The effect of slaked lime on rice yield at Panagoda, Pussellawa and Bombuwela

MERVYN W. THENABADU

Division of Agricultural Chemistry, Central Agricultural Research Institute, Peradeniya, Ceylon

(Received September, 1969)

INTRODUCTION

LIMING is one of the oldest practices for maintaining soil fertility especially in humid regions where leaching removes bases from the soil which encourages the build up of soil acidity. Many crops grow best only if the soil reaction is optimum for them and the adjustment of soil acidity to a suitable level is important in good soil management. Although the importance of liming acid soils was known to the Japanese since the beginning of this century, Japanese farmers attached more importance to limiting of paddy soils than upland soils (1).

The effect of slacked lime on the yields of rice in the low-country wet-zone of Ceylon has been studied by Ponnamperuma (2, 3). Slaked lime at the rate of 6 tons per acre gave yield responses of 20.6 and 14.2 bushels per acre on imperfectly drained strongly acid clay loams at Mirigama and Panagoda respectively. At Mirigama the response to lime was in the absence of nitrogen. It was also observed that slaked coral lime performed better than ground coral limestone or ground dolomite. On the ill-drained humic soils of Bombuwela, Labuduwa and Karapincha however, there were no significant effects of lime on the yield of rice.

In the investigation reported here a study of the response to liming of soils on growth and yield of rice was made at three stations in the wet-zone of Ceylon. The levels of slaked lime used ranged between 0.25 and 3.00 tons per acre at each location.

MATERIALS AND METHODS

Four field trials were laid down at three Research Stations, in the wet-zone, viz. Panagoda, Pussellawa, and Bombuwela during Yala 1960. At Bombuwela the effect of slaked lime was studied on two soil types—(*a*) the very poorly drained humic clay loam and (*b*)

the sandy soils. The characteristics of soils at the experimental sites are presented in Table 1. The levels of lime used were 0 ; 0.25 ; 0.50 ; 1.00 ; 2.00 ; and 3.00 ; tons per acre. The design of the experiment at each location (and on each soil type) was a randomized block replicated four times. At each of these levels of lime the same quantity of N, P and K. fertilizers was added. For comparison, lime at 3 tons per acre was applied without NPK fertilizer. There was a NPK fertilizer treatment without any lime, and a control plot without lime and without fertilizer was also included. Two additional treatments with 3 and 6 tons straw compost per acre were included in the experiment on the sandy soils at Bombuwela. In all treatments lime was applied to the plots two weeks before transplanting.

In the NPK fertilizer, nitrogen was supplied at the rate of 40 lbs. N per acre, as ammonium sulphate at Panagoda and Pussellawa and as urea at Bombuwela. These were applied in three split doses at transplanting, two weeks after transplanting and at primordial initiation. Phosphorus, in the form of concentrated superphosphate, was supplied as a basal dressing at the rate of 84 lbs. P_2O_5 per acre. Potassium was supplied as muriate potash (50 per cent. grade) at the rate of 100 lbs. K_2O per acre, half of it being given at planting and the remainder at the stage of primordial initiation.

The variety of rice used in all trials was H-4. Soil samples were collected at regular intervals from each plot throughout the experiment for PH determinations. The trials at Bombuwela were continued during Maha 1960-61 to evaluate the residual effects of slaked lime.

RESULTS AND DISCUSSION

The effect of treatments on the yield of rice at the four locations are presented in Table 2 and 3.

Panagoda

The data on the effect of treatments on yield of rice at Panagoda is presented in Table 2. This information has been presented earlier (4). At Panagoda the plots that received lime at the rates of 2 and 3 tons per acre showed luxurient vegetative growth, particularly that of leaves. In the early stages of growth there was better root development in plants from plots at the lower levels of lime, but at the later stages plants in plots treated with 2 and 3 tons of lime per acre generally had more extensive root development. These observations may be explained on the basis of the toxic effects of excess lime on root growth although lime was applied two weeks before transplanting.

