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Study Effects of Different Nitrogen and Micronutrients Fertilizers Rates on Yield and Yield Components of Rice

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Abstract: In order to study effects of different nitrogen and micronutrients fertilizers rates on yield and yield components of rice cultivar Rezajo, an experiment in factorial format based on randomized complete block design with 3 replications, in Rodsar Township (north of Iran) in 2009 was performed. Factors of experiment was consist of 4 levels of nitrogen fertilizer rates (n_1:30 kg/ha, n_2:60 kg/ha, n_3:90 kg/ha and n_4:120 kg/ha pure nitrogen from source of ure) and 3 levels of micronutrients fertilizers (m_1: without use of micronutrients, m_2: (Zn, Cu and Mn) m_3: (Zn, Cu, Mn, Fe, Mo and B)). In harvest time, grain yield, straw yield, number of grain per panicle, number of bearer tillers (m^2), percentage of unfilled grain, 1000 grain weight and harvest index was measured. Results show that there is significant difference in 1% probability level in all measured traits affected by nitrogen, micronutrients and interaction effect of nitrogen and micronutrient fertilizer rates. Among nitrogen fertilizers the highest grain yield was recorded from n_4 treatment with 3872 kg/ha. Also, between micronutrients fertilizers the m_2 treatment recorded the highest grain yield with 3947 kg/ha. On the other hand, the interaction effect of n_4m_2 with 4299.25 kg/ha grain yield was recorded highest amount of this trait.

Key words: Rice · Nitrogen · Micronutrient · Yield · Rezajo Cultivar

INTRODUCTION

Rice (Oryza sativa L.) plays an important role as a staple food in Asia and other parts of the world, including Mediterranean Europe [4]. Nitrogen is a macronutrient that required by plants in comparatively larger amounts than other elements [16]. Nitrogen deficiency generally results in stunted growth and chlorotic leaves caused by poor assimilate formation that leads to premature flowering and shortening of the growth cycle. The presence of N in excess promotes development of the above ground organs with abundant dark green (high chlorophyll) tissues of soft consistency and relatively poor root growth. This increases the risk of lodging and reduces the plants resistance to harsh climatic conditions and to foliar diseases [13]. Nitrogen (N) fertilizer use has played a significant role in increase of crop yield [17]. El-Rewainy recorded that applying 40 kg N/fed caused significant increase in plant height, number of panicles/m^2, panicle length, panicle weight, number of filled grains/panicle as well as grain and straw yields [3]. Belder *et al.* was reported that increase of nitrogen fertilizer application causing to increase rice grain yield [1]. Ibrahiem *et al.* found that number of grains/panicle, 1000-grain weight, panicle weight and grain and straw yields were not significant effect by increasing nitrogen levels from 30 to 60 kg N/fed [10]. Zayed *et al* found that increasing nitrogen levels up to 165kg N/ha significantly increased growth and yield and its components [23]. The human body requires more than 22 mineral elements that can be supplied by an appropriate diet [18]. However, the diets of the populations subsisting largely on cereals, or inhabiting regions where soil mineral imbalances occur, often lack Fe, Zn, Ca, Mg and Mn. These minerals are known to play an essential role in the metabolism and physiological process of human body [14]. Although micronutrients are required in small quantities by plants, the deficiency of any one of them can have profound effect and may cause deficiency of major elements [8]. Gurmani, *et al.* with study effect of micronutrients Zn, Cu, Fe and Mn on yield of rice Cv. IRRI-6, were reported that with Cu and Fe application grain yield increased by 12% whereas yield responses to Zn and Mn were not significant [6]. Gurmani *et al.* [7]. Studied the effect of Zn, Cu, Fe and Mn on the yield and yield components of rice Cv. IRRI-6, were concluded that Zn alone, Mn alone and combined application of Cu and Mn increased the yield significantly

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over NPK. Zinc, Mn and Cu increased 15, 11 and 10% increase over NPK, respectively. They also found antagonistic effect of micronutrients with one another. Chaudhry *et al.* with study rice responses to micronutrients consist of Zn, Cu, Fe and B on the farmer's field on 65 sites of Punjab were found that coarse variety responded significantly to all the micronutrients while the fine variety responded to Zn, Cu, Fe only. The response of Zn was maximum followed by Cu and B [2]. The aim of this experiment was to study the effect of nitrogen and micronutrients fertilizer yield and yield components of Rice cultivar Rezajo and determine the optimum nitrogen and micronutrients fertilizers dose for introduce to farmers.

