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Effect of Age of Seedling, Number of Seedling per Hill and Fertility Level on Yield and NPK Uptake by Hybrid Rice (PHB-71)

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Abstract

The present experiment was carried out in split plot design with age of seedlings (10, 20 and 30 days old) in main plot and number of seedlings/hill (one, two and three) and fertility level (125, 100, 75 and 50% recommended level of NPK) in sub-plots during rainy season of 2005 and 2006. Experiment comprised 36 treatments replicated three times with following seed rate 5 for one seedling/hill, 10 for two seedling/hill and 15 kg/ha for three seedling/hill. Ten days old seedling being at par with 20 days old seedling recorded maximum grain yield (66.28 q/ha) and straw yield (90.24 q/ha), NPK uptake (127.27, 24.51 and 152.95 kg/ha, respectively) ; 125% recommended level of NPK being at par with 100% recommended level of NPK recorded maximum grain yield (73.84 q/ha) and straw yield (99.65 q/ha), NPK% in rice grain (1.274, 0.260 and 0.634%, respectively) and in straw (0.492, 0.099 and 1.389%, respectively), NPK uptake (143.35, 29.07 and 185.63 kg/ha, respectively). Similarly, 10-day old seedlings with two seedlings/hill recorded maximum grain yield (69.17 q/ha) and straw yield (93.85 q/ha), NPK uptake by rice plant (132.98, 25.72 and 160.18 kg/ha, respectively).

Key words : Age of seedling, No. of seedling/hill, Fertility, Nutrient uptake.

Rice is the most important crop of India and it occupies 23.3% of gross cropped area of the country. Rice contributes 43% of total food grain production and 46% of total cereal production. It continues to play vital role in the national food grain supply. At the current rate of population growth of India, feeding the nation will require the great challenge, especially rice production, as this increase has to be attained with shrinking land, existing water resources and other inputs. In this context the hybrid rice has to play a vital role. Jharkhand belongs to low productivity group of country in rice production. The state accounts for 3.3% of total geographical area of the country. Productivity of 15 districts out of 18 districts of Jharkhand fall under low (yield range of 1000 to 1500 kg/ha) productivity group and three districts under very low (yield below 1000 kg/ha) productivity group. Age of seedling at the time of transplanting is an important factor for uniform stand establishment of rice. If the age of seedlings is less than optimum, tender seedlings may die in greater number due to high temperature and ultimately the plant population is reduced. On the other hand, if the age of seedlings is more than optimum, the seedlings produce less tillers due to reduce vegetative period and thereby results in poor yield. Practice of transplanting 1 or 2 seedlings/hill has a potential to increase rice yield, through reducing transplanting stress or injury and increasing tiller and root number on lower nodes. It is generally accepted that growth of rice roots are supported by substrate supply from lower leaves. Since shading of lower leaves by upper leaves was less severe at 1 plant/hill than that at 3 plants/hill for a prolonged period, more substrate could be supplied to developing roots (1). However, we need to keep in mind that the full potential of hybrid rice can only be harnessed with appropriate management, particularly nutrient management. One of the major reasons for falling partial factor productivity in the country is inadequate and imbalanced nutrient application.

Methods

The soil of the experimental plots belongs to Red-yellow—light grey catenary soil association group (Paleustaff) representing the major soil group of Jharkhand plateau. The soil was loamy in texture, acidic in reaction, low in available nitrogen and medium in organic carbon, available phosphorus and potassium. Experiment was laid out in split plot

Table 1. Methods adopted for soil and plant analysis.

