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Response of N and P_2O_5 Levels, Spacing and Seed Rate on Yield of Paddy and Nutrient Status of Soil

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A B S T R A C T

A field experiment was conducted at College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari on a clayey soil during *kharif* season of 2013-14 and 2014-15 to find out the effect of with four factors viz. three nitrogen levels (100, 150 and 200 kg N ha^{-1}), two phosphorus levels (30 and 60 kg P_2O_5 ha^{-1}), two levels of inter-row spacing (20 and 30 cm) and two levels of seed rate (40 and 60 kg ha^{-1}) were evaluated in randomized block design with three replications. The size of gross plot 3.0 X 4.0 m and in net plot 2.4 m x 3.5 m. Sowing was completed on 25th June, 2013 and 21th June, 2014, in first year and second year, respectively. The fertilizer dose was applied as per treatment after sowing. Based on the findings of two years experimentation, it can be concluded that higher production and profit from *kharif* paddy (var. GNR-3) can be secured by applying 200 kg N ha^{-1}, 60 kg P_2O_5 ha^{-1} and seed rate @ 60 kg ha^{-1} along with 30 cm inter-row spacing in clayey soil of south Gujarat.

Introduction

Rice (*Oryza sativa* L.) is one of the most important cereal crops as it is a staple food for more than 70% of the world population. Among the cereals, it is the major source of calories for 40 % of the world population. India is the leading rice producing country in terms of area and it is the second largest producer next to China. Rice is grown in an area of 45 million ha annually with a production of 90 million tonnes, which contributes 45% of the total food grain production of the country. India has to produce 135-145 million tonnes of rice by 2020 to feed the additional 350 million people. Keeping in view the average annual population growth rate of 1.5% and per capita consumption estimate of about 400 g of rice per day, demand for rice in India expected to be 140 million tonnes by 2025 (Mishra, 2003). Hence, to satisfy the growing demand of increasing population, 38 per cent more rice has to be produced by 2030 (Khush, 2007).

Nitrogen is the kingpin for any fertilizer management programme in rice cultivation and is the universal key element for realizing the yield potential of high yielding rice varieties in Indian soils. Fertilizer N use efficiency varies from 18 to 40 per cent in different rice soils, because applied inorganic

N is hurriedly lost from soil by ammonia volatilization, denitrification, leaching and runoff. In recent years, soil health deterioration by the enormous application of chemical N fertilizer coupled with escalating price of N fertilizer has paved the way for an efficient N management strategy for lowland transplanted rice.

The growth, final yield and quality of crops are greatly affected by moisture and nutrients in the soil, as well as their interactions. Phosphorus is one of the main elements necessary for crop growth. Applying P fertilizer can improve the nutritional quality of rice (Hao *et al.,* 2009) and appropriately applied P at the heading stage will improve the eating quality of rice (Chang *et al.,* 2007)

The optimum seed rate is another important factor that affects crop micro-environment by influencing the degree of inter and intra plant competition. Therefore, while fixing seed rates for direct-seeded crop, the plants should be planted neither too thick not too thin, so that the input use efficiency may be enhanced to the maximum possible extent.

The growth and yield of rice plant is known to be affected quantitatively and qualitatively by plant spacing. There have been some contradictions regarding the adequate spacing for rice crops. Various experiments have suggested a dose of 120 kg N, 30 kg P_2O_5 and spacing of 15 x 15 cm (Banerjee and Pal, 2011). These experiments were conducted either only with levels of N and common spacing or levels of N with simultaneously levels of P_2O_5 with common spacing or with varying spacing with either levels of N or P_2O_5. This indicated that a combined experiment involving all the four growth factors (*viz*. levels of N and P_2O_5 as well as spacing and seed rate) were absolutely lacking. To augment higher crop yield per unit area, proper plant density and nutrient management may cause a marked effect on the growth and yield attributes eventually raising crop yield.

The availability of labour for agricultural operations is becoming the scarce and costlier input. Aggressive urbanization and industrialization offers higher wage package, resulting in bulk migration of agricultural workers to urban areas.

Hence, the timely pulling out of seedlings, transplanting and after care, *etc*., in this labour intensive crop is also going to be a serious limiting factor. However, adoption of direct seeding of rice is a viable alternative to reduce the labour requirement to considerable extent (Bala Subramanian and Hill, 2000). Considering the above facts and views, the present experiment is planned to study the "Effect of N and P_2O_5 levels on yield of paddy var. GNR-3 under varying spacing and seed rate during *kharif*"

Materials and Methods

A field experiment was conducted during the period of 2013-14 and 2014-15 at College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari to study the effect of N and P_2O_5 levels on yield of paddy var. GNR-3 under varying spacing and seed rate during *kharif*. The soil of the experimental field was clayey in texture and slightly alkaline in reaction.