The plot receiving no fertilizer and no lime gave 60.8 bushels per acre. The addition of NPK fertilizers alone significantly increased yields by 19 bushels per acre. The addition of lime at levels ranging from 0.25 to 2 tons per acre together with NPK fertilizer made no further contribution to yield. Where 3 tons of lime were applied in addition to NPK fertilizer a yield of 86.6 bushels per acre was obtained, representing an increase in yield of 26 bushels over the unfertilized and unlimed control. Lime alone at 3 tons per acre gave a 11 bushels per acre increase in yield in the season of application. Increase in yield with lime was 11 bushels per acre with NPK fertilizer 19 bushels per acre.

From the above it is seen that the effect of lime and fertilizer were nearly additive. The conclusion is therefore drawn that a level of at least 3 tons per acre lime is necessary to effect an increase in yield in the season of application and this increase in yield can be more than doubled (26 bushels per acre) by the further addition of NPK fertilizer. In contrast to these findings, Ponnamperuma (3) obtained a very highly significant and linear response to lime in the range 0-6 tons per acre at Panagoda. This difference may most probably be due to the fact that the soil on which Ponnamperuma worked was relatively more acidic, low in cation exchange capacity and deficient in nutrients than the soil on which this investigation was made.

Canges in pH of the soil were expected due to application of lime, and therefore determinations of pH were made at various stages of growth in each treatment. Contrary to expectation there were no marked differences in pH with application of lime. It appears that 3 tons of lime per acre was insufficient to appreciably alter the pH of the soil. It is probable that the effect of lime was neutralized to some extent by the organic acids and carbon dioxide liberated during the mineralization of soil organic matter.

Pussellawa

The response to liming at Pussellawa is seen from the results in Table 2. The effect of treatments was significant at Pussellawa. Lime at the rate of 0.5 to 1.0 ton per acre increased the yield of rice by approximately 5 to 6 bushels per acre as compared with the no lime treatment. Levels of lime higher than 1.0 ton per acre depressed yields on this soil. As expected the need for fertilizers on this soil is seen from comparison of the yields of treatments 1, 2, 7 and 8. There was a yield increase of approximately 15 bushels per acre, 200 per cent, due to NPK alone when the yields of the first two treatments are compared. One ton of lime with NPK gave the highest increase

in yield, viz. 21 bushels per acre. This benefit of lime is not apparent with applications of 2 and 3 tons lime per acre. This may most probably be due to accelerated mineralization of soil organic matter with release of nitrogen and phosphorus, especially phosphorus. The data in table 1, indicates that the available phosphorus is low while nitrogen and exchangeable potassium are relatively well supplied on this soil.

Bombuwela

The effect of treatments on rice yields on the two soil types at Bombuwela during Yala 1969 and the residual effects of liming studied during Maha 1960-61 are presented in Table 3.

There was no significant responses to lime applications in the presence of fertilizer on the humic clay loan during Yala 1960, nor were there any significant residual effects seen during the following season (Maha 1960-61). These results confirm the findings of Ponnamperuma (2, 3).

The effect of treatments on the sandy soil were however significant during the season of application, i.e., Yala 1960. There were significant yield responses to NPK fertilizers on this sandy soil which is relatively poor in organic matter (Table 1). The effect of lime showed a maximum response at 0.50 tons per acre and the difference between this treatment and the control was significant. Straw compost only at 3.0 tons per acre was almost as good as the no lime with NPK treatment indicating a beneficial effect of the compost on this sandy soil. At 6.0 tons per acre the straw compost treatment was not better than that at the lower level, (there being a slight depression of yield).

The residual effects of liming or fertilizer treatments were not significant on the sandy soil during Maha 1960-61. However, the residual effects of lime treatments could be observed in some treatments. (viz., treatments 2 to 7). Straw compost at the rate of 6.0 tons per acre appeared to contribute to a yield increase of approximately 14 bushels per acre over the unfertilized plots. Straw compost at this rate appeared to be equivalent to NPK fertilizers plus lime at 1 ton per acre.

CONCLUSIONS

Slaked lime at the rate of 3 tons per acre increased yields of rice at Panagoda and the application of fertilizers in addition to the lime more than doubled this yield increase. At Pussellawa the best response was to 1 ton slaked lime per acre with fertilizers. There was no response to lime applications on the humic clay loan soil at Bombuwela, but there was a response to lime on the sandy soil.