MATERIALS AND METHODS

In order to study effects of different nitrogen and micronutrients fertilizers rates on yield and yield components of rice cultivar Rezajo, an experiment in factorial format based on randomized complete block design with 3 replications, in Roudsar Township (Guilan Province, north of Iran) with 37°7′ N latitude and 49°35′ E longitude on a land parcel of 1000 square meter area in 2009 was performed. Soil analysis results show that (Table 1), the soil texture was Silty Loam and pH 7.7. Factors of experiment was consist of 4 levels of nitrogen fertilizer rates (n_1:30 kg/ha, n_2:60 kg/ha, n_3:90 kg/ha and n_4:120 kg/ha pure nitrogen from source of urea (46%)) and 3 levels of micronutrients fertilizers (m_1: without use of micronutrients, m_2: (Zn, Cu and Mn) m_3: (Zn, Cu, Mn, Fe, Mo and B)). Amounts of microelements were included: Zinc (Zn), Copper (Cu), Manganese (Mn) and Iron (Fe) respectively with 5, 5, 2.5 and 2.5 kg/ha from source of Sulfate and Molybdenum (Mo) 1 kg/ha from source of Molybdate and Boron (B) 2 kg/ha from source of Borax. The operations of preparing land include first plough in winter and secondary plough along with giving phosphorus and potash was done. Sowing in nursery was done April 15 and transplanted to main field May 22. During growth period, cultivate cares were done ordinarily. In maturity time, grain yield, straw yield, number of grain per panicle, number of bearer tillers (m^2), percentage of unfilled grain, 1000 grain weight and harvest index was measured. The yield and yield components were analyzed by using MSTAT-C software. The Duncan's multiple range tests was used to compare the means at 5% of significant.

Table1: Soil analysis results of the experimental sites

Depth (cm)	0-30	Soil texture	Silty loam
Clay	31	SP %	63.3
Silt	58.6	P (p.p.m)	9.2
sand	10.4	Mn (p.p.m)	5.72
OC %	0.96	Zn (p.p.m)	1.04
pH	7.7	Cu (p.p.m)	0.48

RESULTS AND DISSCUSSION

Effect of Nitrogen Fertilizer: Results of variance analysis show that (Table 2), the effect of nitrogen fertilizer on all measured traits was significant in 1% probability level. Comparison of mean between nitrogen fertilizer treatments show that (Table 3), the highest grain yield, straw yield and number of bearer tillers (m^2) respectively with 3872 kg/ha, 5614 kg/ha and 352 tillers was recorded by n_4 treatment (120 kg/ha pure nitrogen). The n_3 level (90 kg/ha pure nitrogen) with 3801 kg/ha grain yield and 339 bearer tillers (m^2) statistically was placed on same level with n_4 treatment. The lowest grain yield with 3479 was obtained by n_1 treatment (30 kg/ha pure nitrogen). The minimum amounts of straw yield and number of bearer tillers (m^2) was found from n_2 treatment (60 kg/ha pure nitrogen) respectively with 5093 kg/ha and 291 tillers. The n_2 treatment with 3569 kg/ha grain yield statistically was placed on same level with n_1 treatment. Also, the n_1 treatment with 292 bearer tillers (m^2) was placed on same level with n_2 treatment. The highest number of grain per panicle, 1000 grain weight and harvest index respectively with 139.1, 25.06 g and 41.18 % was recorded by n_2 treatment. The n4 treatment with 40.79 % harvest index statistically was placed on same level with n_2 treatment. The lowest number of grain per panicle with 100.4, 1000 grain weight with 23.36 and harvest index with 39.75 was found from n_1 treatment. Maximum amount of unfilled grain percentage with 27.46 was obtained by use of 30 kg/ha pure nitrogen treatment. On the other hand, the minimum amount of unfilled grain percentage with 21.13 was recorded by n_4 treatment. Similar results were reported by Kalita and Sarmah [11], Gupta [5], Belder *et al.* [1], Salem [21] and Rezaei *et al.* [19].

Effect of Micronutrient Fertilizer: All the studied traits significantly (In 1% probability level) were affected by number of micronutrient fertilizer (Table 2). Comparison of mean between micronutrient fertilizers treatments show that (Table 3), the highest grain yield, straw yield and number of bearer tillers (m^2) respectively with 3947 kg/ha, 5641 kg/ha and 388 tillers (m^2) was found

Table 2: Analysis of variance on studied traits of rice variety under different levels of nitrogen and micronutrient fertilizers rates

Source of variance	df	Grain yield (kg/ha) MS	Straw yield (kg/ha)	No.of grain per panicle	No.of bearer tiller (m^2)	Unfilled grain (%)	1000 grain weight (g)	Harvest index (%)
Nitrogen (N)	2	2412185**	15544**	3571.7**	92363.4**	290.65**	6.43**	17.2**
Micronutrient (M)	3	542693**	7743.6**	3161.4**	12016.3**	106.9**	6.7**	4.4**
N×M	6	49002**	2804**	429**	5699.8**	17.16**	4.37**	3.7**
Error	33	48594	51.11	10.17	387.2	2.32	0.3	0.9

Ns,** and * respectively non significant, significant in 1% and 5% area

Table 3: Comparison of mean effect of nitrogen and micronutrient fertilizer rates

Treatment	Grain yield (kg/ha)	Straw yield (kg/ha)	No.of grain per panicle	No.of bearer tiller (m^2)	Unfilled grain (%)	1000 grain weight (g)	Harvest index (%)
Nitrogen							
n_1	3479b	5249c	100.4d	292b	27.46a	23.36c	39.75b
n_2	3569b	5093d	139.1a	291b	25.3b	25.06a	41.18a
n_3	3801a	5577b	119.1b	339a	21.18c	24.8ab	40.5ab
n_4	3872a	5614a	111.8c	352a	21.13c	24.43b	40.79a
Micronutrient							
m_1	3256b	5037c	101.5c	231c	28.7a	23.7b	39.35b
m_2	3947a	5641a	120.3b	388a	20.77c	24.65a	41.01a
m_3	3838a	5471b	131.1a	335b	22.22b	24.9a	41.27a

