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Full Length Research Paper

Super nitro plus influence on yield and yield components of two wheat cultivars under NPK fertilizer application

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To evaluate the beneficial impact of biological and chemical fertilizers application on wheat (*Triticum aestivum*) some yield characters were investigated. Our objective in this study was the interactive effects of biofertilizer (BF) and chemical fertilizer (CF) applications on: quantity yield at Iran in 2006. In this respect, the experimental unit had designed by achieved treatments in factorial on the basis completely randomized block design with four replicates. Certain factors including five levels of fertilizer (100% CF application; 75% CF and 25% BF applications; 50% CF and 50% BF applications; 25% CF and 75% BF applications and 100% BF application respectively) and two wheat cultivars (Omid and Alvand) were studied. Our final statistical analysis was indicated that in the 50% CF and 50% BF applications, yield components were significantly higher. Those such as: biological yield, seed yield, stem dry weight, ear dry weight, awn dry weight, leaf dry weight, plant height, leaf number per main stem and spikelet number per spike were higher in unites by 50% CF and 50% BF applications together cultivated. Although the wheat cultivars treatment significantly increased yield components and harvest index. However highest yield components were produced by Alvand cultivar but highest plant height was obtained by Omid cultivar. Our finding may give applicable advice to farmers for management and concern on fertilizer strategy and carefully estimate chemical fertilizer supply by biofertilizer application.

Key words: Biofertilizer, chemical fertilizer, biological yield, seed yield, harvest index, wheat cultivars.

INTRODUCTION

Super nitro plus is a special compound of three bacterium with different effect on plant growth, soil boom diseases and nematode control. Bacterium active ingredients: 10^8 *Azospirillum* spp. g^{-1} or ml of the product. The combination different bacteria: 10^8 *Bacillus subtilis* per g or ml of the product. In super nitro plus produce different kinds of plant growth regulators, sidrophores, antibiotics and inhibitors for pathogenic agents and hydrogen cyanide for control of nematodes and finally increase the growth and yield of the crops. Many soil born disease agents like *Pythium, Fusarium, Rhizoctionia, Phytophthora, Sclerotinia* and *Verticillium* will be controlled by application of super nitro plus (Sagi et al., 1988). Biofertilizers are products containing living cells of different types of microorganisms (Vessey, 2003; Chen, 2006) that have an ability to convert nutritionally important elements from unavailable to available form through biological processes (Vessey, 2003) and are known to help with expansion of the root system and better seed germination.

Biofertilizers differ from chemical and organic fertilizers in that they do not directly supply any nutrients to crops and are cultures of special bacteria and fungi. Some microorganisms have positive effects on plant growth promotion, including the Plant Growth Promoting Rhizobacteria (PGPR) such as *Azospirillum*, *Azotobacter*, *Pseudomonas fluorescens* and several gram positive *Bacillus* spp. (Chen, 2006). The diazotrophic rhizobiocoenosis is an important biological process that plays a

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Table 1. The results of soil analysis.

Soil texture	Sand (%)	Silt (%)	Clay (%)	K (mg/kg)	P (mg/kg)	N (mg/kg)	Na (Ds/m)	EC (1: 2.5)	pH	Depth of sampling
Sa.L	45	30	25	142.2	5.2	38.7	0.05	0.18	7.9	0-30 cm

major role in satisfying the nutritional requirements of the commercial medicinal plants (Deka et al., 1992). The strong and rapidly stimulating effect of fungal elicitor on plant secondary metabolism in main crops has attracted considerable attention and research efforts (Zhao et al., 2005). *Azotobacter* and *Azospirillum* are free-living N_2-fixing bacteria that in the rhizospheric zone have the ability to synthesize and secret some biologically active substances that enhance root growth. They also increase germination and vigour in young plants, leading to improved crop stands (Chen, 2006).

Various *Pseudomonas* species have shown to be effective in controlling pathogenic fungi and stimulating plant growth by a variety of mechanisms, including production of siderophores, synthesis of antibiotics, production of phytohormones, enhancement of phosphate uptake by the plant, nitrogen fixation and synthesis of enzymes that regulate plant ethylene levels (Abdul-Jaleel et al., 2007). Nitrogen is the major nutrient that influences plants yield and protein concentration. When the amount of available soil N limits yield potential, additions of N fertilizers can substantially increase plants yield.