	Methods adopted
A. Soil Analysis	
pH (1:2.5, Soil : water)	PH meter (2)
Organic carbon	Rapid titration (Walkley & Black method) (3)
Available nitrogen	Kjeldahl's method
Available phosphorus	Bray's Pl
Available potassium	Flame photometer
B. Plant Analysis	
Nitrogen content	Modified macro Kjeldahl's method (3)
Phosphorus content	Colorimeter (4)
Potassium content	Flame photometer method

design in 36 treatments replicated three times with following seed rate 5 for one seedling/hill, 10 for two seedling/hill and for three seedling/hill 15 kg/ha, recommended level of nutrient was 150 : 75: 60 kg/ha of N: P_2O_5 : K_2O and sub-plot treatment combinations was S_1F_1, S_1F_2, S_1F_3, S_1F_4 and S_2F_1, S_2F_2,S_2F_3,S_2F_4 and S_3F_1, S_3F_2, S_3F_3, S_3F_4. Whereas, S_1 (one seedling/hill), S_2 (two seedlings/hill) and S_3 (three seedlings/hill). Similarly, F_1 (125% recommended level of nutrient), F_2 (100% recommended level of nutrient), F_3 (75% recommended level of nutrient) and F_4 (50% recommended level of nutrient).

Uptake of nitrogen, phosphorus and potassium was calculated by multiplying the N, P and K contents of grain and straw yield values (Table 1). Uptake of N, P and K by grains and straw was combined to give total uptake by crop and uptake values were expressed in kg/ha.

Results and Discussion

Grain Yield and Straw Yield (q/ha)

Grain yield and straw yield (q/ha) are presented in the Table 2. Ten day old seedling produced 65.84 and 66.70 q/ha grain yield and straw yield of 88.65 and 89.32 q/ha during 2005-06 and 2006-07, respectively which was significantly higher (9.22 and 9.62% and 7.81 and 9.06% for grain and straw in both years, respectively. Pooled analysis also revealed that 10 days old seedling produced significantly higher (9.45%) yield of 66.28 q/ha over 30 days and was at par with 20 days old seedling. However, analysis of pooled data of two years also revealed that 10 days old seedling recorded maximum straw yield (90.24q/ha) which was significantly higher by 8.78% as compared to 30 days old seedling being at par with 20 days old seedling. Number of seedling/hill did not influence rice grain and straw yield significantly. Fertility levels significantly affected grain yield during both the years of experimentation. 125% recommended fertilizer produced significantly higher grain yield over 75 and 50% recommended level of NPK 22.5 and 44.62% during 2005-06 and 21.87 and 46.17% during 2006-07, respectively and was at par with 100% recommended level of NPK during both the years. Straw yield was significantly influenced by fertility levels during both the years of experimentation. 125% recommended level of NPK produced maximum straw yield (99.65 q/ha) which was significantly higher over 75% and 50% recommended level of NPK and was at par with 100% recommended level of NPK during both the years. Analysis of pooled data of two years revealed that 125% recommendedlevet of NPK produced maximum grain yield (73.84 q/ha) which was significantly higher as compared to 75% and 50% recommended level of NPK by 22.17 and 45.38 percent, respectively being at par with 100% recommended level of nutrients NPK. The pooled analysis of data showed that 125% recommended level of NPK recorded maximum straw yield which was 20.28 and 40.96% higher as compared to 75% and 50% recommended level of NPK.

Impact of transplanting of healthy seedling of optimum age ensures better rice yield. When seedling is transplanted at right time, tillering and growth proceeded normally. However, when seedlings stay longer in seed nursery bed, primary tiller buds on the lower nodes of the main culms often degenerate. Primary tiller buds of 4th to 7th nodes are held inside when seedling are planted at 7th leaf age (5) also suggested if the age of seedlings is less than optimum, tender seedlings may die in greater number due to high temperature and ultimately the plant population is reduced. On the other hand, if the age of seedlings is more than optimum, the seedlings produce less tillers due to reduce vegetative period and thereby results in poor yield. In the present investigation positive impact on grain yield due to 10 days old seedling is accordance with the earlier findings (6).

Table 2. Grain yield (q/ha) and straw yield (q/ha) as affected by age of seedling, number of seedling/hill and fertility level.