Within each column, means followed by the same letter do not differ significantly at P<0.05

Table 4: The interaction effects of nitrogen and micronutrient fertilizers

Treatment	Grain yield (kg/ha)	Straw yield (kg/ha)	No.of grain per panicle	No.of bearer tiller (m^2)	Unfilled grain (%)	1000 grain weight (g)	Harvest index (%)
n_1m_1	3167d	4926.25L	89.7f	216.7e	30.2a	22.6f	39.18c
n_1m_2	3561.25cd	5475.5d	90.2f	326c	26.2bc	24.3cd	39.41c
n_1m_3	3711.75bc	5357.25f	121.5b	335.2c	26cd	23.2ef	40.93ab
n_2m_1	3212d	4959k	109.7cd	228.7e	29.2ab	24.2cd	39.40c
n_2m_2	3754.5bc	5214.5h	152.7a	361.7c	22.7e	25.3ab	41.86ab
n_2m_3	3741bc	5103.75i	154.8a	284d	24de	25.7ab	42.30a
n_3m_1	3403.75cd	5269.5g	108.2d	249.2de	26.7bc	23.6de	39.25c
n_3m_2	4175.5ab	6089.5a	123b	410.5b	17.5f	26a	40.68ab
n_3m_3	3825.5bc	5373.5e	126.2b	359c	21.2e	24.8bc	41.58ab
n_4m_1	3241.25d	5004.5j	98.5e	238.2e	29ab	24.4cd	39.57c
n_4m_2	4299.25a	5787.5c	115.2c	454a	16.7f	23f	42.49a
n_4m_3	4077.75ab	6051.20b	121.7b	365.2c	17.7f	25.9ab	40.26bc

Within each column, treatments that carry the same superscript letter are not significantly different at P<0.05

from m_2 treatment (Zn, Cu and Mn). The m_3 treatment with 3838 grain yield statistically was placed on same level with m_2 treatment. The lowest grain yield with 3256, straw yield with 5037 and number of bearer tillers (m^2) with 231 was recorded by m1 treatment (without use of micronutrient fertilizer). The highest number of grain per panicle, 1000 grain weight and harvest index respectively with 131.1, 24.9 g and 41.27% was recorded by m_3 treatment (Zn, Cu, Mn, Fe, Mo and B). The m_2 treatment with 24.65 g 1000 grain weight and 41.01 harvest index statistically was placed on same level with m_3 treatment. The lowest number of grain per panicle, 1000 grain weight and harvest index respectively with 101.5, 23.7 g and 39.35% was obtained by m_1 treatment. on the other hand, the highest values of unfilled grain percentage with 28.7% and the lowest unfilled grain percentage with 20.77% respectively were recorded by m_1 and m_2 treatments. Similar results were reported by Sahay *et al.* [20], Gurmani *et al.* [8], Shomali *et al.* [22] and Koohkan *et al.* [12].

Interaction Effect: Results of variance analysis show that (Table 2), interaction effect of nitrogen and micronutrient fertilizers treatments on all studied traits was significant in 1% probability level. Comparison of mean between interaction effect treatments show that (Table 4), the highest grain yield, number of bearer tillers (m^2) and harvest index respectively with 4299.25 kg/ha, 454 tillers (m^2) and 42.49% was found from n_4m_2 treatment (120 kg/ha pure nitrogen along with micronutrients of Zn, Cu and Mn). The n_2m_3 treatment (60 kg/ha pure nitrogen along with micronutrients of Zn, Cu, Mn, Fe, Mo and B) with 42.30% harvest index statistically was placed on same level with n_4m_2 treatment. The minimum amounts of grain yield with 3167 kg/ha, number of tillers (m^2) with 216.7 and harvest index with 39.18 % was recorded from n_1m_1 treatment (30 kg/ha pure nitrogen without use of micronutrient fertilizer). The highest straw yield and 1000 grain weight respectively with 6089.5 kg/ha and 26 g was recorded from n_3m_2 treatment. on the other hand, the lowest straw yield and 1000 grain weight respectively with 4926.25 kg/ha and 22.6 g was recorded from n_1m_1 treatment. The maximum amount of number of grains per panicle with 154.8 was recorded from n_2m_3 treatment and the minimum amount of this trait was found from n_1m_1 treatment with 89.7 grains per panicle. The n_2m_2 treatment with 152.7 grain per panicle statistically was placed on same level with n_2m_3 treatment. The highest unfilled grain percentage with 30.2 % was obtained by n_1m_1 treatment. Also, the lowest unfilled grain percentage with 16.7 % was found from n_4m_2 treatment. Similar results were reported by Majid *et al.* [15], Koohkan *et al.* [12] and Hu-lin *et al.* [9].

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