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Effect of Cultivars and Time of Potassium Application on Yield Attributes, Yield, K-content and Uptake of Rice

B M Yalasangi, A Ravi Kumar, Ch Pulla Rao, P Ravindra Babu and R Veeraraghavaiah

Department of Agronomy, Agricultural College, Bapatla - 522 101, (A.P), India.

ABSTRACT

A field experiment was conducted on a sandy clay loam soils of the Agricultural College Farm, Bapatla during *kharif* 2005 to evaluate the influence of cultivars and time of potassium application on yield attributes, yield, K-content and uptake of rice. Significant increase in yield attributes, yield and potassium uptake was observed with Swarna compared to other cultivars. Application of 40 kg K_2O ha^{-1} in three splits (50% as basal + 25% at active tillering + 25% at panicle imitation) significantly increased the productive tillers, panicle weight, filled grain $panicle^{-1}$, test weight, grain and straw yield, K-content and uptake of rice.

Key words : Cultivars, K-content and Uptake, Potassium, Time, Yield, Yield Attributes.

Rice is grown in 113 countries and most of the rice produced is consumed directly as food. In 2001, more than three billion people consumed 517.9 million tonnes of rice out of a total production of 580 million tonnes *i.e.,* 89.2 per cent of total production (Solh, 2005). Rice is the most important and staple food crop for more than two third population of India. India has the largest acreage under rice (44.6 m ha) with a production of 90 m t and a productivity of 2086 kg ha^{-1} ranking next only to China (Survey of Indian Agriculture, 2005).

The removal of potassium by rice grain, straw and stubble determined from crop cuts and potassium concentrations in the plant materials was virtually influenced by rice cultivars. However, potassium balance in soil is a measure of leaching and erosion losses, that depends on soil and time of potassium application (Nguyen My Hoa *et al.,* 2006). Though normally farmers apply entire potassium as basal, recent study had revealed rice response to split application of potassium. Keeping these points in view, present investigation was conducted to study the effect of cultivars and time of potassium application on yield attributes, yield, K-content and uptake of rice.

MATERIAL AND METHODS

A field experiment was conducted at Agricultural College Farm, Bapatla during *kharif* 2005 in randomized block design with factorial concept and replicated thrice with 15 treatment combinations (5 cultivars and 3 times of potassium application). The trial consisted of five cultivars (Swarnamukhi (NLR-145), Swarna (MTU-7029), Deepti (MTU-4870), Samba Mahsuri (BPT-5204) and Bapatla Sannalu (BPT-1768)) and three times of potassium application (T_1-100% as basal, T_2-75% as basal + 25% at PI and T_3- 50% as basal + 25% at AT + 25% at PI). Thirty three day old seedlings were transplanted using two seedlings $hill^{-1}$ in 1st week of September with a spacing of 20 cm x 15 cm. The soil of experimental site was sandy clay loam in texture with pH 8.47 and 0.57% organic carbon. The fertility status of the soil was low, medium and high in available N, P_2O_5 and K_2O, respectively.

RESULTS AND DISCUSSION

Yield attributes and Yield

The yield attributing characters and yield were significantly influenced by cultivars and time of potassium application but not due to their interaction (Table 1). Swarna recorded the maximum number of productive tillers m^{-2} and filled grains $panicle^{-1}$, while thousand grain weight was the highest (22.2 g) with Swarnamukhi and highest panicle weight (3.4 g) was noticed with Bapatla Sannalu (Table 1). with Swarna might be due to its high tillering ability, resistant to lodging and high conversion of total tillers into reproductive tillers. Significantly higher 1000 grain weight recorded with Swarnamukhi (22.2 g) might be due to the bold size of the grain, while Bapatla Sannalu - being a

fine and slender rice recorded the lowest 1000 grain weight (15.5 g). The highest grain yield (4676 kg ha^{-1}) was observed with Swarna followed by Deepti (4513 kg ha^{-1}). The highest grain yield could be attributed to more productive tillers m^{-2} and higher number of filled grains $panicle^{-1}$ in Swarna compared to other cultivars. The lowest grain yield (3545 kg ha^{-1}) with Samba Mahsuri might be due to its lower number of yield attributes. Similar results were also reported by Priyadarsini and Prasad (2003). Application of potassium in three splits recorded significantly higher productive tillers m^{-2} (286.4), panicle weight (3.0 g), filled grains $panicle^{-1}$ (132.3), test weight (19.4 g), grain (4622 kg ha^{-1}) and straw (5910 kg ha^{-1}) yields than other times of potassium application.

K-content & uptake in rice

Higher K-content was observed at initial stage of rice growth compared to panicle initiation and maturity stages irrespective of cultivars and time of potassium application (Table 2). These results agree with those of Thakur *et al.* (1997). Singh *et al.* (1994) also reported higher K-content at 30 DAS compared with 60 and 90 DAS. Potassium content (%) at different stages of sampling and uptake (kg ha^{-1}) determined at harvesting stage was significantly influenced by cultivars and time of potassium application but interaction affect was found to be non significant. Swarnamukhi recorded higher K content in plants estimated at all the stages of observation. While the highest K uptake (110.6 kg ha^{-1}) was registered with Swarna. The potassium uptake almost followed similar trend to that of grain yields and the uptake differences in K between cultivars was small. These results were also in agreement with Surekha *et al.* (2003).