The soil was low in available N, while medium in available P and high in available K. Total twenty four treatment combinations comprising of three nitrogen levels (100, 150 and 200 kg N ha^{-1}), two phosphorus levels (30 and 60 kg P_2O_5 ha^{-1}), two levels of inter-row spacing (20 and 30 cm) and two levels of seed rate (40 and 60 kg ha^{-1}) treatments were tried in randomized block design with three replications. Data on effective tillers per m^2,

seed per panicle, test weight, yields and dry weight of plant were recorded. For recording dry matter, plants were removed from the base and first sun dried and then in oven at 60ºC till constant weight was obtained. Soil samples were taken at the time of harvest of crop from 0-15 and 15-30 cm soil depths. The package of recommended practices was adopted to maintain the crop.

Results and Discussion

Effect on yield attributes and yield

Effect of N levels

The results presented in (Table 1) revealed that, effective tillers per m^2 and seed per panicle, dry matter production per plant, test weight, seed and straw yields (kg ha^{-1}) application of 200 kg N ha^{-1} recorded significantly higher seed yield 4711 kg ha^{-1} as compare to 100 kg N ha^{-1}, but was statistically remained on same bar with 150 kg N ha^{-1}. Straw yield 5270 kg ha^{-1} also influenced significantly with varying N levels. The probable reason for such a positive response to higher N level is due to responsive nature of paddy which tended to put more vegetative growth, better root development and resulted in efficient photosynthesis. Nitrogen played an important role in plant metabolism by virtue of being an essential constituent of diverse type of metabolically active components, like amino acids, proteins, nucleic acids, enzymes, co-enzymes and alkaloids which are important for higher growth and yield. The results collaborates the early findings Banerjee and Pal (2011), Gill and Walia (2013), Mallareddy and Padmaja (2013) and Pramanik *et al.*, (2015).

Effect of P_2O_5 levels

Most of the growth and yield attributes viz. effective tillers per m^2 and seed per panicle, test weight, seed and straw yields (kg ha^{-1}) application of 60 kg P_2O_5 ha^{-1} recorded significantly higher growth and yield attributes over 30 kg P_2O_5 ha^{-1}. The pooled analysis indicated that phosphorus application at 60 kg P_2O_5 ha^{-1} during both the years as well as in pooled analysis.

With respect to seed and straw yield the differences are at significance levels. Among varying P levels, paddy sown with application of P @ 60 kg ha^{-1} recorded significantly higher seed and straw yield as compare to 30 kg ha^{-1}.

This may probably due to vigorous and profuse growth habit of paddy with resource responsive nature. The results collaborates the early findings of Singh and Singh (2006), Alam *et al.,* (2009) and Meena *et al.,* (2014).

Effect of inter-row spacing

Data pertaining to growth and yield attributes viz. effective tillers per m^2 and seed per panicle, test weight, dry matter production per plant and seed and straw yields (kg ha^{-1}) did not exert any significant variation due to inter-row spacing in individual years and pooled results.

This may probably due to vigorous and profuse growth habit of paddy with resource responsive nature. With increase in space availability individual plant faced minimum competition for space, nutrients, light and water and resulted into increase in growth parameters of paddy.

Effect of seed rate

The data revealed that seed rate did not exert any significant effect on effective tillers per m^2 and seed per panicle, test weight, dry matter production per plant and seed and straw yields (kg ha^{-1}) during 2013-14, 2014-15 as well as in pooled analysis.

Table.1 Yield attributes and yield of paddy at harvest as influenced by various treatments (Pooled data of two years)

Treatments	No. of tillers	Dry matter production plant^{-1} (g)	Seed panicle^{-1}	Test weight (g)	Seed yield (Kg ha^{-1})	Straw yield (Kg ha^{-1})
N levels (Kg ha^{-1})						
120 x30cm	11.89	31.34	60.80	27.82	3680	4333
120 x45 cm	13.79	37.90	68.78	29.28	4517	5037
120 x60 cm	16.81	45.60	79.76	31.00	4711	5270
SE ±	0.27	0.69	2.76	0.50	90.58	123.89
CD at 5 %	0.76	1.94	7.85	1.43	257.85	348.42
P_2O_5 levels (Kg ha^{-1})						
P1: 30	13.48	36.40	64.01	28.97	4156	4719
P2: 60	14.85	40.15	75.55	29.76	4449	5041
S.Em±	0.22	0.57	2.25	0.41	73.96	101.66
C.D. (0.05)	0.62	1.69	6.41	NS	210.53	285.96
Inter-row spacing levels (cm)						
D1: 20	13.78	37.63	69.10	29.15	4222	4802
D2: 30	14.54	38.93	70.46	29.58	4384	4958
S.Em±	0.22	0.57	2.25	0.41	73.96	101.63
C.D. (0.05)	0.62	NS	NS	NS	NS	NS
Seed rate levels (Kg ha^{-1})						
S1: 40	14.36	38.84	71.37	29.49	4257	4873
S2: 60	13.96	37.71	68.19	29.25	4349	4887
S.Em±	0.22	0.57	2.25	0.41	73.96	101.59
C.D. (0.05)	NS	NS	NS	NS	NS	NS
C.V.	13.33	12.65	19.35	8.36	10.31	17.76

