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Hybrid Rice Response to Levels and Time of Potassium Application on Growth and Yield

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ABSTRACT

A field experiment was conducted at Agricultural College Farm, Bapatla on a sandy clay loam soil during *kharif* season of 2010 to study the effect of levels and time of potassium application on the growth, yield attributes and yield of rice cultivars. The findings of the experiment revealed that the growth, yield attributes, and yield was higher with the hybrid PA-6444 than the hybrid KRH-2 and local variety BPT-5204. Application of 80 kg K_2O ha^{-1} recorded maximum growth, yield attributes and yield. Split application of potassium (½ as basal + ½ at Panicle Initiation) performed better in growth, yield attributes and yield.

Key words : Hybrid rice, Potassium, Split application, Yield

Rice (*Oryza sativa*.L) is the most important and extensively grown food crop of India. It is the staple food for more than half of the world population and is of paramount importance to Indian economy. The present production level of rice needs to be increased in order to meet the ever growing population pressure on the land to reach self sufficiency in food grain production in the country. Since there is little scope for expanding the rice area, it is necessary to increase the rice productivity from unit land area. Therefore, hybrid rice is practically feasible and readily adaptable genetic option to increase the rice productivity. The higher yield of hybrids can be realized with proper fertilizer management practices. Rice hybrids yield about 20 per cent increased grain yield over inbred cultivars (Virmani *et al*., 1991).

Potassium is one of the three major plant nutrients. The application of which to rice crop has received least attention, even though potassium accounts for a greater share of total nutrients removed from the soil by rice crop. Being a major nutrient, potassium increases vigour and disease resistance in crop plants and strengthens the straw. Response of rice to applied potassium is highly variable. The method of fertilizer application and its efficiency are largely governed by the differences in the uptake pattern of the plant at different stages of growth (Singh *et al*., 1983).

Normally, the farmers apply the entire potassium as basal. In recent times, information is mounting on rice response to split application of potassium. Keeping this in view, the present investigation was carried out to study the effect of levels and split application of potassium on growth and yield of hybrid rice.

MATERIAL AND METHODS

The field experiment was conducted at Agricultural College Farm, Bapatla during *kharif* 2010. The soil was sandy clay loam in texture with 7.8 pH, 0.8 dS m^{-1} E.C; 0.50 % organic carbon; 175 kg ha^{-1} available nitrogen; 12.5 kg P_2O_5 ha^{-1} available phosphorus and 495 kg K_2O ha^{-1} available potassium. The study comprised of twenty four treatments *viz.,* Hybrids-2+1(Two hybrids *viz*., PA-6444 and KRH-2 and one local variety, BPT-5204), four levels of potassium (0, 40, 60 and 80 kg K_2O ha^{-1}) and two times of potassium application (Basal and Basal + P.I stage). The experiment was conducted in a randomized block design with three replications. Rice seedlings (thirty three days old) were transplanted by adopting a spacing of 20 cm x 15 cm. A recommended dose of 160 kg N and 60 kg P_2O_5 ha^{-1} was applied uniformly to all plots. Nitrogen was applied in the form of urea in three equal splits at basal, tillering and panicle initiation stages. Phosphorus was applied as basal through single super phosphate. Potassium was applied as per the treatments in the form of muriate of potash. Recommended agronomic practices and plant protection measures were followed. The data was subjected to statistical analysis as prescribed by Panse and Sukhatme (1978). The plant samples were collected at harvest for chemical analysis and K content was determined by flame photometer (Muhr *et al*., 1965).

Table 1. Effect of levels and time of potassium application on growth and yield attributes of rice cultivars.

Treatments	Plant height (cm)	Drymatter production (kg ha^{-1})	Productive tillers (No. m^{-2})	Grains per panicle (No.)	Filled grains per panicle (No.)	Test weight (g/1000 grains)
Cultivars (V)						
PA-6444	95	11101	356	136	120	23.5
KRH-2	93	10415	342	136	121	22.1
BPT- 5204 (Local)	90	9255	258	159	140	16.5
SEm ±	0.7	186.1	2.6	1.0	1.4	0.2
C D (P=0.05)	3.5	530	7.4	3.0	3.9	0.6
Levels of potassium (kg K_2O ha^{-1})						
0	90	9951	315	141	123	19.9
40	93	10120	315	143	127	20.8
60	93	10261	321	144	127	21.0
80	94	10697	324	146	131	21.2
SEm ±	0.8	214.9	3.0	1.2	1.6	0.2
C D (P=0.05)	NS	NS	NS	3.4	4.5	0.7
Time of potassium application (T)						
All Basal	92	10196	317	142	125	20.5
½ Basal + ½ at PI	93	10318	320	145	130	21.0
SEm ±	0.5	151.9	2.1	0.9	1.1	0.2
C D (P=0.05)	NS	NS	NS	2.4	3.2	0.5
Interaction	NS	NS	NS	NS	NS	NS
C V (%)	8.5	8.9	4.0	3.6	5.3	4.8