ACKNOWLEDGMENTS

The advice, encouragement and continued interest of Dr. L. H. Fernando, former Botanist, Department of Agriculture is gratefully acknowledged. Thanks are also due to the field staff at the stations and to the Laboratory staff of the Division of Botany for their assistance during this investigaion.

REFERENCES

1. MITSUI, S., (1955). Inorganic Nutrition Fertilization and Soil Amelioration for Lowland Rice. Yokendo Ltd., Tokyo, Japan.

2. PONNAMPERUMA, F. N., (1959). Administration Report of the Director of Agriculture for 1958. P. c. 158.

3. PONNAMPERUMA, F. N., (1960). Lime as an amendment for the acid lateritic rice soils of Ceylon. *Trop. Agrist.* 116 : 234-252.

4. THENABADU, M. W., (1960). An investigation of the effects of slaked lime on the growth and yield of rice. Proc. Ceylon Assoc. for the Advancement of Science. 16 (1) : 17.

Table 1.—Some characteristics of soils from experimental fields

Location	*Texture*	*pH 1:1 soil: water*	*Organic matter* %	*Total Nitrogen* %	*Available P_2O_5 (Olsen) ppm*	*Available SiO_2 (Imaizumi and Yoshoida) ppm*	*Cation Exchange capacity me/100 g*	*Total exchangeable cation me/100g*	*Exchangeable cations me/100g*		
									Potassium	*Calcium*	*Magnesium*
Panagoda	Clay Loam	5.3	5.95	0.37	2.5	192.6	18.0	2.00	0.11	0.88	0.28
Pussellawa	Sandy clay loam	5.13	8.4	0.38	14.5	509.6	15.6	2.42	0.24	0.98	0.58
Bombuwela	Humic clay loam	5.4	7.02	0.38	41.3	128.4	16.4	3.38	0.16	1.57	0.80
Bombuwela	Sand	5.2	2.54	0.19	7.8	24.1	2.8	1.68	0.04	0.29	0.10

THE EFFECT OF SLAKED TIME ON RICE YIELDS AT PANAGODA PUSSELAWA AND BOMBUWELA

Table 2.—Effect of Treatments on yield of rice at Panagoda and Pussellawa (bu/ac)

No	*Treatment*	*Location*	
		Panagoda	*Pussellawa*
1 ..	No lime, no NPK	60.8 ..	7.4
2 ..	No lime with NPK	79.5 ..	22.2
3 ..	0.25 tons lime/ac with NPK	79.5 ..	21.6
4 ..	0.50 tons lime/ac with NPK	79.5 ..	27.0
5 ..	1.00 tons lime/ac with NPK	79.8 ..	28.3
6 ..	2.00 tons lime/ac with NPK	79.2 ..	20.0
7 ..	3.00 tons lime/ac with NPK	86.6 ..	23.4
8 ..	3.00 tons without NPK	72.0 ..	19.9
	L.S.D. 0.05	15.0 ..	3.68

Table 3.—Effect of Treatments on yield of rice at Bombuwela (bu/ac)

	Soil type	*Humic Clay Loam Soil*		*Sandy Soil*	
	Season	*Yala 1960*	*Maha 1960/61*	*Yala 1960*	*Maha 1960/61*
No.	*Treatment*				
1	No Lime no NPK	62.2	62.3	42.1	27.6
2	No Lime with NPK	65.7	72.2	53.9	39.5
3	0.25 tons lime/acre with NPK	73.8	70.3	52.2	36.2
4	0.50 do.	63.4	74.5	61.8	41.8
5	1.00 do.	62.3	70.7	59.1	42.8
6	2.00 do.	67.9	69.5	48.5	41.7
7	3.00 do.	67.9	71.9	59.6	40.9
8	3.00 do.	62.4	66.4	41.2	29.0
9	3.00 tons Straw compost/acre only	—	—	53.1	23.8
10	6.00 do.	—	—	52.4	42.1
	L.S.D.=0.05	8.6	8.4	11.3	6.7
		(N.S.)	(N.S.)	(Significant)	(N.S.)