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Determination Nitrogen Fertilization Effect at Different Transplanting Dates on Rice Yield and Yield Traits

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Abstract: In order to investigate nitrogen fertilization effect at different transplanting dates on rice yield and yield traits a field experiment was carried out in factorial in basis of Randomized Completely Block Design with three replications in north of Iran. Variety that used in this design was Shirodi. Factors were nitrogen amount in 4 levels (60, 90, 120, 150 kg N ha^{-1}) and transplanting date in 2 levels (May 1 and May 30). Results showed that planting date had significant effect on total tiller, fertile tiller, panicle per m^{-2}, sterile spikelets per panicle and 1000 grains weight and also except harvest index all of measured yield traits influenced significantly by nitrogen fertilization. Most total tiller, fertile tiller, panicle per m^{-2} and steril spikelets per panicle were produced in May 30 planting date. May 30 planting date and 90 kg N ha^{-1} for best yield attributes of this variety were recommended.

Key words: Rice・Nitrogen・Planting date・Yield

INTRODUCTION

Rice is one of the oldest cultivated crops on the earth. It is the staple food of more than 50% of the world population, including people of Asia, Africa and South America. The world population of about 5.5 billion today is likely to reach about 6.2 billion in the year 2000 and about 8.3 billion in 2025. Total demand for rice will probably increase 70% during the next 30 years, thus 350 million more tones of rice will have to be produced by 2025 [1]. Nitrogen is the single most important production input and it is the most limiting nutrient for flooded or lowland rice production worldwide,nitrogen is the single most important production input and it is the most limiting nutrient for flooded or lowland rice production worldwide. Amount application of N may improve a crops response to N, especially at high rates, most of the studies on N fertilizer management for lowland rice as affected by timing of application and weather condition. Rice production in much of the world increasingly focuses on optimizing grain yield, reducing production costs and minimizing pollution risks to the environment. One of the inputs limiting rice production is N. Nitrogen is essential to the rice plant, with about 75% of leaf N associated with chloroplasts, which are physiologically important in dry matter production through photosynthesis. Rice plants require N during the vegetative stage to promote growth and tillering which determines the potential number of panicles [2]. Nitrogen contributes to spikelet production during the early panicle formation stage and contributes to sink size by decreasing the number of degenerated spikelets and increasing hull size during the late panicle formation stage. Nitrogen contributes to carbohydrate accumulation in culms and leaf sheaths during the prehanding stage and in grain during the grain-filling stage by being a component of photosynthesis. Ladha and Reddy (2003) compared the rice grain yields and plant N requirement as they have increased through the years [3]. The average recovery efficiency of fertilizer nitrogen in irrigated rice can be as low as 30% but an adequate supply of nitrogen is essential for high yields. Most soils in world are low in N and organic matter [4]. The requirement of N, P and K for high rice yields vary, depending on soil and climatic conditions [5; 6] higher N rates increased yields when rice was planted at the optimum time [7, 8, 9], but had no effect for late planted rice [10]. The proper time and method of N application to any varietyof rice depends on several factors, such as soil texture, permeability, climatic conditions and water management practices [11; 12]. Managing nitrogen fertilization in rice fields can be challenging for producers because ammonium nitrate is subjected to denitrification on flooded soils, urea is the main N source for rice. In drill-seeded rice, urea fertilizer is broadcast immediately before

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flooding. Depending on irrigation well pump capacity. Field size and weather conditions, urea can be lost by volatilization while a field is being flooded optimum N rates vary by rice variety, soil texture, climate and rotations. Given the importance of nitrogen fertilization on the yield in grain from the rice plant. It is necessary to know what the best dose is for each variety as well as its influence on components of yield and other agronomic parameters such as the cycle, plant height, lodging and moisture content of the grain [13]. Determined best nitrogen fertilization level in different transplanting dates are purposes of this experiment.

MATERIAL AND METHODS

In order to investigation nitrogen fertilization effect at different transplanting dates on rice yield components. A field experiment was conducted at an experiment field in Mazandaran where located in Babol-Amol road in north of Iran (52°22′ N. 36° 28′ E altitude 28m). the experiment design was laid out in factorial as Randomized Completely Block Design with three replications. The plot size was 12 m^2 (3×4 m). Variety that used in this design was shirodi. Factors were nitrogen amount in 4 level (60, 90, 120, 150 kg N ha^{-1}) and transplanting date in 2 levels (May 1 and May 30), All plots were received 100 kg P_2O_5 ha^{-1} and 100 kg K_2O ha^{-1} before transplanting. The nitrogen fertilizer in the form of urea was applied in two split doses. Half of nitrogen fertilizer was applied before transplanting, while the remaining amount applied as a top dressing in the maximum tillering stage. Standards cultural practices were carried out until the crop was mature. Six hills (excluding border hill) were randomly selected from each plot prior to harvest for measure yield components. Grain yield was determined from harvest area of 5 m^2 adjusting to 14% moisture content. All Statistical tests were done using the statically Analysis System (SAS, Institute, 1996) and mean values were compared by Duncan Multiple Range Test (DMRT).