Treatments	Grain yield (q/ha)			Straw yield (q/ha)		
	2005-06	2006-07	Pooled	2005-06	2006-07	Pooled
Age of Seedling						
10	65.84	66.70	66.28	89.45	90.64	90.24
20	64.18	66.02	65.12	87.74	89.80	88.77
30	60.28	60.84	60.56	82.81	83.11	82.96
SE ±	0.89	0.81	0.86	0.88	1.17	1.03
CD at 5%	3.50	3.18	3.38	3.46	4.60	4.05
Number of Seedling/Hill						
One	61.96	63.27	62.62	85.03	86.33	85.68
Two	64.89	65.77	65.33	88.65	89.32	88.98
Three	63.54	64.52	64.00	86.72	87.91	87.31
SE ±	0.98	1.01	0.99	1.17	1.20	1.17
CD at 5%	NS	NS	NS	NS	NS	NS
Fertility Level (%)						
125	73.22	74.46	73.84	99.02	100.29	99.65
100	70.15	71.58	70.87	95.27	96.95	96.11
75	59.77	61.10	60.44	82.10	83.58	82.85
50	50.63	50.94	50.79	70.80	70.58	70.69
SE ±	1.13	1.17	1.14	1.36	1.38	1.36
CD at 5%	3.13	2.24	3.16	3.77	3.83	3.77

Nutrients in Plant

Nitrogen, phosphorus and potassium percent in rice grain and straw are presented in the Table 3. Age of seedling and number of seedling/hill did not influ-

Table 3. NPK % in rice grain and straw as affected by age of seedling, number of seedling/hill and fertility level.

Treatments	N concentration (%)		P concentration (%)		K concentration (%)	
	Grain	Straw	Grain	Straw	Grain	Straw
Age of Seedling						
10	1.263	0.478	0.246	0.088	0.540	1.276
20	1.259	0.476	0.244	0.088	0.538	1.270
30	1.246	0.471	0.241	0.087	0.531	1.256
SE ±	0.008	0.003	0.001	0.001	0.004	0.007
CD at 5%	NS	NS	NS	NS	NS	NS
Number of Seedling/Hill						
One	1.253	0.474	0.243	0.087	0.534	1.261
Two	1.259	0.477	0.245	0.088	0.539	1.273
Three	1.256	0.475	0.244	0.088	0.536	1.269
SE ±	0.007	0.003	0.001	0.001	0.003	0.009
CD at 5%	NS	NS	NS	NS	NS	NS
Fertility Level (%)						
125	1.274	0.492	0.260	0.099	0.634	1.389
100	1.265	0.486	0.252	0.093	0.578	1.323
75	1.251	0.468	0.238	0.085	0.515	1.231
50	1.233	0.456	0.225	0.074	0.418	1.128
SE ±	0.008	0.003	0.001	0.001	0.004	0.010
CD at 5%	0.022	0.008	0.003	0.001	0.011	0.028

Table 4. NPK uptake by rice plant as affected by age of seedling , number of seedling/hill and fertility level.

Treatments	N uptake (kg/ha)		P uptake (kg/ha)		K uptake (kg/ha)	
	Grain	Straw	Grain	Straw	Grain	Straw
Age of Seedling						
10	83.94	43.36	16.43	8.07	36.55	116.38
20	82.29	42.53	16.06	7.94	35.87	114.23
30	75.70	39.31	14.74	7.31	32.95	105.46
SE ±	1.55	0.75	0.285	0.141	0.636	1.92
CD at 5%	6.09	2.95	1.12	0.55	2.50	7.55
Number of Seedling/Hill						
One	78.70	40.82	15.34	7.58	34.15	109.26
Two	82.52	42.64	16.14	7.96	36.03	114.66
Three	80.72	41.74	15.75	7.78	35.20	112.16
SE ±	1.58	0.75	0.289	0.139	0.680	2.00
CD at 5%	NS	NS	NS	NS	NS	NS
Fertility Level (%)						
125	94.27	49.08	19.22	9.86	47.02	138.62
100	89.79	46.75	17.87	8.93	40.99	127.27
75	75.75	38.73	14.43	7.02	31.19	101.89
50	62.77	32.37	11.46	5.26	21.30	80.31
SE±	1.83	0.84	0.334	0.16	0.785	2.35
CD at 5%	5.07	2.33	0.93	0.44	2.18	6.51

ence percent nitrogen content in rice grain and straw significantly. Fertility levels significantly affected percent nitrogen content in rice grain. The analysis of pooled data of 2005 and 2006 revealed significantly higher percent nitrogen content (1.274%) in rice grain due to 125% recommended level of NPK over 75 and 50% recommended level of NPK (1.251 and 1.233%, respectively) being at par with 100% recommended level of NPK. The pooled analysis of data revealed maximum percent nitrogen content in rice straw due to 125% recommended level of NPK, which was significantly higher as compared to 75 and 50% recommended level of NPK (5.13 and 7.90%, respectively) being at par with 100% recommended level of NPK.

