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INFLUENCE OF POTASSIUM ON PRODUCTIVITY IN THREE RICE VARIETIES

H. VIJAYARAGAVAN[1] M. MOOSASHERIFF[2] and N. NATARAJAATHNAM[3]
Department of Crop Physiology, Tamil Nadu Agrl. University, Coimbatore.

ABSTRACT

A field experiment was conducted to find out the differential response of potassium in three rice varieties. The varieties differed in their parental composition. 'Kannaki' which has 'IR 8" as female parent showed highest response in terms of increased productive tillers, panicle length, total number of grains per panicle, and 1000-grain weight which, in turn produced highest yield of grain. The Grain-Straw ratio and Harvest index also found to be maximum in 'Kannaki'. The increased response of 'Kannaki' to applied potassium is attributed to its female parent 'IR 8'.

Physiology of yield as a consequence of potassium supplements deserves a recognition of the impact of potassium on productive parameters that have direct bearing on ultimate yield. The application of potassium to rice has been disputed and their is still no conclusive evidence as to whether to apply potassium along with N & P to rice crop or not However, Mahapatra and Prasad (1970) obtained high yield in rice with increase in dose of potassium. Kiuchi et al (1962) reported that potassium increased the 1000-grain weight and percentage of mature rice grains. It is known that high potassium level increased the grain to straw ratio (Velasco and Plantastico (1963). Kalicharan Das et al (1970) found that high potash application resulted in good favourable panicle size and increase infertile in fertile grains. The number of grains per panicle was highest at 30kg K_2O per hectare (Agarwal, (1978). Alphonso (1957) noticed significant increase in yield of rice due to 90kg potassium application per hectare. Feng (1968) reported that rice needs potassium throughout its vegetative period. Raheja et al (1970) observed that the yield increase due to potassium application was almost twice as high yielding varieties as compared to existing varieties.

The response of rice to Potassium supplements has been demonstrated as a function of variety. Kalyanikutti (1969) compared indica (Co 33), japonica (Tainan 3), indica x indica (IR 8) and indica x japonica (ADT 27) and con-

1. Assistant Professor (Crop physiology), Soil Salinity Research Centre, Trichy-9.,

2. Associate Professor, Department of Crop Physiology, Tamil Nadu Agricultural University, Coimbatore,

3. Dean, Jawaharlal Nehru College of Agricultural Karikal

cluded that 'Tainan 3 and 'IR 8' needed nearly double the amount of nitrogen as required by 'ADT 27' and 'Co 33'. High yielding varieties like 'IR 8' 'IR 26' and 'IR 30' are considerably more responsive to potassium than 'IR 20' and 'IR 22' (Von Uexkull 1976). Hence the employment of high yielding varieties in which 'IR 8' as one of the parent deserves consideration. With this background, attempt has been made to study the response of two rice varieties which have 'IR 8' as one of the parents. An entirely different rice genotype has also been involved in the study for comparison.

MATERIALS AND METHODS

Three rice varieties viz, 'IET 3280' (Dhungansahli x IR 8), 'Kannaki', (IR 8 x TKM 6) and Co 29, Co13 x Co 4) were selected for the study. 'Kannaki' and 'IET 3280' were short duration varieties (100-110 days duration each) with short stature. 'Co 29' on the other hand was a long duration (135 days) variety with long stature. These were treated with 0, 40, 60 and 80 kg K_2O per ha under wetland conditions at Central Farm, Tamil Nadu Agricultural University, Coimbatore. The potassium is applied as basal dressing along with recommended N and P_2O5 (100 kg N as urea in two equal splits one at active tillering and second at panicle initiation stages and 50 kg P_2O5 as Superphosphate as basal dressing were applied). Observations on Tiller production, panicle length; Number of grains per panicle, 1000-grain weight and yield of grain and straw were recorded at harvest.

RESULTS AND DISCUSSION

The effect of potassium on the productive parameters in three rice varieties is presented (Table 1). The variety 'Kannaki' showed increased response upto 80kg level whereas IET 3280 and Co 29 showed highest productive tillers in 60 kg level beyond which the number of productive tillers decrease. Highest number indicated on of productive tillers was produced in 'Kannaki' at 80 kg level.

