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RESEARCH ARTICLE

EFFECT OF VARIOUS NITROGEN LEVELS ON GROWTH, YIELD AND YIELD ATTRIBUTES OF DIFFERENT GENOTYPES OF RICE (*ORYZA SATIVA* L.)

Anil Kumar, Rajeev Kumar, Sandeep Kumar[1], Sanjeev Kumar and B.B. Singh

Janta Maha Vidiyalaya Ajeetmal, Auraiya (U.P.) INDIA

[1]Department of Agronomy, S.V. Patel University of Agricultural and Technology, Meerut (U.P.) INDIA

Email:- kumargautam78jmv@gmail.com

ABSTRACT

A field experiment was conducted during *Kharif* season 2008 at crop research station, C.S. Azad Uni. of Agriculture & Technology, Kanpur, to evaluate the effect of four nitrogen levels *i.e.* 0, 50,100 and 150 % recommended dose of nitrogen on growth, yield and yield attributes of four rice cultivars. Plant height, number of leaves, number of tillers hill$^{-1,}$and dry weight showed increasing trend from 50 % upto 150 % recommended dose of nitrogen ha^{-1}. The yield and yield parameters such as number of panicle hill^{-1}, number of spikelets hill^{-1}, number of productive tillers, number of filled grain hill^{-1}, grain yield, straw yieldincreased upto 150 % recommended dose of nitrogen ha^{-1}. Harvest index decreased with increasing levels of nitrogen .Maximum grain yield (9.97 tonnes h^{-1}) was obtained from 150 kg/ha nitrogen application which also produced highest values of number of grains per panicle (1340) alongwith maximum 1000 grain weight (26.08gm).

Key Words **: Rice, Growth, Nitrogen levels, Yield parameters, Yield**

Nitrogen is an essential element and constituents of protoplasm, proteins and chlorophyll. It plays an important role in many physiological and biochemical activities of plant such as synthesis of nucleotides, phosphatides, enzymes, hormones and vitamins. Nitrogen fertilizers applied to soil undergo physical, chemical and biological transformation by virtue of enzymes and microbial activities and ultimately become available to crops. Rice plant prefersammonical form of nitrogen during the early stage and utilize nitrate form with equal efficiency during later stages of growth period irrespective of the sources of ammonical, nitrate, amide or organic form (Yawalkar *etal.,* 1996).

Nearly 30-40 per cent of applied nitrogen is actually utilized by the crop; even with the best agronomic practices and strictly controlled conditions the recovery of nitrogen seldom exceeds 50-65 per cent (Dutta *etal.,* 1968 and Aulakh *etal.,* 1992). The efficieut use of nitrogenous fertilizers is a challenge due to various losses and increase in fertilizers cost. Availability of nitrogen is a determinant factor for the growth and yield of plants. Lowland rice is noted for the efficient utilization of applied nitrogenous fertilizer as compared to upland conditions and this is especially true for top dressed nitrogen (Mitsui, 1959). Increased rate of nitrogen from 0 to 27 and 59 kg ha^{-1} significantly increased the number of panicles $hill^{-1}$, number of grains panicles $^{-1}$and test weight of rice (Naine, 1987 and Meena *et al.,* 2003). A significant enhancement was recorded in tillers number, dry matter and yield (Meena*et al.,* 2003 and Reager *et.al*. 2011). Vigorous growth of paddy crop and uptake of nitrogen was due to increasing ammonium ion concentration in the root zone of paddy (Meena *et al.,* 2003 and Laroo and Shivay, 2011). An application of 60 kg N_2 produced significantly more grains and straw yield of rice over control (Singh *et.al.,* 1996 and Patel *et.al.,* 1997).

Rice (*Oryza sativa* L.) being the staple food of more than 60 per cent of the global population deserves top most priority in agriculture. It is grownin over 161.0 million hectares of land worldwide producing 699.10 million tonnes per annum (FAO, 2011). The total food grains production in the country during 2010-11 was 241.56 million ton,ofwhich rice contributed 148 metric ton from an area of 44.8 million hectare witha productivity level of 1940 kg ha-^{1}(Anonymous,2011). Rice is capable of growing under a diverse condition of climate, soil, water, high altitudes and heavy rain fall areas.