RESULTS AND DISCUSION

Total Tiller: Results showed that planting date and nitrogen fertilization levels had significant effect on total tiller number at 0.01 probability level (Table 1). In simple comparision mean, the most tiller number (17.60) and least tiller number (10.07) were obtained in 60 kg N ha^{-1} and 90 kg N ha^{-1} respectively (Table 2). In interaction effect of planting date and nitrogen fertilization levels, the most tiller number (24.4) and least tiller number (13.81) were produced in interaction effect of 1 May at 60 kg Nha^{-1}and 30 May at 150 kg Nha^{-1}respectively (Table 3).

Fertile Tiller: Analysis variance results showed that planting date and nitrogen fertilization levels had significant effect on fertile tiller number at 0.05 and 0.01 probability levels respectively (Table 1). Mean comparision results indicated that in different planting dates and nitrogen fertilization treatments, most fertile tiller (17.31) and least fertile tiller (9.38) were obtained in

Table 1: Mean Squars of yield and yield components in different nitrogen and planting dates treatments

S.O.V	df	Total tiller	Fertile tiller	Panicle per m^2	Spikelet per panicle	Sterile spikelet per panicle	1000 grains weight	Grain yield	Harvest index
Block	2	1.11	1.15	2830.1	660.64	29.3	1.3	31207.8	40732.9 *
Planting date	1	29.54 **	20.6 *	16488.07 **	196.13	26.3 *	2.04 **	4667.05 ns	11088506.6 **
Nitrogen	3	365.2 **	320.6 **	71784.1 **	1079.4**	49.3 *	1.91 *	118214.17 **	21804.7 **
Planting date×Nitrogen	3	2.9	1.91	1075.12	160.7	22.02	1.03	10348.15	76297.6 **
Error		3.3	2.3	598.33	203.16	17.58	1.20	10703.46	789.7
CV		9.8	8.7	7.6	7.54	20.8	2.43	9.73	3.18

Table 2: Mean Comparision of yield and yield components in different nitrogen and planting dates treatments.

		Total tiller	Fertile tiller	Panicle per m^2	Spikelet per panicle	Steril spikelet per panicle	1000 grains weight	Grain yield	Harvest index
Planting	May 1	15.88 b	14.23 a	28.06 a	161.6 a	17.03 a	30.4 a	1003 a	45.49 a
date	May 30	16.98 a	15.29 a	316 a	154.5 a	17.21 a	29.3 a	1015 a	46.12 a
Nitrogen	60 Kg ha^{-1}	17.60 a	16.55 b	351.6 a	158 a	18.4 a	29.26 a	974.3 ab	45.12 a
	90 Kg ha^{-1}	10.07 d	9.38 d	417.3 a	147.4 c	20.93 a	29.57 ab	1118 a	45.11 a
	120 Kg ha^{-1}	14.04 c	13.25 c	318 b	153.2 bc	16.79 b	29.02 a	1028 a	46.56 a
	150 Kg ha^{-1}	18.1 b	17.31 a	265 c	178.2 a	17.03 b	28.95 a	924.5 b	45.07 a

Table 3: Interaction Effect Mean Comparision of yield and yield components in different nitrogen and planting dates

Planting date	Nitrogen	Total tiller	Fertile tiller	Panicle number	Spikelet per panicle	Steril spikelet per panicle	1000 grains weight	Grain yield	Harvest index
May 1	60 Kg ha^{-1}	24.4 a	23.08 a	458 a	171.6 a	19.03 a	31.5 a	1139 a	46.59 a
	90 Kg ha^{-1}	23.15 b	22.13 a	423.3 a	164.5 a	19.21 a	31.35 a	1115 a	47.22 a
	120 Kg ha^{-1}	19.98 c	19.35 b	369.8 b	168.0 a	21.42 a	31.05 a	1110 ab	46.22 a
	150 Kg ha^{-1}	19.30 c	18.35 bc	355.8 b	157.4 c	22.93 a	30.85 a	1043 a	46.22 a
May 30	60 Kg ha^{-1}	17.63 d	17 bcd	303 c	163.2 bc	18.79 ab	29.8 ab	1041 a	47.76 a
	90 Kg ha^{-1}	17.37 d	16.58 cd	301.8 c	178.6 a	18.79 ab	29.6 ab	1001 b	47.77 a
	120 Kg ha^{-1}	16.1 e	14.58 e	301.5 c	172.9 ab	19.03 a	29.5 ab	988.8 b	46.07 a
	150 Kg ha^{-1}	13.81 f	12.73 ef	261.01 d	175.3 ab	18.03 b	29.5 ab	987.5 b	45.08 a

*,**= Significant at 0.05 and 0.01 probability levels respectively

Coloumn with similar letter had not significantly differences in Duncan Multiple Range Test at 0.05 Probability level.