However, plants protein concentration can decrease if the amount of added N is not adequate for potential yield (Olson et al., 1976; Grant et al., 1985). Many researchers have found that late-season top-dress N additions as dry fertilizer materials were the most effective in attaining higher plants protein concentration (Fowler and Brydon, 1989; Vaughan et al., 1990; Stark and Tindall, 1992; Wuest and Cassman, 1992; Knowles et al., 1994). Good soil fertility management ensures adequate nutrient availability to plants and increases yields. High above-ground biomass yield is obviously accompanied by an active root system, which releases an array of organic compounds into the rhizosphere (Mandal et al., 2007).

It is well known that a considerable number of bacterial and fungal species possess a functional relationship and constitute a holistic system with plants. They are able to exert beneficial effects on plant growth (Vessey, 2003) and also enhance plant resistance to adverse environmental stresses, such as water and nutrient deficiency and heavy metal contamination (Wu et al., 2005). Therefore, the objective of this study was to evaluate the super nitro plus influence on yield and yield components of two wheat cultivars under NPK fertilizer application.

MATERIALS AND METHODS

This study was conducted on experimental field of Research Institute of Damavand (Absard station) at Iran (25°30' N, 52°15' W; 1860 m above sea level) during 2006, with sandy loam soil (Table 1), mean annual temperature (30°C) and rainfall in the study area is distributed with an annual mean of 321 mm. The experimental unit had designed by achieved treatment in factorial on the basis completely randomized block design with four replicates.

Certain factors including five levels of fertilizer (100% CF application; 75% CF and 25% BF applications; 50% CF and 50% BF applications; 25% CF and 75% BF applications and 100% BF application respectively) and two wheat cultivars (Omid and Alvand) were studied. Also we used 150 kg ha^{-1} chemical fertilizer of NPK and 1 lit ha^{-1} biofertilizer of super nitro plus. The soil consisted of 25% clay, 30% silt and 45% sand (Table 1) and further the field was prepared in a 15 m^2 area (5 × 3 m) totally 40 plots.

To determined biological yield and seed yield, stem dry weight, ear dry weight, awn dry weight, leaf dry weight, plant height, leaf number per main stem and spikelet number per spike 10 plants were selected randomly from each plot at maturity and then harvest index was determined by the following formula (Aliabadi-Farahani, 2006).

$$HI = \frac{\text{Seed yield (kg/ha)}}{\text{Biological yield (kg/ha)}} \times 100$$

The data were subjected to analysis of variance (ANOVA) using Statistical Analysis System (SAS) computer software at $P < 0.05$ (SAS institute Cary, USA 1988).

RESULTS

Final results of plants values showed that fertilizer levels significantly affected biological yield, seed yield, stem dry weight, ear dry weight, awn dry weight, leaf dry weight, plant height, leaf number per main stem and spikelet number per spike in $p \leq 0.01$ and harvest index and tiller number were not significantly affected due to by fertilizer levels (Table 2) which indicated the highest biological yield (14206 kg/ha), seed yield (4815 kg/ha), stem dry weight (5228 kg/ha), ear dry weight (605.2 kg/ha), awn dry weight (27.5 kg/ha), leaf dry weight (2476 kg/ha), plant height (104 cm), tiller number (4 tiller/plant), leaf number per main stem (7.2 leaf/main stem) and spikelet number per spike (19.1 spikelet/spike) under 50% CF and 50% BF applications and highest harvest index (34.72%) was obtained by 25% CF and 75% BF (Table 3).

Also, wheat cultivars significantly affected biological yield, seed yield, stem dry weight, ear dry weight, awn dry weight, leaf dry weight, plant height, tiller number, leaf number per main stem and spikelet number per spike in $p \leq 0.01$ and harvest index was not significantly affected due to by wheat cultivars (Table 2). However highest biological yield (15080 kg/ha), seed yield (5279 kg/ha),

Table 2. Analysis of variance.