In India human population and fertilizers cost are increasing continuously. In order to overcome these problems, there is a dire need to utilize the high yielding genotypes for crop production. It can be possible to minimize nutrients loss through manipulation of nitrogen fertilizer doses. This can also increase nitrogen use efficiency of such high yielding genotypes of rice including the hybrids.Keeping this in view the present study was undertaken to find out the optimum doses of nitrogen fertilizers for enhanced growth parameters and productivity of four rice genotypes.

MATERIALS AND METHODS

A field experiment was carried out during 2008 at crop research station, C.S. Azad Uni. of Agri. & Technology, Kanpur, to evaluate the effect of different nitrogen levels on growth, yield and yield parameters of different rice cultivars. Soil samples were collected randomly from different places of experimental field before starting experimentation, the composite soil sample was analyzed for mechanical separates and also for available nutrients by adopting the method suggested by Jackson, 1958. Three levels of nitrogen were selected in addition to control are as follows,

N_o :Control (No nitrogen)

N_1 : 50 % of recommended dose of N kg ha^{-1}

N_2 : 100 % of recommended dose of N kg ha^{-1}(150 Kg N ha^{-1} along with 60 Kg $P_2O_5 ha^{-1}$& 50 Kg K_2O ha^{-1}.

N_3 :150 % of recommended dose of N kg ha^{-1}

Seeds of rice cultivars were collected from Director, Seed and Farm, C.S. Azad Uni. of Agri. & Technology, Kanpur. Three hybrids genotypes and one local cultivar were included in the study which is as follows,

PHB-71	
KRH-2	Hybrids
NDRH-2	
NDR-359 }	Local

The experiment was laid out in split plot design with three replications by allocating nitrogen levels in main plot and genotypes in sub plot. Nursery of rice cultivars was raised in a nearby experimental field. 25 days old seedlings were transplanted@ 2-3 seedlings per hill in 20x10 cm spacing. Half amount of nitrogen dose and full amount of phosphorous and potash was applied as basal dose just before transplanting and remaining nitrogen was split at tillering and panicle initiation stage. Irrigation, weeding and plant protection measure were applied as per the requirement of crop.

Plant height was measured at the base of stem to the top leaf of the plant with the help of the meter scale in centimeters. Number of leaves, panicle number per hill was noted. Biomass accumulation was calculated on oven dry weight basis in gram. Number of panicle $hill^{-1}$, Number of spikelets $hill^{-1}$, Number of productive tiller m^{-2}, Number of filled grain $hill^{-1}$, Grain, straw yield and test weight were calculated at harvesting stage. The collected data of different observations were statistically analyzed by the procedure described by Panse and Sukhatme (1976).

RESULTS AND DISCUSSION

Plant height (Table 1) of different rice genotypes increased significantly with increasing levels of nitrogen up to 100 % recommended dose of nitrogen ha^{-1} and above this, it did not increase significantly. As regards genotypic performance,genotype KRH-2 (62.17 and 99.94 cm) produced maximum plant height followed by PHB-71(58.00 and 93.97 cm), NDRH-2 (55.75 and 88.24 cm) and NDR-359 (52.75 and 87.00 cm) at 30 and 60 days after planting. Number of leaves (Table 1) was maximum at 150 % recommended dose of nitrogen ha^{-1}, while lowest leaves number was noted in control. Genotype KRH-2 produced maximum number of leavesandgenotype NDR-359 produced minimum number of leaves.The increase in plant height and leaves number with increased nitrogen application might be primarily due to enhanced vegetative growth with more supply of nitrogen to plant. Meena*et al.*, *(*2003) and Manzoor *et al.*,(2006) reported similar results.

