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Effect of Biologic Stabilizers of Nitrogen and Chemical Fertilizers on Quantitative and Qualitative Characteristics of Rice

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Abstract: To study the effects of reconciliation usage of some of nitrogen stabilizers (Azetobacter, Azospirilium and Azorhizobioum), chemical fertilizer of urea, Zn (Zinc) and Fe (Iron)-EDDHA on the operation and operation components of rice, a split-factorial test in the framework of complete random block design was conducted with 3 replication in Bandar-Anzali (North of Iran) in 2011 crop year. In this test, nitrogen fertilizer as the main factor was in 3 levels (control, biologic fertilizers (reconciling Azetobacter, Azospirilium and Azorhizobioum bacteria) and chemical fertilizer of nitrogen (150 kg ha^{-1} urea)) and two subsidiary factors were fertilizers of Zn and Fe-EDDHA in two levels (control and using 5 in 1000 EDTA EDDHA in the form of leaf). Results showed that the effect of nitrogen fertilizer on stalk length, number of grain per cluster and the content of grain was meaningful in 1%. Reciprocal effects of nitrogen and Zn on the number of tillers in square meter and reciprocal effect of nitrogen, Zn and Fe on the length of cluster was meaningful in 5%. The highest mean of stalk (113 cm), number of grain per cluster (89.4) and the content of grain (54.2 kg ha^{-1}) was achieved by using urea fertilizer.

Key words: Rice, biologic and chemical fertilizer, nitrogen, Fe- EDDHA, Zn (Zinc)-EDDHA

INTRODUCTION

Cereals are one of the important sources which provide necessary food of human beings. Today, using chemical fertilizers such as nitrogen for promoting their operation has increased considerably. Chemical fertilizers are tonic salts but many times they are destroyer and in long run will decrease penetrability, increase special exterior weight, pollution and soil salinity, make stem penetration problematic and finally reduce the operation. In addition to this, high cost of producing these fertilizers and also biologic problems of their unprincipled consumption necessitates reviewing nutrition methods of these plants (Malakouti, 1996; Ventura, 1992). However, nitrogen is one of the necessary elements of plant and plant's need for nitrogen is more than other elements. Morphologic and physiologic traits of plants often change in reaction to the amount of availability of sources (such as fertilizer). Considering that the plant growth and its' operation is dependant on photosynthesis process and nitrogen can have a direct effect on the value of photosynthesis in leaf level unit, its shortage might result in the reduction of carbon dioxide absorption and therefore, plant nitrogen balance is directly related to carbon dioxide balance because nitrogen consumption lead to increasing its density in plant, increasing photosynthesis enzymes density and chlorophyll density in photosynthesis reaction centers in the plant (Cechin, 1997). Whereas there is a near relationship between the value of leaf photosynthesis and nitrogen density (Mohtashami, 2001), it is necessary to balance leaf nitrogen value along the growth period to get to a high operation (Keshavarzi, 1999). Traits which lead to operation promotion have a good correlation with nitrogen consumption value. Continuous and long term cultivation of rice in farmlands and usage of high consumption chemical fertilizers such as nitrogen and phosphor and non-consumption of other elements such as Zinc (Zn) lead to the lack of nutrient elements in farms soil. In special, after nitrogen and posphor, Zn is the most important restricting element of rice growth in flooding situation (Toghifi and Najafi, 2001). Lack of Fe can be observed in a wide spectrum of soils other than acidic soils. Soils >6 pH are usually in lack of Fe. Fe like some of the nutrient elements in these soils would become insoluble, immobile and unavailable (Fajeria, 1996). Perhaps, note that proportion of H^+/OH^- ions which would be sprinkled from stem in the soil create a completely complex process with Fe nourishment in plants which are highly dependent on soil parameters including soil calcium carbonate content (Fajeria, 1996).