		Mean squares										
Sources of variation	**Df**	**Biological yield**	**Seed yield**	**Stem dry weight**	**Ear dry weight**	**Awn dry weight**	**Leaf dry weight**	**Plant height**	**Tiller number**	**Leaf number per main stem**	**Spikelet number per spike**	**Harvest index**
Replication	3	0.007	15.931 **	151.124 **	189143.313	0.005	5.414 **	0.084 **	67.521	0.445	46.788	0.102
Fertilizer	4	1.423 **	10.087 **	112.006 **	1520201.243**	0.071 **	41.633 **	0.041 **	45.688	16.016 **	211.387 **	0.032
Cultivar	1	1.515 **	11.797 **	169.053 **	1089514.354**	0.058 **	67.903 **	0.022 **	14367.854 **	19.007 **	114.37 **	0.021
Fertilizer × Cultivar	4	0.027 *	0.008	0.961	211820.317 *	0.056	0.267	0.004	78.354	2.836	14.323	0.036
Error	27	0.009	0.032	2.608	86199.201	0.003	1.541	0.002	310.654	1.299	16.201	0.031
CV (%)		6.92	4.54	6.99	8.22	2.77	9.64	8.08	7.57	7.13	7.28	8.48

* and ** : Significant at 5% and 1% levels respectively.

Table 3. Means comparison.

Treatments		**Biological yield (kg/ha)**	**Seed yield (kg/ha)**	**Stem dry weight (kg/ha)**	**Ear dry weight (g/m2)**	**Awn dry weight (g/m2)**	**Leaf dry weight (kg/ha)**	**Plant height (cm)**	**Tiller number (tiller/plant)**	**Leaf number per main stem (leaf/main stem)**	**Spikelet number per spike (spikelet /spike)**	**Harvest Index (%)**
Cultivar	Omid	12433 b	4352 b	4725 b	547 b	24.8 b	2238 b	112 a	3 b	5.3 b	16.1 b	35 a
	Alvand	15080 a	5279 a	5731 a	663.5 a	30.1 a	2714 a	78 b	5 a	7.1 a	18.6 a	35.1 a
Fertilizer	100% CF	12803 b	4433 b	4991 ab	560.5 b	26.5 b	2207 b	102 a	3 ab	6 b	17.8 b	34.6 a
	75% CF and 25% BF	12473 b	4303 b	4830 b	546.2 b	26.6 b	2181 b	98 a	3 ab	5.9 b	17.6 b	34.4 a
	50% CF and 50% BF	14206 a	4815 a	5228 a	605.2 a	27.5 a	2476 a	104 a	4 a	7.2 a	19.1 a	33.9 b
	25% CF and 75% BF	12217 b	4244 b	4861 b	537.9 b	25.7 c	1977 b	87 b	3 ab	5.7 b	17 b	34.72 a
	100% BF	10555 c	3673 c	4108 c	466 c	22.6 d	1787 c	83 b	2 b	4.3 c	15.2 c	34.7 a

Means within the same column and rows and factors, followed by the same letter are not significantly difference ($p < 0.05$).

stem dry weight (5731 kg/ha), ear dry weight (663.5 kg/ha), awn dry weight (30.1 kg/ha), leaf dry weight (2714 kg/ha), tiller number (5 tiller/ plant), leaf number per main stem (7.1 leaf/main stem) and spikelet number per spike (18.6 spikelet/spike) were produced by Alvand cultivar but highest plant height (112 cm) was achieved by Omid cultivar (Table 3).

Interaction of the fertilizer levels and wheat cultivars had significant effect on ear dry weight in $p < 0.05$ (Table 2) and highest biological yield (14643 kg/ha), seed yield (5047 kg/ha), stem dry weight (5479 kg/ha), ear dry weight (634.3 kg/ha), awn dry weight (28.8 kg/ha), leaf dry weight (2595 kg/ha), leaf number per main stem (7.2 leaf/main stem) and spikelet number per spike (18.8 spikelet/spike) were achieved under 50% CF and 50% BF applications and Alvand cultivar and highest plant height (123 cm) was obtained under 50% CF and 50% BF applications and Omid cultivar and also, the highest harvest index (39.71%) was produced by 75% CF and 25% BF applications and Alvand cultivar (Table 4).

DISCUSSION

In this study, increases in agronomic criteria were observed following inoculation with biofertilizer. This may be due to better utilization of nutrients in

Table 4. Means comparison of interaction.