Number of tillers $plant^{-1}$(Table 1) increased in rice genotypes with increasing supply of nitrogen up to 150 % recommended dose of nitrogen ha^{-1}at variousstages of growth. Genotypic performance showed a decreasing trends KRH-2 > PHB-71> NDRH-2 >NDR-359. Dry matter accumulation was lowest at

Table 1 : Effect of different levels of nitrogen on plant height, number of leaves, tiller number and dry weight of different Varieties of rice

Nitrogen levels/ Genotypes	Plant height (cm) Days after planting (DAP)		Number of leaves DAP		Number of tiller $hill^{-1}$ DAP		Dry weight (g) DAP	
	30	60	30	60	30	60	30	60
PHB-71								
N_0	50.33	86.00	37.33	56.33	09.00	12.33	4.71	16.24
N_1	56.00	92.67	39.67	66.33	11.67	18.33	5.47	24.00
N_2	62.67	94.67	41.00	72.33	14.00	18.67	7.94	26.50
N_3	63.00	100.13	41.67	74.00	15.67	19.37	8.70	28.21
Mean	58.00	93.97	39.92	67.25	12.58	17.17	6.71	23.76
KRH-2								
N_0	53.67	94.33	39.67	59.00	10.67	14.33	7.41	21.08
N_1	59.67	99.77	42.00	70.67	13.33	20.33	8.14	25.23
N_2	66.67	100.36	43.00	78.65	16.00	21.33	8.41	26.78
N_3	68.67	103.33	46.27	81.60	17.67	22.50	9.23	31.50
Mean	62.17	99.94	42.73	72.48	14.42	19.63	8.30	26.14
NDRH-2								
N_0	49.67	82.00	35.67	56.00	8.33	11.33	4.49	15.58
N_1	55.33	87.30	38.00	64.67	11.33	16.33	5.10	23.31
N_2	59.33	91.00	39.53	70.62	13.00	17.33	6.28	25.54
N_3	58.67	92.67	39.83	72.12	14.00	18.67	6.60	25.74
Mean	55.75	88.24	38.26	65.85	11.67	15.92	5.62	22.54
NDR-359								
N_0	46.67	81.33	33.00	55.33	7.62	10.33	4.22	13.63
N_1	53.33	85.83	36.65	59.67	9.67	15.50	5.00	18.76
N_2	55.67	89.50	38.60	69.15	11.33	14.00	5.01	24.07
N_3	55.33	91.67	39.10	71.15	13.33	17.33	6.34	25.94
Mean	52.75	87.00	36.84	63.82	10.50	14.29	5.14	20.60
N	4.32	1.96	3.02	6.01	1.15	1.01	0.28	0.01
G	2.02	1.32	1.78	1.77	0.69	0.62	0.24	0.98
CD at 5 % d.f.	NS	NS	NS	NS	NS	NS	NS	NS

NS=Non-significant

30 days after planting thereafter, it was increased. Dry matter accumulation (Table 1) was maximum at 150 % recommended dose of nitrogen ha^{-1}. However lowest dry matter was noticed in control. Genotype KRH-2 (8.30 and 26.14 g) produced maximum dry matter, while genotype NDR-359 (5.14 and 20.60 g) recorded lowest value of dry matter accumulation at 30 and 60 days after planting.Nitrogen supply to the plant results in improved leaf area which might have accelerated the photosynthetic rate thereby increasing the supply of carbohydrates to the plant (Khanpura *et al.*, (1993). This might have attributed to significantly higher plant/ crop growth. Enhanced tillers production and dry matter accumulation by plant due to increased nitrogen application might be attributed to more nitrogen supply to plant. These findings have also been confirmed by Meena *et. al.*, (2003), Manzoor *et al.*,(2006) and Laroo and Shivay, (2011).

