

Performance of rainfed rice (*Oryza sativa*) as influenced by varieties and nutrient levels

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ABSTRACT

A field experiment was conducted during the first-crop season of 1991 and 1992 to select a suitable rice (*Oryza sativa* L.) variety for rainfed cultivation in southern Kerala and also to work out the nutrient level required for maximum rice production under such condition. The growth parameters showed significant variation due to varieties and nutrient levels. Pooled analysis of yield data revealed that varieties like 'Jaya', 'Rasi' and 'Tulasi' performed better than the other varieties and to get better grain yields, 75% of nutrient recommendation, i.e. 67.5 : 33.75 : 33.75 kg N, P_2O_5 and K_2O /ha, for medium-duration varieties, was found sufficient for rainfed rice.

Rainfed rice (*Oryza sativa* L.) undergoes a different agro-ecological environment which is highly specific to each location. The untimely and uncertain rainfall results in varying levels of moisture stress which, in turn, affects crop production. Enhanced and stabilized productivity from these rainfed areas is possible through adoption of improved varieties (Paroda and Rai, 1991). Similarly, occurrence of moisture stress or flooding in rainfed rice results in comparatively poor utilization of applied nutrients. Choice of appropriate variety and improved agronomic package for the rainfed situation would go a long way in improving the productivity of rice. Hence an experiment was conducted to study the influence of varieties and nutrient levels on the growth and yield of rainfed rice.

MATERIALS AND METHODS

The field experiment was laid out during

the first crop season (*khari*) of 1991 and 1992. The treatments consisted of 6 varieties ['Jaya', 'Culture 4' and 'M 102' (medium duration), 'Rasi', 'Ravi' and 'Tulasi' (short duration)] and 3 nutrient levels (100% of recommended dose (90 : 45 : 45 kg N : P_2O_5 : K_2O /ha), 75% of recommended dose and 50% of recommended dose). The experiment was laid out as a factorial experiment in randomized block design with 18 treatments and 3 replications.

The soil of the experimental site was riverine alluvium, acidic in reaction (pH 5.3), low in cation-exchange capacity (6.8 c mol (P^+)/kg and medium in organic carbon (0.72%), available N (287 kg/ha), P (40 kg/ha) and K (129 kg/ha). The seed was sown on 8 May during the first year and 22 May during the second year according to the availability of pre-monsoon showers. Sowing was done by dibbling in rows 20 cm

apart. Thinning was done on the twelfth day and plant-to-plant spacing adjusted to 10 cm. The required quantity of fertilizers, as per the treatments were applied to individual plots. One-third N, full P and half K were applied after thinning, one-third N at active tillering and one-third N and half K at panicle-initiation stage. Hand-weeding was done at 20 and 40 days after sowing. The experiment was conducted under the rainfed condition and no irrigation was provided to the crop.

The rainfall received during the cropping period of 1991 and 1992 showed different pattern. In 1991, 141.6 cm rainfall was received during cropping period and its distribution was adequate to maintain standing water during the early growth stage, panicle initiation, flowering and milk stages. In the second year of cropping there was heavy rainfall immediately after the sowing. Though a total rainfall of 124.6 cm was received, the distribution was in such a way that the crop experienced moisture stress at late-vegetative and milk stages, of the crops especially for medium-duration varieties.

RESULTS AND DISCUSSION

Growth characters

Variety 'M 102' recorded maximum plant height at harvest during both the years. 'Tulasi' and 'Rasi' recorded significantly higher tiller number than others during the first year, whereas 'Tulasi', 'Rasi' and 'Culture 4' were at par and significantly superior to others during the second year. The leaf-area index recorded at flowering stage showed significant variation among varieties during both the years. In 1991, 'Jaya' attained a maximum leaf-area index of 6.32 and was on a par with 'M 102'. During 1992, 'Culture 4' registered the highest leaf-area index (5.91) and was on a par with

'M 102', 'Rasi' and 'Tulasi'. The better rainfall distribution during the first year enabled 'Jaya', a medium-duration variety, to exhibit better performance. Deshmukh *et al.* (1988) and Sharma and Reddy (1991) observed varietal variation in vegetative growth characters of rainfed lowland rice.

Nutrient levels had significant influence on plant height during both the years. The nutrient level of 100% recommended dose recorded the highest plant height during 1991 and 1992. The different nutrient levels did not produce any significant difference in tiller number during 1991. However, 100 and 75% of recommended nutrient levels showed the same response during 1991 and were significantly superior to 50% of the recommended level. In both the years, increasing nutrient levels improved the leaf-area index.

Yield

Varietal variation was significant in grain yield during both the years. 'Jaya' gave the highest grain yield during 1991, followed by 'Tulasi', 'Culture 4' and 'Rasi', the latter 3 varieties being at par. During 1992, 'Tulasi' recorded the maximum grain yield and was on a par with 'M 102' and 'Rasi'. Pooled analysis of the 2-year data revealed that 'Jaya' was the highest yielder and was on a par with 'Tulasi' and 'Rasi'. This could be attributed to the high number of productive tillers, greater number of grains/panicle and low sterility percentage of 'Rasi' and 'Tulasi' and increased panicle length and panicle weight of 'Jaya'. Similar varietal variation in the yield of rainfed rice was also reported by Deshmukh *et al.* (1988) and Sharma and Reddy (1991).