Panicle length increased only upto 60 kg/ha in 'IET 3280' but it is increased still further in 'Kannaki' showing better responsiveness. 'Co 29' shows a somewhat reduced panicle length but here spacing again maximum values are obtained in medium level, (60 kg/ha).

The total number of filled grains increased only upto 60 kg/ha in IET 3280' but the increase was still high in 'Kannaki'. In the case of 'Co 29', potassium supplement increase the total number of grains, the increase is maximum at 60 kg/ha with a slight decrease with high dose. With regard to the unfilled grains, Potassium supplements appear to decrease the number of unfilled grains per panicle in all the three varieties. The percentage of filled grains has increased in almost all the varieties with added potassium.

1000-grain weight is perhaps one of the deciding factors of yield. Between 'IET 3280' and 'Kannaki' the later shows better responsiveness. The increase is from 25.18 to 27.50 g between nil and high dose of Potassium (80 kg/ha). In

TABLE 1 : Effect of potassium levels (kg/ha) on tiller production, panicle length (cm), Number of grains per Panicle and 1000-grain weight (g) in Three Rice Varieties.

Variety	Potassium dosage	Productive tillers	Panicle length	Total No. of grains per Panicle	Total No. of filled per Panicle	Total No. of unfilled grains per Panicle	Percentage of filled grains	1000-grain Weight
"IET 3280"	Nil	6.5	16.2	90.22	79.42	10.80	88.03	23.20
	Low	6.8	16.5	95.66	85.62	10.30	89.51	24.15
	Medium	7.7	18.9	105.28	96.61	8.67	91.75	26.20
	High	7.2	17.9	97.27	88.43	7.34	90.91	24.82
"Kannaki"	Nil	7.3	20.2	93.94	83.83	10.11	89.24	25.18
	Low	7.8	20.9	94.73	86.27	10.60	91.07	25.80
	Medium	8.3	21.8	112.43	105.60	7.72	93.04	26.62
	High	10.4	21.9	119.00	105.68	6.83	93.80	27.50
"CO 29"	Nil	5.2	18.6	84.98	74.98	10.00	88.23	23.71
	Low	5.4	19.1	99.39	90.22	9.17	90.68	25.12
	Medium	6.9	19.5	106.66	99.16	7.50	92.91	25.25
	High	6.3	19.2	104.12	98.39	5.73	94.42	25.42
SE : Variety		0.047	0.177	2.483	2.585	0.383		0.349
Treatment		0.055	0.204	2.867	2.985	0.443		0.403
V x T		0.095	0.354	4.966	5.171	0.767		0.699
CD : Variety		0.148**	0.552**	7.728	8.047	1.195		1.088*
(P:0.05) Treatment		0.171**	0.637**	8.924**	9.293**	1.195**		1.257*
V x T		0.297**	1.104	15.457	9.293	2.390		2.177

the case of 'IET 3250' it ranges from 23.20 to 26.20 g for nil and 60 kg/ha treatment. At high level of potassium there is a tendency to reduce 1000-grain weight. The response of 'CO 29' does not show much difference to dosages though large difference is met with, between nil and medium level of potassium supplement (60 kg/ha).

YIELD OF GRAIN

Yield data per plot are presented for all the three varieties (Table 2). Both the short duration varieties, 'IET 3280' and 'Kannaki' easily gave a higher yield from the long duration 'CO 29'. Between the two short duration varieties. 'Kannaki' yields slightly higher than 'IET 3280'. Besides there is a continuous increase due to potassium supplements in grain yield but the maximum effect is due to 60 kg/ha and not 80 kg/ha in case of 'IET 3280'. Kannaki shows highest yield increase in spacing terms of percentage of control (18.2%).

YIELD OF STRAW

The straw yield of the two short duration varieties is less than the straw yield of 'CO 29'. Comparing the two short duration varieties, straw yield of 'Kannaki' is lower in general to 'IET 3280', the maximum straw yield is attained at medium potassium level whereas in 'Kannaki' there is a continuous increase in straw yield upto 80 kg/ha of potassium, It is apparent that high grain yield in 'Kannaki' compared to 'IET 3280' is essentially due to better mobilisation of assimilates as indicated by high grain/straw ratio. The straw yield increased upto 11.2 percent over control in the case of 'Kannaki'

GRAIN/STRAW RATIO

The grain straw ratio is presented (Table 2). It is seen that the grain/straw ratio is less in 'IET 3280' compared to 'Kannaki'. In the case of 'CO 29', the grain/straw ratio is extremely low. It is interesting that in short duration varieties, 'IET 3280' shows response to potassium at medium and high levels for grain/straw ratio. whereas 'Kannaki' shows appreciable response at low and medium levels. This indicates that potassium requirement of 'Kannaki' is far less and efficiency is also high. 'CO 29' shows a marked contrast in that potassium supplement decreases the grain/straw ratio. It would appear that potassium has contributed only to straw yield and not grain yield to any appreciable extent and also increased dry-matter production is not attended to by the efficient translocation or assimilate partition.