RESULTS AND DISCUSSION

The data on growth indicated that the plant height, number of productive tillers m^{-2}, drymatter production were significantly influenced by cultivars but not due to the level and time of potassium application and their interaction (Table 1). The hybrid PA-6444 recorded the highest plant height. Irrespective of levels and time of potassium application, the plant height increased with advancement of crop age. There was rapid increase in plant height of rice hybrids from transplanting to 30 DAT and thereafter, the rate of increase was less. Split application of potassium failed to show any significant influence on plant height, over all as basal.

Significantly higher drymatter production (DMP) was observed with hybrid PA-6444 over hybrid KRH-2 and variety BPT-5204. Maximum DMP was recorded with application of 80 kg K_2O ha^{-1} at 30, 60 90 DAT and at maturity. Both the levels of potassium viz., 40 and 60 kg K_2O ha^{-1} were superior to control at all the stages of crop growth. The lowest DMP was recorded in the absence of potassium, at the crop growth period. The increased plant height and number of shoots, more number of tillers hill^{-1} had a positive effect on DMP and hence application of potassium might have accelerated the higher quantity of DMP. The results are in agreement with the findings of Gobi *et al*., (2006). Split application of potassium did not show any significant increase in DMP over basal application.

The hybrids recorded significantly higher productive tillers m^{-2} over variety BPT-5204. Among the hybrids, the maximum number of productive tillers was recorded with PA-6444 (356) which might be due to its high tillering ability. These results corroborate with the findings of Singh *et al*. (1997) and Chandrasekhar *et al*., (2004). Maximum number of productive tillers m^{-2} was recorded with application of 80 kg K_2O ha^{-1}. Only, a marginal increase was noticed in number of productive tillers with increase in potassium dose from 0 to 80 kg K_2O ha^{-1}. Since the potassium exerts very little influence on the vegetative growth, there might have been very negligible influence on the production of tillers. Application of potassium ½ basal + ½ at P.I stage recorded maximum productive tillers m^{-2} than the basal. Though there was numerical increase in tillers due to split application, the difference in increase was not significant. Similar results were also reported by Krishnappa *et al*., (1990).

Significantly higher number of grains per panicle was obtained with BPT- 5204 (159) than the

Table 2. Effect of levels and time of potassium application on the grain yield, straw yield and harvest index of rice cultivars.

Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index (%)
Cultivars (V)			
PA-6444	5252	6171	46.0
KRH-2	5198	5610	48.1
BPT- 5204 (Local)	4214	4429	48.8
SEm ±	59.9	63.6	0.4
C D (P=0.05)	170.4	181.0	1.2
Levels of potassium (kg K_2O ha^{-1})			
0	4763	5261	47.6
40	4828	5312	47.8
60	4931	5413	47.7
80	5030	5628	47.4
SEm ±	69.1	73.4	0.5
C D (P=0.05)	196.8	209	NS
Time of potassium application (T)			
All Basal	4852	5243	48.1
½ Basal + ½ at PI	4924	5564	47.1
SEm ±	48.9	51.9	0.4
C D (P=0.05)	NS	147.8	NS
Interaction	NS	NS	NS
C V (%)	6.0	5.8	4.4

hybrids PA-6444 and KRH-2, while filled grains per panicle was more with PA-6444. Thousand grain weight was significantly higher with hybrid PA-6444 (23.5) and lowest with BPT-5204 (14.6). Variation in total number of grains panicle^{-1} might be due to difference in panicle size of the varieties, which is a genetic character and specific to each variety. Maximum number of grains per panicle, filled grains per panicle, was recorded with the application of 80 kg K_2O ha^{-1}. Yuan *et al*., (1995) reported that potassium application markedly reduced the number of unfilled spikelets due to its promoting effects on cytokinin synthesis which resulted in less zygote degeneration. Potassium is required for activation of starch synthase which might have played a vital role in starch conservation thus might have resulted in heavier grains. Similar results were also reported by Mondal and Dasmhapatra (1982) and Thakur and Patel (1997).

Significantly higher grain yield was observed with hybrid, PA-6444 (5252 kg ha^{-1}) over KRH-2 (5198 kg ha^{-1}) and BPT-5204 (4214 kg ha^{-1}) but both the hybrids were remained statistically identical (Table-2). The grain yield observed with hybrid KRH-2 was significantly greater than that was observed with BPT-5204. All the yield attributing characters such as productive tillers m^{-2}, filled grains per panicle and test weight were significantly reflected in respective grain yield of the cultivars. Similar results with different cultivars, were also reported by many investigators such as Muthukrishnan *et al*., (1997) and Rama Rao (2004).