Table.2 Organic carbon, available N, P_2O_5 and K_2O status of soil as influenced by different treatments after harvest of paddy

Treatments	Organic C (%)			Available N (Kg ha^{-1})			Available P_2O_5 (Kg ha^{-1})			Available K_2O (Kg ha^{-1})		
	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled
Initial status	0.43	0.44		221.0	219.80		40.0	40.60		320.0	319.80	
N levels (Kg ha^{-1})												
N_1: 100	0.45	0.47	0.46	225.81	227.36	226.58	43.43	43.70	43.56	317.43	319.41	318.42
N_2: 150	0.45	0.47	0.46	227.49	229.04	228.26	43.77	44.01	43.89	319.80	321.79	320.79
N_3: 200	0.46	0.48	0.47	229.55	231.09	230.32	44.17	44.41	44.29	322.71	324.81	323.76
S.Em±	0.01	0.01	0.01	2.24	2.56	1.68	0.46	0.68	0.41	3.60	4.57	2.88
C.D. (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
P_2O_5 levels (Kg ha^{-1})												
P_1: 30	0.45	0.47	0.46	225.71	227.26	226.49	43.43	43.67	43.55	317.30	319.31	318.31
P_2: 60	0.46	0.48	0.47	229.51	231.07	230.29	44.16	44.41	44.28	322.66	324.70	323.68
S.Em±	0.01	0.01	0.01	1.83	2.09	1.38	0.37	0.56	0.33	2.94	3.73	2.36
C.D. (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Inter-row spacing levels (cm)												
D_1: 20	0.45	0.47	0.46	226.59	228.24	227.41	43.61	43.96	43.78	318.68	321.12	319.90
D_2: 30	0.45	0.47	0.46	228.63	230.09	229.36	43.98	44.12	44.05	321.28	322.89	322.08
S.Em±	0.01	0.01	0.01	1.83	2.09	1.38	0.37	0.56	0.33	2.94	3.73	2.36
C.D. (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Seed rate levels (Kg ha^{-1})												
S_1: 40	0.45	0.47	0.46	227.13	228.69	227.91	43.69	43.94	43.82	319.29	321.32	320.31
S_2: 60	0.45	0.47	0.46	228.09	229.64	228.87	43.89	44.14	44.01	320.66	322.69	321.68
S.Em±	0.01	0.01	0.01	1.83	2.09	1.38	0.37	0.56	0.33	2.94	3.73	2.36
C.D. (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.V.	6.89	7.23	7.07	4.83	5.48	5.16	5.10	7.57	6.46	5.51	6.95	6.28
Sig. Int.	-	-	-	-	-	-	-	-	-	-	-	-

Table.3 Available S, Fe, Cu and Zn status of soil as influenced by different treatments after harvest of paddy

