RESPONSE OF RICE TO N AND K FERTILIZERS ON THE GRUMUSOLS OF MANNAR DISTRICT

P. YOGARATNAM
Agricultural Research Station, Murunkan

ABSTRACT

An experiment was carried out on a grumusol soil at Murunkan to study the response of the new improved rice variety Bg 11—11 to six levels of nitrogen (0, 40, 80, 120, 160 and 200 kg N/ha) for two consecutive maha seasons commencing from maha 1981/82. In another field experiment response to different levels and methods of split application of potassium fertilizer was evaluated. Grain yield response to N during maha 1981/82 was significant up to 200 kg N/ha, but in maha 1982/83 the response was only up to 160 kg N/ha. For K addition, significant response was obtained only during maha 1982/83 and that too not beyond 30 kg K_2O/ha. There was no response to split application of K.

INTRODUCTION

Mannar district lies in the north western part of Sri Lanka and receives an annual rainfall of over 967 mm. The total extent of rice land in this district is around 23,000 hectares and over 80 % of this is cultivated with new improved varieties, especially Bg 11—11 (age—4½ m).

The predominant rice growing soil groups present are the Grumusols (De Alwis and Panabokke, 1972). The area under grumusol soil type covers about 65 % of the total rice extent. In this region, rice is grown with rains but supplemented by irrigation from the tanks. Owing to the limited supply of water rice is grown only during the maha season. Despite the good chemical characteristics of these soils they present management problems which arise out of their physical properties (Moormann and Panabokke, 1961). Owing to high clay content, the soil becomes very sticky when wet and very hard when dry, making cultivation of these soils extremely difficult.

In the grumusol region, farmers growing rice in lands assured of water supply from the major tanks and from tube wells, use more fertilizer, especially N than that recommended by Sri Lankan Department of Agriculture. Since there are no experimental data to support such a practice, fertilizer response studies were carried out during the period 1981 to 1983 and their results are discussed in this paper.

MATERIALS AND METHODS

Nitrogen response experiments

Field experiments were started in maha 1981/82 and continued in maha 1982/83 at the Agricultural Research Station, Murunkan. The soil characteristics are given in Table 1. The nitrogen levels were 0, 40, 80, 120, 160 and 200 kg N/ha. It was split applied as urea according to times and proportions recommended by the Department of Agriculture (Table 2). Phosphorus as triple superphosphate was applied at the rate of 75 kg P_2O_5/ha before planting, while potassium in the form of muriate of potash was applied before planting (75 kg K_2O/ha) and at primodial initiation stage (76 kg K_2O/ha). The variety used was Bg 11—11.

The treatments (Table 2) were laid out in a randomized complete block design with 4 replications. The plot size was 3 m × 6 m. Plots were separated from each other by bunds (30 cm width). Rice was transplanted at a spacing of 20 cm between rows and 15 cm within rows with three seedlings per hill.

Potassium response experiments

In another field experiment at the same experimental station the response of rice to different levels and methods of potassium fertilizer application was evaluated. Levels of potassium were 0, 30, 60 and 90 kg K_2O/ha. Potassium was split applied according to times and proportions shown in Table 3. Phosphorus as triple superphosphate was applied at the rate of 75 kg P_2O_5/ha while nitrogen at 120 kg/ha was split applied at 2, 4 and 8 weeks after transplanting which is according to the recommendation of the Department of Agriculture. The treatments (Table 3) were laid out in randomized complete block design with 3 replications. Other experimental details were same as those followed in the nitrogen experiment.

Both N and K response experiments were carried out by maintaining the same treatments in the same plots during the two seasons.

RESULTS AND DISCUSSION

Nitrogen response experiments

The data showed that even without applied nitrogen the grumusol soil could produce a fairly good yield (2.9 to 4.4 t/ha; Table 2), if adequate water is available. In maha 1981/82 there was a significant response to each increment of added nitrogen up to 200 kg N/ha. In maha 1982/83 the trend was similar to that in maha 1981/82, but there was no significant difference between 160 and 200 kg N/ha (Table 2). Nitrogen at 200 kg N/ha however, resulted in lodging of the crop. These levels are much higher than the range of optimum amounts of N for maximum yield of 83.3 to 114.6 kg N/ha reported for the variety Bg 11—11 in the dry and intermediate zones (Unpublished data, Division of Botany, CARI, Gannoruwa). Similar trials carried out by the Field Trials Division, Peradeniya (Unpublished data) in the dry zone during maha 1971/72 and yala 1972 indicated the responses to be linear in most cases, but only up to 134.4 kg N/ha.