Similarly, phosphorus content (%) in rice grain as influenced by age of seedling and number of seedling/hill did not influence percent phosphorus content in rice grain and straw significantly. The analysis of pooled data of two years revealed that 125% recommended level of NPK recorded significantly higher percent phosphorus content in rice grain (0.260%) over 100, 75 and 50% recommended dose fertilizer being higher by 3.17, 9.24 and 15.56% respectively. The analysis of pooled data of two years revealed that 125% recommended level of NPK recorded maximum phosphorus content in rice straw (0.099%) which was significantly superior to 100, 75 and 50% recommended dose fertilizer by 6.45, 16.47 and 33.78%, respectively.

However, age of seedling and number of seedling/hill did not influence percent potassium content in rice grain & straw significantly. The analysis of pooled data revealed significantly higher potassium content in rice grain (0.634%) due to 125% recommended level of NPK as compared to 100, 75 and 50% recommended level of NPK (9.69, 23.11 and 51.68% respectively). Analysis of pooled data of two years revealed that 125% recommended level of NPK recorded maximum potassium content in rice straw (1.389%) which was significantly higher by 4.99, 12.84 and 23.14% respectively over 100, 75 and 50% recommended dose fertilizer.

Nutrient Uptake by Rice Grain and Straw

Nitrogen uptake (kg/ha) by rice grain as influenced by age of seedling, number of seedling/hill and

fertility level, pooled data are presented in the Table 4.Pooled analysis of two years data revealed that 10 days old seedlings recorded maximum nitrogen uptake (83.94 and 43.36 kg/ha by grain and straw, respectively) being significantly higher by 10.89% for grain uptake over 30 days old seedlings and was at par with 20 days old seedlings. Number of seedling/ hill did not affect the nitrogen uptake by rice grain and straw. The analysis of pooled data of two years revealed that 125% recommended level of NPK recorded maximum nitrogen uptake by rice grain over 75 and 50% recommended level of NPK (24.45 and 50.18%, respectively) being at par with 100% recommended level of NPK. The analysis of pooled data of two years revealed significantly higher nitrogen uptake by rice straw due to 125% recommended level of NPK over 75% and 50% recommended level of NPK (26.72 and 51.62%, respectively) being at par with 100% recommended level of NPK. Pooled analysis also revealed that transplanting 10 days old seedlings recorded maximum total nitrogen uptake by rice plant (127.27 kg/ha) which was significantly higher by 10.66% over 30 days old seedlings and was at par with 20 days old transplanted seedlings. Number of seedling/hill did not affect the total nitrogen uptake by rice plant. Analysis of pooled data of two years revealed that 125% recommended level of NPK recorded maximum total nitrogen uptake by rice plant (143.35 kg/ha) which was significantly higher over 75 and 50% recommended level of NPK by 25.04 and 50.99% respectively and being at par with 100% recommended level of NPK. Singh and Singh (7) also suggested that the transplanting of younger seedling recorded significantly higher nitrogen by rice grain and straw. Similarly, Mishra and Solakhe (8) have also supported the view by explaining that younger seedlings of 12 days old performed better than older seedlings of 30 days in terms of greater uptake of nitrogen. They also suggested that constraints associated with rice cultivation may be alleviated by transplanting younger seedlings.