150 kg Nha^{-1} and 90 kg Nha^{-1}respectively (Table 2). In interaction effect of planting date and nitrogen fertilization the most fertile tiller number (23.08) was produced in 1 May planting date and 60 kg Nha^{-1} while least fertile tiller number (12.73) was obtained in 30 May planting date at 150 kg N ha^{-1} (Table 3).

Panicle per m^2: Results showed that planting date and nitrogen fertilization had significant effect on panicle per m^2 at 0.01 probability level (Table 1). Mean comparision indicated that in different planting dates and nitrogen fertilization level, most panicle per m^{-2} (417.3) was obtained in 90 kg N ha^{-1} and least panicle per m^{-2} (265) was produced in use of 150 kg N ha^{-1} (Table 2). Interaction effect of planting dates and nitrogen fertilization showed that most panicle per m^{-2} (458) was observed in interaction of 1 May planting date at 60 kg N ha^{-1} and least panicle number (261.01) was observed in 30 kg N ha^{-1} at 30 May (Table 3).

Spikelet per Panicle: Analysis variance showed that spikelet per panicle was influenced significantly by nitrogen fertilization at 0.01 probability level (Table 1). The most spikelet per panicle (178.2) was obtained in use of 150kg Nha^{-1}, while least spikelet per panicle (147.4) was produced in 90 kg N ha^{-1} (Table 2). Interaction effect of planting date and nitrogen fertilization showed that most spikelet per panicle (178.6) and least spikelet per panicle (157. 4) were produced in interaction effect of May 30 at 90 kg Nha^{-1} and May1 at 150 kg Nha^{-1} respectively (Table 3).

Sterile Spikelet per Panicle: Planting date and nitrogen fertilization had significant effect on sterile spikelet per panicle at 0.05 probability level (Table 1). Results indicated that most steril spikelet was produced in 90kg Nha^{-1} with amount 20.93 and least spikelet was obtained in 120 kg Nha^{-1} with amount 16.79 (Table 2). Interaction effect of planting date and nitrogen fertilization level showed that most steril spikelet per panicle (22.93) was obtained in May 1 at 150kg Nha^{-1} supply and least steril spikelet per panicle (18.03) was observed in May 30 at 150 kg Nha^{-1} (Table 3).

1000 Grains Weight: Results showed that planting date had significant effect on 1000 grains weight at 0.01 probability level and nitrogen had significant effect on 1000 grains weight at 0.05 probability level (Table 1). Most 1000 grain weight (30.4) was produced in May 1 planting date and least 1000 grains weight was obtained in 120kg Nha^{-1} (Table 2), In interaction effect of planting date and nitrogen fertilization showed that most 1000 grains weight (31.35) was obtained in May 1 planting date at 90 kg N ha^{-1} and least 1000 grains (29.5) weight was obtained in May 30 at 120 and 150 kg Nha^{-1} (Table 3).

Grain Yield: Analysis variance showed that grain yield influenced significantly by nitrogen at 0.01 probability level (Table 1). Most grain yield (1118.0) was produced in use of 90 kg N ha^{-1}. And least grain yield (924.5) was obtained at use of 150 kg N ha^{-1} (Table 2). Interaction effect of nitrogen fertilization and planting date showed that most grain yield (1139) was observed in May 1 at 60 kg N ha^{-1} and least grain yield (987.5) was produced in planting date at 30 May planting date in 150 kg N ha^{-1} (Table 3).

Harvest Index:: Results showed that treatments had not significant effect on harvest index, a measurement of crop yield (Table 1). The weight of a harvested product as a percentage of the total plant weight of a crop. The simulation of HI has basically followed two approaches.

One approach is to increase the HI from a given time after anthesis until physiological maturity or a maximum present HI is reached. The latter usually occurring after two-third of the time between anthesis and physiological maturity.

CONCLUSION

Rice N requirements are closely related to crop yield levels, which in turn are sensitive to climate, particularly solar radiation and the supply of other nutrients. These factors also affect the pattern and quantity of N supplied from indigenous soil resources. Nowadays, the environmental as well as financial impact of N fertilizer use deserves increased attention. Planting date is a important factor that affected nutrient supply in crop production with regulate planting date, crop growth phase improve in appropriate condition. For this variety, May 30 planting date and 90 kg N ha^{-1} for best yield attributes were recommended.

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