Fe and Zn elements have an important role in grain formation and increasing its weight and helping carbohydrates and proteins synthesis. Zn has a key role

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in helping material metabolism and affecting electron transmission reactions in Krebs cycle by increasing the value of growth regulators and iron has a key role in increasing grain weight and number and finally grain operation by participating in hydrocarbon and protein materials metabolism and their transmission and also affecting generative processes (Welch and Shuman, 1995). Meanwhile using biologic products for cereal nourishment seems to be one of the important and beneficial solutions. Azetobacter and Azospirilium bacteria are the most important motive bacteria for plant growth which in addition to nitrogen biologic stabilization would affect plants growth and operation by producing considerable amounts of growth motive hormones, especially auxin, gibberellin and cytokinins. Growth motive bacteria such as Azospirilium and Azetobacter beside the ability to stabilize nitrogen cooperate in vitamins creation process (Hegde *et al*., 1999). Suneja *et al*. (1994) reported that Azetobacter inhibits Fe sediment and helps Fe absorption of the plant by producing sidrophors. Results of the study by Ebrahim and Aly (2004) showed that using 50 mg L^{-1} Zn with Azetobacter and Azospirilium leads to the increase of the value of nitrogen, magnesium, manganese, carbohydrate and the whole proteins saluted in stalk. Ardakani reported increased absorption of iron, magnesium, Zn, copper, nitrogen, phosphor and potassium, respectively 16, 20, 18, 21, 17, 14 and 20% because of the effect of wheat seed fertilization with azospirilium bacterium. The goal of the present research is to study the effect of nitrogen biologic stabilizers and chemical fertilizers on quantitative and qualitative characteristics of rice.

MATERIALS AND METHODS

To study the effects of nitrogen biologic stabilizers and chemical fertilizers on the quantitative and qualitative characteristics of rice, a split-factorial test with the basic plan of complete random block was conducted with 3 replication in Anzali County in 2011. In this study, nitrogen fertilizer as the main factor was in 3 levels (control, biologic fertilizers (Azetobacter, Azospirilium and Azorhizobioum) and chemical fertilizer of nitrogen (150 kg ha^{-1} urea in three stages)) and two subsidiary factors were fertilizers of Zn and Fe-EDDHA in two levels (control and 5 in 1000 iron EDTA-EDDHA). Consumption of EDTA Fe and Zn-EDDHA fertilizers in plant midtillering was done in the form of leaf solution scattering. Nitrogen fertilizer consumption had three stages of transplanting, midtillering and blooming and in each stage 50 kg urea fertilizer was used. The test was conducted in 36 Kurt of 2.5×2.5 m. Farm plowing was in late February and troweling and flattening was early in spring. In April 5th, seeding of Hashemi genotype was done and transplants in 4-5 leaf stage were transmitted to the main land in 27th of May. Firstly, side effects were removed for determining operation component and morphologic traits. Then, 10 bushes were randomly selected from each Kurt and their mean was considered for each Kurt. After drying the samples, ash method was used to measure grain Iron and Zn content and density. Chloric acid was used for decoction. Fe and Zn density was then measured in the samples by atomic absorption machine. Data were analyzed by software and test was used for mean comparison.

RESULTS AND DISCUSSION

Stalk length: Variance analysis results showed that the effect of nitrogen fertilizer on plant height was meaningful in 1% probability level (Table 1). The most and least stalk height was respectively in chemical fertilizer treatment with the mean of 113 cm and usage of biologic, Zn and Fe fertilizers with the height of 98 cm. Bush height in chemical fertilizer treatment had a meaningful difference with biologic and control fertilizers in 1% probability level (Table 1). Other researchers reported increase of rice stalk length because of using nitrogen fertilizer (Liagas *et al*., 1987; Islam *et al*., 2008; Rezaei *et al*., 2009).