Number of panicle $hill^{-1}$, spikelets, productive tiller $plant^{-1}$ and number of filled grain $hill^{-1}$(Table 2) were more at nitrogen 100 %recommended dose of nitrogen ha^{-1}, increasing nitrogen levelthereafter resulted in a non-significant enhancementin these characters. The lowest value of these parameters was recorded in control. Genotype KRH-2 produced

Table 2 : Effect of different levels of nitrogen on panicle numbers, spikelet's numbers, number of productive tillers, filled grain $hill^{-1}$, grain yield, straw yields and test weight of different Varieties of rice

Nitrogen levels/ Genotypes	Number of panicle $hill^{-1}$	Number of spikelet's $hill^{-1}$	Number of productive tiller m^{-2}	Number of filled grain $hill^{-1}$	Grain yield (q h^{-1})	Straw yield (q h^{-1})	Test weight
PHB-71							
N_0	8.00	1023.33	366.00	813.67	41.02	52.42	29.97
N_1	11.33	1200.00	400.00	1000.00	56.64	75.41	24.55
N_2	12.60	1305.00	413.33	1195.67	66.43	92.91	24.40
N_3	13.33	1405.00	420.67	1275.00	71.53	97.36	23.05
Mean	11.33	1233.33	400.17	1071.08	58.91	79.53	24.49
KRH-2							
N_0	9.00	1224.33	389.00	932.00	41.50	55.05	28.20
N_1	12.66	1412.33	435.00	1228.33	58.17	78.91	25.32
N_2	14.00	1550.00	444.00	1246.67	68.28	94.08	25.88
N_3	15.00	1680.00	448.67	1340.00	75.36	97.97	24.93
Mean	12.66	1466.67	429.17	1186.75	60.83	81.50	26.08
NDRH-2							
N_0	7.66	998.00	350.67	799.00	38.66	52.66	26.42
N_1	9.33	1100.00	385.67	801.67	52.33	72.14	24.78
N_2	11.33	1202.00	400.67	1007.67	60.72	84.02	24.55
N_3	12.66	1290.00	406.33	1050.00	61.36	85.97	23.48
Mean	10.24	1447.50	385.33	914.58	53.27	73.70	24.81
NDR-359							
N_0	07.00	681.67	345.00	545.67	36.03	50.00	29.08
N_1	09.00	846.67	379.67	608.33	51.08	69.88	28.10
N_2	10.66	1034.67	389.00	763.67	59.08	82.47	27.00
N_3	11.80	1100.00	395.67	800.00	59.83	82.89	26.20
Mean	09.61	915.75	377.33	679.42	51.50	71.31	27.60
N	0.99	166.40	14.77	255.83	3.53	3.12	0.950
G	1.32	186.86	11.41	192.35	3.51	3.35	0.450
CD at 5 % d.f.	NS	NS	NS	NS	NS	NS	NS

NS=Non-significant

maximum values of these parameters followed by genotype PHB-71, NDRH-2 and NDR-359.The enhancement in above parameters might be due to better nitrogen utilization by plants at panicle initiation stage of growth. Similar results were also reported by Manzoor *et al.,* (2006)and Laroo and Shivay (2011) earlier.

A significant enhancement was noted in grain yield and straw yield (Table 2) at 150 % recommended dose of nitrogen ha$^{-1,}$while lowest values were observedin control. With regard to genotypes, it was observed that genotypes KRH-2 and PHB-71 produced significantly higher grain and straw yield as compared to NDRH-2 and NDR-359. Test weight (Table 2) of rice genotypes declined with increasing levels of nitrogen up to 150 % recommended dose of nitrogen ha$^{-1.}$ Genotype KRH-2 (26.08 g) produced maximum test weight. However lowest test weight was noticed in genotype NDR-359 (27.60 g). Increase in grain yield, straw yield and test weight at higher supply of nitrogen might be due to enhancements in chlorophyll content in leaves, which led to higher photosynthetic rate and ultimately plenty of photosynthates available during grain development. These findings were also confirmed by Bali *et al.*,(1995)and Meena *et al.,* (2003).

Although increasing nitrogen supply beyond recommended dose of fertilizers have resulted in perceptive yield increase, but the same have failed to stand statistical and economical tests. This leads to the conclusion that applying more nitrogen than the recommended one is not economically viable and hence not verification through further experimentation.

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