combinated method of seed treat and irrigation produced the highest number of ear. Seed treat and no fertilizer application methods, showed the lowest number of number of ear per square meter (Table 2). Probably Fulzaym application may stimulate tillering and had more fertility at the plant.

Table 2. Effect of application methods of FULZYME$_{PLUS}$ biofertilizer on grain number per ear, ear per square meter, 1000 grains weight and grain yield of wheat cultivars

	Wheat cultivar	Method of fertilizer application			
		Seed Treat	fertigation	Seed Treat & fertigation	control
ear per square meter	Falat	316.7 ab	322 ab	363 a	264 b
	Pishtaz	298 b	318.7 ab	369.7 a	339 a
	Bahar	281 b	377.7 a	363 a	311.3 b
	Toos	261.3 b	348 a	348.3 a	310.3 b
grain number per ear	Falat	47.83 ab	44.27 abcd	45.40abc	45.23abc
	Pishtaz	39.40 cdef	34.77 f	35.47ef	37.03 def
	Bahar	42.20abcd	45.00 abc	49.53a	42.50abcd
	Toos	39.73cdfe	43.10 abcd	42.40abcd	41.00bcde
1000 grains weight	Falat	49.25 ab	48.73 ab	43.43 b	48.96 ab
	Pishtaz	50.73 ab	58.20 a	53.10 ab	54.41 ab
	Bahar	51.56 ab	53.35 ab	47.78 ab	48.90 ab
	Toos	50.29 ab	47.69 ab	51.63 ab	50.48 ab
grain yield	Falat	7446 ab	6955 b	7164 ab	5858 c
	Pishtaz	5976 bc	6436 b	6956 b	6848 b
	Bahar	6122 bc	9063 a	8609 a	6479 b
	Toos	7832 a	7155 ab	7638 a	6425 b

Similar letters in each column show non-significant differences according to Duncan's Multiple Range Test at 5% level.

Numberofgrainsperear

The results of data analysis showed that the Falat and Bahar had the highest and Pishtaz had the lowest number of grains per ear,respectively (Table 2). Falat , Bahar and Toos had 24.6, 22.2 and 13.3 more number of grains per ear. Although the number of ear per square meter in Pishtaz cultivar, was the highest in number, but the number of ear showed no significant differences between varieties. Conversely, although Pishtaz cultivar had the lowest number of grains per ear but with the 1000 grains weight of 11/54 gr showed the highest value, so that its1000 grains weight was 13.7% higher than Falat, respectively (Table 2). This would show the compensation effect of component yield in plants such as wheat.

1000grainsweight

This treat had an Inverse relation to the number of grains per ear, so that each treatment was increased the number of grains per ear by reducing 1000 grains weight (Table 2). Although had stated that seed weight is under genetic control, but relative compensation effect between the yield components can reduce lack of yield when a component is reduced to a minimum.

Grainyield

Yield is a function of the interacting components therefore it is expectable that the treatments have improved the yield components are likely to have a higher yield. The results showed that the relative grain yield was greatest in Bahar and Toos on application methods, while the lowest yield was found in Pishtaz in all forms of application methods. The highest grain yield was observed in treatments of irrigation and combinated method of seed treat and irrigation fertilizer application in Bahar (9063 and 8609 kg ha, respectively) and lowest in the control treatment (5858 kg ha). Maximum response to fertilizer application was observed in Bahar and Falat, so that in Bahar cultivar by using method of irrigation and combinated method of seed treat and irrigation fertilizer application , yield of 39.8 and 32.8% increased while Pishtaz cultivar did not react to the Fulzyme application and its yield did not change (Table 2).

4. Conclusion

The effects of fertilizers containing the bacteria Bacillus (fertilizer Fulzaym) on wheat cultivars can have different reactions due to genetic differences and growth characteristics of wheat varieties. Also irrigation method and combinated method of seed treat and irrigation fertilizer application were the best treatments to lead the most yield.

5. References

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