Number of tillers: There was a meaningful difference between reciprocal effect treatment of Zn and nitrogen in the number of tillers in square meter with 5% probability level (Table 1). Most tillers were in urea fertilizer treatment (23.8 tillers m^{-2}) and the least were in control treatment (20.41 m^{-2}) (Table 2). Sadrzadeh (2002) reported that increasing nitrogen fertilizer lead to the increase of tillers in square meter. Reports showed that beside nitrogen fertilizer, solution scattering of some of the cereal with low consumption elements, including Copper, Manganese, Fe and Zn also results in the increase of fertilized tillers in the surface unit (Seadh *et al*., 2009).

Cluster length: Reciprocal effect of nitrogen, Zn and Fe on cluster length was meaningful in 5% probability level (Table 1). Rice cluster length in usage treatment of Zn fertilizer along with nitrogen chemical fertilizer with the value of 27.1 cm was the lowest and the highest cluster was achieved in the treatment of Fe fertilizer and biologic fertilizer (Table 2). Chemical fertilizer in Fe and Zn non-consumption situation, lead to the increase of rice

Table1: Analysis of variance for effect of biological stabilization of nitrogen and chemical fertilizers (urea, zinc and iron) on quantitative and qualitative of rice

		Mean^2						
SOV	df	Stem length	Cluster length	No. of grain	No. of tillers in cluster	Zn content of grains	Fe content of grains	Grain yield
Replication	2	71.250	1.643	210.251	4.539	13.185	22374.727	10128.80
Nitrogen	2	523.498**	1.961	233.011**	15.315	768.745*	2825.560	7627.16
Error	4	21.439	1.305	11.597	0.918	85.626	3288.506	4218.83
Zn	1	113.778	2.250	354.694*	0.035	325.021	296.241	11319.18
Nitrigen and Zn	2	113.138	0.766	23.630	6.975*	426.204	7990.457	2601.20
Fe	1	9.000	0.028	12.018	3.980	0.760	116.460	22.29
Nitrogen and Fe	2	4.203	0.617	5.959	0.877	12.605	710.835	513.03
Zn and Fe	1	10.671	1.068	6.084	5.577	32.699	0.226	0.69
Nitrigen and Zn andFe	2	77.414	3.089*	13.700	2.431	1.893	6532.280	352.91
Error	18	58.695	0.789	74.031	1.913	188.390	3917.300	2875.90
CV (%)		7.230	3.420	10.160	6.210	30.490	34.050	19.20

*Significant at $p<0.05$ and **Significant at $p<0.01$

Table 2: Mean comparison of the effect of biological stabilization of nitrogen and chemical fertilizers (urea, zinc and iron) on quantitative and qualitative of rice by Tukey test

Treatments	---------Categories----------		Stem length (cm)	Cluster length (cm)	No.of seeds in cluster	No.of tillers (m^2)	Zn content of grains	Fe content of grains	Grain yield (g m^{-2})
Control	Zn	Fe	108.800	26.830	83.860	21.180	47.390	184.170	303.440
Control	Zn	Without Fe	102.460	25.760	82.760	22.970	51.430	206.790	302.330
Control	Without Zn	Fe	99.100	24.960	77.300	21.350	33.290	152.530	246.210
Control	Without Zn	Without Fe	102.030	25.460	78.960	19.480	31.970	121.510	220.660
Chemical	Zn	Fe	116.330	26.000	94.930	23.550	57.530	228.840	315.100
Chemical	Zn	Without Fe	119.530	27.100	93.360	22.800	58.970	156.120	318.990
Chemical	Without Zn	Fe	110.360	26.430	86.430	24.450	50.570	171.350	288.440
Chemical	Without Zn	Without Fe	107.900	26.260	82.930	23.150	49.830	206.710	306.770
Biologic	Zn	Fe	98.000	25.430	85.060	21.830	36.710	152.740	268.440
Biologic	Zn	Without Fe	101.400	26.260	86.730	21.170	36.070	191.580	269.550
Biologic	Without Zn	Fe	106.260	26.400	83.760	23.320	45.460	224.180	245.100
Biologic	Without Zn	Without Fe	99.530	24.860	79.660	22.130	40.920	209.520	257.880
	Q		13.269	1.536	14.901	2.394	23.772	108.405	92.886

cluster length. While, biologic fertilizer was not effective in increasing cluster length. Sadrzadeh (2002) reported that different levels of nitrogen fertilizer lead to the increase of cluster length. In a research by Ashraf *et al.* (1994), the highest cluster length was achieved in 120 kg ha^{-1} urea and the lowest cluster length in the control treatment.