HARVEST INDEX

This parameter is an important index for estimating productivity (Table 2). The two short duration varieties show much higher values compared to long duration tall 'CO 29'. Between the two short duration varieties, the difference is no doubt small, but 'Kannaki' exhibits high harvest index consistently with reference to potassium dosage. The difference is large at medium level of potassium. The harvest index in 'CO 29' is very low and the effect of potassium dosage may be considered totally negligible. This resistance to potassium

TABLE 2 : Effect of potassium levels (kg/ha) on the yield of Grain and Straw (kg/plot of 12-6m2), Grain/Straw ratio and Harvest index (%) in three rice varieties.

Potassium Dosage	IET 3280				Kannaki				Co. 29			
	Gy	Sy	G/S	HI	Gy	Sy	G/S	HI	Gy	sy	G/S	HI
Nil	5.4 (100.0)	9.8 (100.0)	55.1	35.5	5.5 (100.0)	9.5 (100.0)	57.9	36.7	4.5 (100.0)	11.1 (100.0)	48.7	28.9
Low	5.5 (101.9)	10.0 (102.0)	55.0	35.5	5.8 (105.5)	9.7 (104.5)	58.6	36.9	4.6 (102.2)	11.8 (106.3)	39.0	28.1
Medium	6.0 (111.1)	10.7 (109.2)	56.1	35.9	6.2 (112.7)	10.5 (110.5)	59.1	37.1	5.0 (111.1)	12.3 (110.0)	40.7	28.9
High	5.8 (107.4)	10.2 (10.2)	56.1	36.3	6.5 (118.2)	11.2 117.9)	58.0	36.7	4.8 (106.6)	12.2 (109.9)	39.3	28.2
SE: Varcity	0.068	0.123										
Treatment	0.078	0.142										
V x T	0.136	0.247										
CD : (P:0.5) : Variety	0.199**	0.363**										
Treatment	0.230**	0.419**										
V x T	0.399	0.726										

Figures in Parenthesis indicate percentage over control.

Gy : Grain yield; Sy: Straw Yield; G/S: Grain/Straw ratio; HI : Harvest index.

dosage has already been witnessed in the increased straw weight rather than grain weight in this variety.

DMP - YIELD RELATIONSHIP

A high harvest index is obtained for the two short duration varieties, 'IEF 3280' and 'Kannaki' and quite a low value is obtained for 'Co 29'. This suggests that assimilate partition is poor in the latter variety. An attempt is therefore made to associate dry matter production and yield (Fig. 1). The short duration varieties almost varieties, irrespective of the levels of potassium supplements have aligned themselves closely and the 'r' value works out to + 0.6219. On the other hand 'Co 29' shows low value in yield and aligns itself in a entirely different line and 'r' value being +0.9918. Total DMP is the integral part of crop growth rate over the entire growth period and it is related to grain yield by harvest index. Although it is possible to show experimentally to some extent how harvest index can be varied restricting the formation of storage organs (Wada, 1965), it is usually difficult to drastically change harvest index of a given variety under most conditions. Harvest index of rice tends to be lower as total DMP increases (Murayama, 1967 and Shigemura, 1966). That is, grain yield of rice increase more slowly than total DMP. The association of yield with DMP has received encyclopedial coverage literature. Biological yield and economic yield have been coined in this context by Nichiporovich (1954). The desirable attributes of 'Kannaki' in increasing almost all the productive parameters with added potassium results in good grain yield. This it is possible to attribute the high responsiveness of 'Kannaki' to potassium to its female parent 'IR 8'. The studies that the increased response of 'Kannaki' to added potassium is due to its female parent 'IR 8'.

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FIG 1. DMP - YIELD RELATIONSHIP