Response to very high N levels may be associated with heavy losses of applied N. In the grumusol soil, N loss through leaching is unlikely to be heavy, because of its very slow infiltration rate and very high CEC (De Alwis and Panabokke, 1972). Ammonia volatilization losses in the grumusol soil may not be significantly higher than in the Reddish Brown Earths (RBE) or in the Low Humic Gley (LHG) soils—the two predominant soil groups in the dry and intermediate zones—because all these three soils have similar soil pH values (slightly acid to neutral). It is possible that denitrification losses may be higher in the grumusol soil. The observed high N requirement for rice in this soil could also be due to reasons other than heavy N losses. Further studies are however, needed to explain the pattern of N response obtained in this soil.

The foregoing results seem to suggest that the present level of 100 kg N/ha recommended by the Department of Agriculture for the 4½ month old varieties in the grumusol region may have to be substantially raised. However, more trials on a wider scale need to be conducted to confirm this.

Potassium response experiments

In maha 1981/82 there was no significant yield response to potassium. However, in maha 1982/83 there was a response to potassium application but it was only up to 30 kg K_2O/ha. Split application of K also did not result in any significant grain yield increase. The marginal response to potassium in this soil is to be expected because of its high exchangeable K content (Table 1). Another reason could be the high K content of the water from the Giant's tank which irrigates these fields (Amarasiri, 1973).

CONCLUSIONS

Field experiments conducted on a grumusol soil at Murunkan in maha 1981/82 and maha 1982/83 showed that the popular variety Bg 11—11 can respond to a N application as high as 200 kg N/ha which is much higher than the 100 kg N/ha presently recommended by the Department of Agriculture. This suggests the need to conduct further N response experiments on a wider scale so that the Department of Agriculture recommendation for the grumusols could be suitably modified.

For K, there was no response except in maha 1982/83 and that too only to the first level of 30 kg K_2O/ha. There was also no response to split application of K. This is attributed to the high K contents of the Murunkan soil and the water of the Giant's tank which provides supplementary irrigation.

REFERENCES

Amarasiri, S. L. (1973). Water quality of major irrigation tanks in Sri Lanka. Tropical Agriculturist 129 : 19—25.

De Alwis, K. A. and C. R. Panabokke (1972). Handbook of the Soils of Sri Lanka (Ceylon). J. Soil Sci. Soc. Ceylon 2 : 1—97.

Moormann, F. R. and C. R. Panabokke (1961). Soils of Ceylon : A new approach to the identification and classification of the most important soil groups of Ceylon. Tropical Agriculturist 117 : 5—70.

Table 1. Some soil characteristics of the experimental site

pH	—	7.1
EC, mmho / cm	—	0.11
Texture	—	Clay
OM, %	—	0.8
Total N, %	—	0.13
Olsen's P, ppm	—	21.7
Exch. K, me / 100g soil	—	0.92

Table 2. Grain yield response to nitrogen

	Nitrogen (kg / ha)					*Grain yield (t/ha)*	
Treatment	*Total*	*0 WAP*	*2 WAP*	*4 WAP*	*8 WAP*	*maha 81 / 82*	*maha 82 / 83*
1	0	0	0	0	0	2.94	4.37
2	40	1.95	11.75	11.75	14.55	3.87	5.37
3	80	3.90	23.50	23.50	29.10	5.13	6.51
4	120	5.85	35.25	35.25	43.65	6.09	6.97
5	160	7.80	47.00	47.00	58.20	7.11	7.51
6	200	9.75	58.75	58.75	72.75	7.61	7.54
LSD (0.05)						0.40	0.53
CV (%)						4.8	5.4

WAP = weeks after planting

Table 3. Grain yield response to potassium

Levels and methods of application of K (kg K_2O / ha)					*Grain yield (t / ha)*	
Treatment	*Total*	*Basal*	*Maximum Tillering*	*P.I. Stage*	*maha 1981 / 82*	*maha 1982 / 83*
1	0	0	0	0	5.45	5.16
2	30	30	0	0	5.77	5.87
3	30	15	0	15	4.95	6.06
4	30	10	10	10	5.79	5.89
5	60	60	0	0	5.98	6.17
6	60	30	0	30	5.60	6.29
7	60	20	20	20	5.72	6.13
8	90	90	0	0	5.44	6.28
9	90	45	0	45	5.25	6.64
10	90	30	30	30	5.94	6.48
LSD (0.05)					0.61	0.61
CV (%)					6.4	4.1

P. I. = Primordia initiation