Treatments	Available S (mg kg^{-1})			Available Fe (mg kg^{-1})			Available Cu (mg kg^{-1})			Available Zn (mg kg^{-1})		
	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled
Initial status	12.10	13.14		9.14	9.35		1.67	1.54		0.42	0.45	
N levels (Kg ha^{-1})												
N_1: 100	12.52	14.81	13.66	9.60	9.65	9.63	1.71	1.87	1.79	0.48	0.45	0.46
N_2: 150	12.62	15.07	13.84	9.67	9.73	9.70	1.72	1.88	1.80	0.48	0.46	0.47
N_3: 200	12.74	15.18	13.96	9.76	9.82	9.79	1.74	1.90	1.82	0.49	0.46	0.47
S.Em±	0.14	0.18	0.11	0.11	0.10	0.07	0.02	0.02	0.01	0.01	0.01	0.01
C.D. (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
P_2O_5 levels (Kg ha^{-1})												
P_1: 30	12.52	14.91	13.71	9.60	9.65	9.62	1.71	1.87	1.79	0.47	0.45	0.46
P_2: 60	12.74	15.13	13.93	9.76	9.81	9.79	1.73	1.90	1.82	0.48	0.46	0.47
S.Em±	0.11	0.15	0.09	0.09	0.08	0.06	0.02	0.01	0.01	0.01	0.01	0.01
C.D. (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Inter-row spacing levels (cm)												
D_1: 20	12.57	14.98	13.78	9.64	9.69	9.66	1.71	1.88	1.80	0.48	0.46	0.47
D_2: 30	12.68	15.05	13.87	9.72	9.78	9.75	1.73	1.89	1.81	0.48	0.46	0.47
S.Em±	0.11	0.15	0.09	0.09	0.08	0.06	0.02	0.01	0.01	0.01	0.01	0.01
C.D. (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Seed rate levels (Kg ha^{-1})												
S_1: 40	12.60	14.99	13.80	9.66	9.71	9.68	1.72	1.88	1.80	0.48	0.46	0.47
S_2: 60	12.65	15.04	13.85	9.70	9.75	9.73	1.72	1.89	1.81	0.48	0.46	0.47
S.Em±	0.11	0.15	0.09	0.09	0.08	0.06	0.02	0.01	0.01	0.01	0.01	0.01
C.D. (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.V.	5.34	5.87	5.68	5.46	4.95	5.21	5.84	4.52	5.17	6.09	5.21	5.68
Significant interactions	-	-	-	-	-	-	-	-	-	-	-	-

Interaction effect

The data further revealed that the effect of various interactions due to N and P_2O_5 levels, inter-row spacing and seed rate on plant height in paddy was found to be non-significant during both the year and in pooled analysis.

Nutrients status of soil

The data revealed that soil available organic carbon, N, P_2O_5, K_2O, S, Fe, Cu and Zn content was not influenced to the significant extent due to individual effect of N and P_2O_5 levels, inter-row spacing and seed rate as well as their interactions during both the years and in pooled analysis (Table 2 and 3).

References

Alam, M. M., Ali, M. H., Rahul Amin, A. K. M. and Hasanuzzaman, M. 2009. Yield attributes, yield and harvest index of three irrigated rice varieties under different levels of phosphorus. *Advances in Biological Research*, 3(3-4):132-139

Anonymous 2014. Directorate of Economics and Statistics, Department of Agriculture and Cooperation.

Balasubramanian, V. and Hill, J. (2000). Direct wet seeding of rice in Asia: emerging issues and strategic research needs for the 21st century. Paper presented at the Annual Workshop of Directorate of Rice Research, Hyderabad.

Banerjee, H. and Pal, S. 2011. Effect of planting geometry and different levels of nitrogen on hybrid rice. *Oryza*, 48(3): 274-275.

Chang, E. H., Zhang, S. F., Wang, Z. Q., Wang, X. M. and Yang, J. C. (2007). Effect of nitrogen and phosphorus on the amino acids in root exudates and grains of rice during grain filling. *Acta Agronomica Sinica*, 33(12): 1949-1959.

Gill, J. S. and Walia, S. S. 2013. Effect of establishment methods and nitrogen levels on basmati rice. *Indian Journal of Agronomy*, 58(4): 506-511.

Hao, H. L., Yang, X. E., Feng, Y. and Wu, C. Y. (2009). Effects of P fertilizer level on distribution of Fe, Mn, Cu and Zn and brown rice qualities in rice. *Plant Nutrition Fertilizer Science*, 15(6):1350-1356.

Khush, G. S. (2007). Rice breeding for 21st century. *Book on Science, Technology and Trade for Peace & Prosperity*. pp. 64-65.

Mallareddy, M. and Padmaja, B. 2013. Response of rice (*Oryza sativa*) varieties to nitrogen under aerobic and flooded conditions. *Indian Journal of Agronomy*, 58(4): 500-505.

Meena, R. K., Neupane, M. P. and Singh, S. P. 2014. Effect of phosphorus levels and bio-organic sources on growth and yield of rice (*Oryza sativa* L.). *Indian Journal of Nutrition*, 1(1): 1-3.

Mishra, B. (2003). Rice research in India-Major achievements and future thrust. Paper presented in winter school on 'Advances in Hybrid Rice Technology' held at DRR Hyderabad during 10-30th September, 2003. pp. 48-59.

Pramanik, K., Bera, A. K., Saren, B. K. and Dhakre, D. S. 2015. Effect of nitrogen and phytohormones on hybrid rice grown under lateritic belt of West Bengal. *International Journal of Bio-resource, Environment and Agricultural Sciences*, 1(2): 1-7.

Singh, R. K. and Singh, C. V. 2006. Effect of phosphorus on drought mitigation and productivity of rainfed upland rice (*Oryza sativa*). *Indian Journal of Agronomy*, 51(4): 293-296.

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