The highest grain and straw yield was recorded with the application of potassium @ 80 kg K_2O ha^{-1} over no potassium. Increasing levels of potassium significantly increasing the grain yield and straw yield was also reported by Saplalrinliana *et al*., (2005). Split application of potassium showed greater influence over basal application.

Among rice cultivars significantly higher straw yield was obtained with P A-6444 (6171 kg ha^{-1}) followed by KRH-2 (5610 kg ha^{-1}) and BPT-5204 (4429 kg ha^{-1}) which were significantly differed with each other. Straw yield as affected by different cultivars was also reported by Kamalanathan *et al*., (2004).

Significantly the highest harvest index was recorded with BPT-5204 (48.8%). followed by KRH-

2 (48.1%), and the lowest harvest index was recorded with PA-6444 (46.0%). The harvest index was on a par with each other with increasing levels of potassium application. However, the harvest index was lowest with 80 kg K_2O ha^{-1}. Potassium application in soil might have resulted in producing more straw yield, which narrowed the differences in harvest index. Similar results were also reported by Ravi (1990). Time of potassium application did not show any significant increase in harvest index. However, both are on a par with basal and split application of potassium.

From the present investigation, it can be concluded that cultivation of hybrid PA-6444 with the application of 80 kg K_2O ha^{-1} in two splits (1/2 basal + 1/2 panicle initiation) performed better in realizing higher growth, yield attributes and yield of rice.

LITERATURE CITED

Chandrasekhar J, Rama Rao G and Reddy K B 2004 Studies on drymatter accumulation and grain yield in hybrid rice. *The Andhra Agricultural Journal,* 51(1&2): 180-183.

Gobi R, Pandian B J and Kanaka S 2006 Evaluation of stand establishment methods and split application of N and K for hybrid rice (CORH-2). *Crop Research,* 32(3): 275-278.

Kamalnathan J, Arviazhagan K, Natarajan S and Dhanasekharan K 2004 Effect of timing of potassium application on growth, yield and nutrient uptake of rice genotypes. *The Andhra Agricultural Journal Golden Jubilee Special Issue,* 50. 452-453.

Krishnappa M, Narayanagowda K, Shankaranarayan V, Mahrrudrappa K and Khan M M 1990 Effect of graded levels and split application of potassium on its availability and yield of rice. *Journal of Potassium Research,* 6(4):156-161.

Mondal S S and Dasmahapatra A N 1982 Role of K_2O/N absorbed by plants in rice yield. *Indian Potash Journal,* 7(4):19-21.

Muhr G R, Datta N P, Sankarasubramoney H, Dever R F, Leley V K and Donachue R L 1965 *Soil testing in India*. United States Agency for International Development Mission of India, New Delhi.

MuthuKrishnan P, Chinnamuthu C R, Ponnuswamy K, Santhi and Budhar M N 1997 Appropriate varieties and management techniques for direct sown rice under puddle condition. *Madras Agricultural Journal* ,54(4): 216-219.

Panse V G and Sukhatme P V 1978 *Statistical methods for Agricultural Workers.* ICAR, New Delhi.

Rama Rao G 2004 Drymatter production and nutrient uptake in rice hybrids. *Madras Agricultural Journal,* 26(3&4):138-140.

Ravi K 1990 Studies on levels and times of application for *kharif* rice (*Oryza sativa L.) M.Sc. (Ag) thesis* submitted to Acharya N. G. Ranga Agricultural University, Hyderabad.

Saplalrinliana H, Sharma S K and Singh P K 2005 Effect of nitrogen and potassium on yield and nutrient uptake by rice crop in acidic soils of Nagaland. *Oryza,* Vol. No.3, (227-229).

Singh C M, Verma S P and Dinesh B 1983 Response of flooded transplanted rice to split application of potassium in acid alfisols of Palampur. *Indian Potash Journal*, 8(4): 8-15.

Singh A, Awasthi R P and Singh R D 1997 Performance of rice under different methods of cultivation in hilly soils of Sikkim. *Indian Journal of Agronomy,* 42(4): 611-613.

Thakur D S and Patel S R 1997 Effect of split application of potassium on rice (*Oryza sativa* L.) in ustic inceptisols. *Journal of Potassium Research*, 13(2):185-189.

Virmani S S, Young J B, Moon H P, Kumar I and Flinn J C1991 Increasing rice yields through exploitation of heterosis. *IRRI Research paper series,* 156, 13p.

Yuan Long Ping, Virmani S S and Changziong Mao 1995 Hybrid rice achievements and outlook. *International Rice Research News letter,* 11: 219-234.

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