Survey instance qualifications		Harvest Index (%)	Spikelet number per spike (spikelet /spike)	Leaf number per main stem (leaf/main stem)	Tiller number (tiller/plant)	Plant height (cm)	Leaf dry weight (kg/ha)	Awn dry weight (g/m2)	Stem dry Weight (kg/ha)	Ear dry weight (g/m2)	Seed yield (kg/ha)	Biological yield (kg/ha)
	100% CF	34.8 b	16.9 cd	4.9 c	3 cd	120 a	2222 c	25.6 c	553.7 c	4858 bcd	4392 cd	12618 d
	75% CF and 25% BF	39.7 a	16.8 d	5 c	3 cd	115 a	2209 c	25.7 c	564.6 c	4777 cd	4327 d	12453 d
Omid	50% CF and 50% BF	34.4 b	17.6 cd	6.5 b	3.4 bc	123 a	2357 b	26.1 c	576.1 c	4976 abcd	4583 ab	13319 c
	25% CF and 75% BF	34.8 b	16.5 d	4.8 c	3 cd	102 b	2107 c	25.7 d	542.4 c	4793 d	4298 d	12325 d
	100% BF	34.8 b	15.6 e	4 d	2 d	96 bc	2012 d	23.7 e	506.5 d	4416 e	4012 e	11494 e
	100% CF	34.8 b	18.2 b	6.4 b	4 a	83 de	2460 b	28.3 b	612 ab	5361 ab	4856 ab	13941 b
	75% CF and 25% BF	39.71 a	18.1 b	6.4 b	4 a	79 def	2447 b	28.2 b	604.8 ab	5280 abcd	4791 abc	13776 bc
Alvand	50% CF and 50% BF	34.4 b	18.8 a	7.2 a	4 a	86 cd	2595 a	28.8 a	634.3 a	5479 a	5047 a	14643 a
	25% CF and 75% BF	34.8 b	17.8 bc	4.7 c	4 a	72 ef	2345 c	27.9 b	600.7 b	5296 abc	4761 bc	13648 bc
	100% BF	34.8 a	16.9 cd	4.2 c	3.8 ab	69 f	2250 c	26.3 c	564.7 c	4919 d	4476 d	12718 d

Means within the same column and rows and factors, followed by the same letter are not significantly difference ($p < 0.05$).

the soil through inoculation of efficient micro-organisms. A positive effect of biofertilizer on yield and yield components has been reported in the literature (Migahed et al., 2004). In addition, higher dry matter production by the inoculated plant might be because of the augmented uptake of N, P and K which in turn was a consequence of the root proliferation. Also, the increased growth parameters in hyssop might be due to the production of growth hormones by the bacteria (Ratti et al., 2001).

The results showed that 50% CF and 50% BF applications and Alvand cultivar increased yield and yield components of wheat, because nitrogen of chemical fertilizer, which is a primary constituent of proteins, is extremely susceptible to loss when considering that average recovery rates fall in the range of 20 to 50% for dry matter production systems in plants. Nitrogenous fertilizers generally cause deficiency of potassium, increased carbohydrate storage and reduced proteins, alteration in amino acid balance and consequently change in the quality of proteins and are a main element in chlorophyll production. Toxic concentrations of nitrogen fertilizers cause characteristic symptoms of nitrite or nitrate toxicity in plants, particularly in the leaves. Although pre plant fertilizer applications decrease the potential for nutrient deficiencies in early stages of growth, presence of residual soil NO_3–N (plant-available mineral N from the previous season) may pose a risk to the environment. The water of soil be salt by inordinate N application and increase its potential. Finally, the plant use high energy for absorb of salt water that be causes dry matter reduces in this condition. Therefore, dry matter reduced under application of high levels of chemical fertilizer application because injured roots and was reduced the absorption. Our results were similar to the findings of Stark and Tindall (1992); Wuest and Cassman (1992) and Knowles et al. (1994).

Conclusion

In general it appears that, as expected, application of biofertilizer improved yield and other plant criteria. Therefore, it appears that application of these biofertilizers could be promising in production of wheat by reduction of chemical fertilizer application. Our finding may give applicable advice to farmers for management and concern on fertilizer strategy and carefully estimate chemical fertilizer supply by biofertilizer application.

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