Phosphorus uptake (kg/ha) by rice grain pooled analysis of two years data also revealed that phosphorus uptake by rice grain was significantly higher in 10 days old transplanted seedlings (16.43 kg/ha) as compared to 30 days old seedlings and was at par with 20 days old transplanted seedlings. Number of seedling/hill did not affect the phosphorus uptake by rice grain and straw. The pooled analysis of data revealed that 125% recommended level of NPK recorded maximum phosphorus uptake by rice grain (19.22 kg/ha) which was significantly higher by 7.5, 33.20 and 67.71% over 100, 75 and 50% recommended level of NPK respectively. Analysis of pooled data also revealed that phosphorus uptake by rice straw was significantly higher in 10 days old transplanted seedlings (10.40%) over 30 days old seedlings and was at par with 20 days old transplanted seedlings. The analysis of pooled data of two years revealed that 125% recommended level of NPK recorded maximum phosphorus uptake by rice straw (9.86 kg/ha) which was significantly higher by 10.41, 40.46 and 87.45% phosphorus uptake by 100, 75 and 50% recommended level of NPK. Total phosphorus (kg/ha) uptake by rice plant as influenced by age of seedling, number of seedlings/hill and fertility level for pooled data are presented in the Table 4. The pooled analysis of data revealed that 125% recommended level of NPK total phosphorus uptake by rice plant (29.07 kg/ ha) which was significantly higher by 8.43%, 35.15% and 74.28% respectively over 100, 75 and 50% recommended level of NPK. The pooled data revealed that 10 days old two seedling/hill resulted in significantly higher phosphorus uptake (25.72 kg/ha) by rice plant being at par with 10 days old one seedling/hill, 20 days old one, two or three seedlings/hill as well as 30 days old three seedlings/hill. It is clear from the above findings that 10 days old transplanted rice seedling with lesser number of seedling /hill (one or two) resulted in maximum total phosphorus uptake by rice plant. While aged seedling (30 days old) needed three seedlings/hill for attaining similar total phosphorus uptake by rice plant.

Potassium uptake (kg/ha) by rice grain and straw. Analysis of pooled data of two years also revealed that potassium uptake by rice grain and straw was significantly higher due to transplanting of 10 days old seedlings (10.93 and 10.35%) as compared to transplanting of 30 days old seedlings and was at par with 20 days old transplanted seedlings. Number of seedling/hill did not affect the potassium uptake by rice grain and straw. The pooled analysis of data revealed that 125% recommended level of NPK recorded maximum potassium uptake by rice grain (47.02 kg/ha) which was significantly higher over 100, 75 and 50% recommended level of NPK by 14.17, 50.75 and 120.75%

respectively. Similarly, pooled analysis of data revealed that 125% recommended level of NPK recorded maximum potassium uptake by rice straw (138.62 kg/ha) which was significantly higher by 100, 75 and 50% recommended level of NPK by 8.92, 36.05 and 72.61% respectively.

References

1. San-oh Y., Y. Mano, T. Ookawa and T. Hirasawa. 2004. Comparison of dry matter production and associated characteristics between direct sown and transplanted rice plants in a submerged paddy field and relationships to planting pattern. *Field Crops Res.* 87: 43—58.
2. Piper C. S. 1950. Soil analysis. The Univ. Adelaid, Australia. *Pl. and Soil.* 252 : 325—337.
3. Jackson M. L. 1973. *Soil chemical analysis. Prentice Hall, New York.* 48— 302 pp.
4. Muhr G. R., N. P. Dutta, H. Sankarasubramoney, Lakey and R. L. Donahve. 1965. *Soil testing in India. USA for Int. development mission to India*. New Delhi, India. 39—46 pp.
5. Ahmad I., M. Ahtar and M. S. Nazir. 2002. Seedling age effect on agronomical trials of basmati rice. *Asian. J. Pl. Sci.* 1 : 330—331.
6. Biradarpatil N. K. 2009. *Studies on seed production techniques and storability of Karnataka rice hybrid-2.* Ph. D. thesis. Univ. Agric. Sci., Dharwad, India.
7. Singh R. S. and S. B. Singh. 1998. Response of rice *(Oryza sativa)* to age of seedlings and level and time of application of nitrogen under irrigated condition. *Ind. J. Agron.* 43 : 632—635.
8. Mishra A. and V. M. Solakhe. 2008. Seedling characteristics and the early growth of transplanted rice under different regimes of water. *Expl. Agric*. 44 : 1—19.