The number of grain each cluster: Nitrogen and Zn fertilizers had a meaningful effect on the number of grain per cluster in the probability level of respectively, 1 and 5% (Table1). Chemical fertilizer, Zn and Fe treatment showed the most amount of grain per cluster (mean of 94.93) (Table 2). Sirjani studied the effect of using biologic fertilizer, Zn sulfate and nitrogen fertilizer on qualitative and quantitative operation of wheat and reported that the most amount of grain was achieved from the treatment of Azetobacter fertilizer, Zn usage and second level factor of nitrogen fertilizer division (120 kg ha^{-1}). This improvement in grain number can be related to the high level of the output of nitrogen fertilizer consumption in jointing and ear emergence.

Increased number of grain by using Zn Solphat can be attributed to the direct role of this element in enzyme activities (Carbonic anhydrase, hydrogenase, proteinase, nitrate reductase) Auxine metabolism, photosynthesis, chlorophyll and catalyzer activity (Brennan, 1992; Ekiz *et al*., 1998).

Grain content: Results of variance analysis (Table 1) showed that using different levels of nitrogen fertilizer became meaningful in grain content in 5% probability level. Usage treatment of chemical nitrogen fertilizer had the highest value in grain content with the amount of 54.2 g ha^{-1} which had a meaningful, difference with biologic and control fertilizers. Biologic and control fertilizers were also in the same statistical level. While grain density did not change, grain operation increase lead to the increase of stores on grains in surface unit.

It was observed in a test on corn hybrid that the reciprocal effect on (nitrogen and type) the amount of grain was meaningful in 5% probability level. Reciprocal effect (nitrogen and Zn) on the amount of corn leaf was also meaningful in 5% statistical level (Shafe *et al*., 2001). According to Karimian (1995), Nitrogen consumption increased Zn density and absorption in corn.

Fe content of grain: Variance analysis results showed that using different levels of nitrogen fertilizer, Zn and Fe-EDDHA and their reciprocal effect on the amount of rice grain operation was not meaningful (Table 1) but the most content of grain Fe (228.84 g mm^{-2}) was achieved from the treatment of chemical nitrogen, Zn and Fe fertilizers and the least (137.02 g mm^{-2}) from control treatment.

Chemical and Zn fertilizer consumption resulted in the most content of grain but did not lead to any meaningful effect on this trait while chemical fertilizer consumption resulted in the meaningfulness of the content of grain, therefore these two elements compete with each other in the stage of transmission to grain (negative interaction). Generally, increasing the amount of Zn leads to the decrease of Fe absorption in the plant. When there is lack of Fe, Zn absorption and Zn density on the stalk will considerably increase in plants (Bayvordi, 2006).

Grain operation: Variance analysis results showed that the effect of different levels of nitrogen, Zn and Fe-EDDHA fertilizers and their reciprocal effects on grain operation of rice didn't become meaningful (Table 1), however the most operation of grain (318.99 g mm^{-2}) was achieved from chemical nitrogen and Zn fertilizer treatment and the least amount (220.66 g mm^{-2} was from control treatment. When there is not proportion between nutrients, increasing one nutrient element not only would not improve operation but also reduce it (Siadat *et al.*, 2004).

CONCLUSION

Results show that the highest amount of tiller (23.8) was also achieved in the treatment of nitrogen and Zn fertilizer and the longest cluster (27.1) in the treatment of urea, Zn and Fe fertilizers.

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