For all the varieties the grain yield was higher during 1991 than 1992, owing to well-distributed, adequate rainfall. 'Jaya'

Table 1. Influence of varieties and nutrient levels on the growth and yield attributes of rainfed rice

Treatment	Plant height at harvest (cm)		Tillers/plant at harvest		LAI at flowering		Productive tillers/plant		Grains/panicle		Sterility (%)	
	1991	1992	1991	1992	1991	1992	1991	1992	1991	1992	1991	1992
<i>Variety</i>												
'Jaya'	95.82	74.06	6.63	7.42	6.32	4.41	5.90	5.22	116.44	75.00	13.86 (21.63)	5.77 (13.53)
'Culture 4'	94.97	72.38	7.26	7.71	5.40	5.90	5.93	5.13	112.67	75.22	14.78 (22.30)	6.82 (14.63)
'M 102'	106.07	90.00	7.16	6.22	5.94	5.81	3.88	4.14	129.56	84.44	18.00 (25.02)	6.54 (14.42)
'Rasi'	101.08	84.11	8.13	8.10	5.37	5.70	6.41	6.30	100.89	79.33	13.98 (21.92)	5.59 (13.42)
'Ravi'	88.34	86.11	4.74	6.92	5.28	5.09	4.03	5.67	81.11	74.00	14.35 (22.12)	6.54 (14.39)
'Tulasi'	98.54	85.11	8.34	7.96	5.45	5.77	6.26	6.59	98.11	85.11	11.40 (19.53)	5.69 (13.27)
CD (P = 0.05)	5.111	3.002	1.039	0.529	0.696	0.471	0.499	0.547	8.027	4.851	3.893	NS
<i>Nutrient*</i>												
100%	101.43	85.68	7.27	7.69	6.60	6.05	5.56	5.81	112.72	80.06	13.97 (21.77)	4.13 (11.53)
75%	96.80	80.71	7.20	7.53	5.54	5.23	5.38	5.72	104.94	81.57	13.58 (21.63)	5.35 (13.22)
50%	94.17	79.52	6.67	6.95	4.74	4.56	5.27	4.99	101.72	74.94	15.64 (23.34)	9.00 (17.28)
CD (P = 0.05)	3.614	2.123	NS	0.374	0.492	0.337	NS	0.387	5.676	3.430	NS	3.581

Figures in parentheses are transformed values

*Recommended dose of N, P₂O₅ and K₂O @ 90, 45 and 45 kg/ha respectively

Table 2. Influence of varieties and nutrient levels on the grain and straw yields of rainfed rice

Treatment	Grain yield (tonnes/ha)			Straw yield (tonnes/ha)		
	1991	1992	Pooled	1991	1992	Pooled
<i>Variety</i>						
'Jaya'	4.70	2.63	3.67	5.48	3.31	4.39
'Culture 4'	4.02	2.55	3.29	4.96	3.45	4.21
'M 102'	3.21	2.92	3.06	6.26	3.69	4.98
'Rasi'	3.84	2.84	3.34	5.36	3.88	4.76
'Ravi'	2.67	2.16	2.41	3.82	2.70	3.26
'Tulasi'	4.11	2.92	3.52	5.91	3.40	4.65
CD (P = 0.05)	0.396	0.192	0.334	0.595	0.281	0.243
<i>Nutrient*</i>						
100%	3.86	2.85	3.35	6.22	3.82	5.02
75%	3.85	2.78	3.31	5.39	3.49	4.44
50%	3.57	2.39	2.98	4.23	2.92	3.67
CD (P = 0.05)	NS	0.136	0.236	0.420	0.199	0.172

*Recommended dose of N, P₂O₅, K₂O @ 90, 45, 45 kg/ha respectively

being a medium-duration variety was most benefitted by the adequate rainfall. In 1992, 2-week delay in sowing due to late receipt in pre-monsoon showers and heavy rainfall immediately after sowing adversely affected the growth and production. Among the varieties the medium-duration ones were more affected by moisture stress at flowering and milk stages, whereas the short-duration varieties escaped the moisture stress at these stages. Nallathambi and Robinson (1992) also reported similar yield reduction in rice varieties when moisture stress was experienced in late-vegetative and milk stages.

The different nutrient levels did not cause any significant variation in grain yield during 1992, whereas 100 and 75% recommended doses were at par and superior to 50% recommended dose during the second year. The pooled analysis of data also confirms the result observed in the second year. This might be due to the loss of nutrients

either by leaching during periods of excess rainfall or by denitrification during alternate wetting and drying as commonly experienced in rainfed conditions. Experiments conducted at the Kerala Agricultural University also revealed no significant variation in grain yield of dry-sown 'Mahsuri' rice between 70, 45 and 45 kg/ha and 50, 25 and 25 kg N, P₂O₅ and K₂O/ha (KAU, 1984).

The interaction effect was significant only during the first year. 'Jaya' at 100% recommended dose and 'Tulasi' at 75% were at par and superior to others. This was attributed to the availability of ample water during the growth period, which enabled 'Jaya' to show better grain yield at the highest nutrient level. Since 'Tulasi' is of short duration, 75% level is adequate.

Straw yield also showed variation among the varieties. Pooled analysis revealed that 'M 102' registered the highest straw yield. Similarly, increasing nutrient levels from 50

to 100% of recommended dose increased the straw yield due to better tiller production and improvement in plant height. It was concluded that varieties like 'Jaya', 'Rasi' and 'Tulasi' could be successfully raised under rainfed conditions with a nutrient level of 67.5, 33.75 and 33.75 kg N, P_2O_5 and K_2O /ha.

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