Application of 40 kg K_2O ha^{-1} in three splits (50% as basal + 25% at AT + 25% at PI) significantly increased K- content compared to that of other treatments at PI and maturity. Whereas basal application of 40 kg K_2O ha^{-1} recorded the highest K-content over different times of potassium application at AT stage. This might be due to absorption of potassium by rice plant increased with increasing concentration of the nutrients in the growth medium (Mahapatra and Rajendra Prasad, 1970) and also higher K-content was recorded in straw than grain and this was in conformity with findings of Mahapatra and Yaduraj (1981). The K concentration in plants increased up to maximum tillering and later decreased gradually. This might be due to the fact that initial and natural supply of potassium from soil and irrigation water might have been higher at early stages than during the later growing season and also the root system will be more active at tillering stages *i.e.,* at earlier stages which results in more uptake of potassium (Raju, 2001).

Application of potassium in three splits showed significant increase in K-uptake compared to other treatments. Split application of potassium maintained higher K content at all the stages of crop growth except at AT stage. However, the improvement in growth parameters, yield attributing characters and yield with potassium applied in three splits reflected on the highest uptake of K (114.6 kg ha^{-1}) at maturity. Similar trend also reflected in case of grain and straw, which is attributed to two peak rates of potassium absorption *i.e.* one at maximum tillering and the other at flowering stages of the crop. The inherent limitation associated with full application at transplanting such as, dilution, penetration and fixation were efficiently over come by split application (Majumdar and Ghosh, 1980). From the present study, it can be concluded that the highest yield attributes, yield and K-uptake were recorded with the cultivar Swarna and application of potassium in three splits (50% as basal + 25% at AT + 25% at PI).

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

Treatments	Productive tillers m^{-2}	Panicle weight (g)	No.of filled grains $panicle^{-1}$	1000 grain Weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
Cultivars						
C_1 - Swarnamulkhi	291.8	3.07	120.9	22.23	4342	5672
C_2 - Swarna	302.0	2.94	139.2	18.07	4676	5960
C_3 - Deepti	284.4	2.70	126.6	19.23	4513	5991
C_4 - Samba Mahsuri	240.3	2.30	114.9	18.63	3548	4885
C_5 - Bapatla Sannalu	257.9	3.40	127.1	15.53	4077	5999
SEm±	7.2	0.06	3.7	0.32	114	112
CD(p=0.05)	14.8	0.12	7.5	0.63	2.34	229
Time of potassium application						
T_1-100% as B	264.1	2.78	119.1	18.12	3912	5429
T_2 - 75% as.B + 25% at PI	275.4	2.90	125.8	18.70	4160	5747
T_3 - 50% as B + 25% at AT + 25% at PI	286.4	2.97	132.3	19.40	4622	5910
SEm±	5.6	0.05	2.8	0.24	88	87
CD (p=0.05)	11.4	0.10	5.8	0.49	181	178
Interaction						
Cultivars x Time of potassium application	NS	NS	NS	NS	NS	NS

B= Basal AT= Active tillering PI= Panicle initiation NS= Non Significant

Table 2. Effect of cultivars and time of potassium application on K-content and uptake in rice

Treatments	K-content (%)				K-uptake(kg ha^{-1})		
	Active tillering	Panicle initiation	Grain	Straw	Grain	Straw	Total
Cultivars							
C_1 - Swarna mulkhi	2.30	1.86	0.57	1.51	24.5	86.0	110.5
C_2 - Swarna	2.13	1.65	0.54	1.43	25.5	85.1	110.6
C_3 - Deepti	2.28	1.78	0.51	1.44	22.9	86.2	109.1
C_4 - Samba Mahsuri	2.14	1.65	0.54	1.47	19.4	74.5	93.9
C_5 - Bapatla Sannalu	2.09	1.78	0.54	1.41	22.0	84.6	106.8
SEm±	0.04	0.04	0.01	0.02	0.7	2.0	3.4
CD(p=0.05)	0.08	0.08	0.03	0.05	1.4	4.1	7.0
Time of potassium application							
T_1-100% as B	2.24	1.75	0.54	1.43	21.1	79.6	100.7
T_2 - 75% as.B + 25% at PI	2.19	1.66	0.52	1.42	21.8	81.4	103.2
T_3 - 50% as B + 25% at AT + 25% at PI	2.13	1.82	0.56	1.50	25.8	88.7	114.7
SEm±	0.03	0.03	0.01	0.02	0.5	1.6	2.7
CD (p=0.05)	NS	0.06	NS	0.04	1.1	3.2	5.4
Interaction							
Cultivars x Time of potassium application	NS	NS	NS	NS	NS	NS	NS

B= Basal AT= Active tillering PI= Panicle initiation NS= Non Significant

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