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Efficacy of Indian and German Basic Slags in Comparison with Superphosphate on the Yield of Rice*

by

J. KRISHNARAJAN[1] and A. MARIAKULANDAI[2]

Introduction: Basic slag is a by-product in the manufacture of steel from pig iron and it owes its fertiliser properties to the phosphorus content of the by-product. The phosphorus content of the basic slag ranges from 2 to 16% of total phosphoric acid. A large number of experiments have been done with basic slag in Western countries. However, experiments with basic slag are very few in India (Raychaudri, 1960). So a study was made on rice to assess the relative merits of superphosphate, high-soluble basic slag and low-soluble basic slag with the objectives, (1) to study the relative merits of the high-soluble slag, low-soluble basic slag and superphosphate on equal dose of phosphoric acid and (2) to study the residual values of superphosphate, high-soluble slag and low-soluble slag applied to first crop of rice on the succeeding second crop of rice.

Review of Literature: *Effect of basic slag on paddy:* Mahapatra and Padalia (1962) found that 30 lb phosphoric acid per acre in the form of basic slag increased the yield of paddy to the extent of 150 kg of grain over the control per acre. Gosh (1963) reported that effects of basic slag were comparable with that of superphosphate on equivalent P_2O_5 basis in increasing the yield of grain either alone or in combination with the organic matter. At Midnapore basic slag has proved superior to superphosphate. Chu and Chen (1963) reported that in pot and field experiments basic slag increased rice yields by 10%.

Residual effect of basic slag: The basic slag had better residual effect on the succeeding crops than superphosphate because of its slow release of phosphorus and the complex nature of the phosphate which avoids the reversion of soluble phosphates. McCarthur as quoted by Russel (1931) reported that on the phosphate deficient soil, marked residual effect of high-soluble slag was noticed even in the third crop of oats. Schmitt (1939) studied the residual effect of some of the phosphatic manures and found that basic slag and superphosphate were equal in performance. Salonen and Tainio (1963) reported that the residual action of basic slag was much more effective than superphosphate, the residual action of basic slag lasted up to four years whereas it was only for two years with superphosphate. Simpson

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1. Agronomy Assistant, Agricultural Research Station, Bhavanisagar. 2. Retired Principal, Agricultural College, Madurai.

(1963) reported that the residual values of ground mineral phosphate and basic slag were considerably greater than those of superphosphate.

Materials and Methods: This experiment was conducted on paddy at the Central Farm, Agricultural College and Research Institute, Coimbatore. CO 29, a short duration (120 days) paddy strain was selected for the experiment in both the seasons.

Fertilisers used in the experiment: (1) *Superphosphate:* Ordinary commercial superphosphate with 18.78% of total phosphoric acid and 28.57% calcium oxide. (2) *German basic slag:* The basic slag sample obtained from Germany had 17.17% of total phosphoric acid of which 15.54% was soluble in 2% citric acid (90.51% solubility). (3) *Indian basic slag:* The Indian basic slag was obtained from Tata Iron and Steel Co. Ltd., Jamshedpur. It contained 10.82% of total phosphoric acid of which 4.98% is soluble in 2% citric acid (46.03% solubility) and (4) *Calcium oxide:* The sample used in the study contained 53.10% calcium oxide.

The following are the treatments: T 1: 30 lb P_2O_5 in the form of superphosphate; T 2: 30 lb P_2O_5 in the form of German basic slag; T 3: 30 lb P_2O_5 in the form of Indian basic slag; T 4: 30 lb P_2O_5 as superphosphate with the amount of calcium oxide in German slag when it supplied 30 lb P_2O_5; T 5: 30 lb P_2O_5 as superphosphate with the amount of calcium oxide in Indian slag when it supplied 30 lb P_2O_5; T 6: German basic slag supplying 30 lb P_2O_5 adjusted in calcium oxide to that of Indian basic slag; and T 7: Control (0 lb P_2O_5).

Five thousand pounds of green leaf per acre was applied as basal dose and 30 lb N was given in two equal split doses. The simple randomised block design was adopted with six replications. Twenty plants were selected at random in each plot and observations for growth and yield characters were made. The data on the yield of grain was analysed statisticall}

Results: In the first crop the different treatments did not influence the yield of grain significantly (Table 1). There was also no significant

TABLE 1. *Grain yield in kg per plot*

Treatments	Mean	S.E.	C.D.
T 1	4.42	—	—
T 2	4.66	—	—
T 3	5.14	—	—
T 4	4.87	—	—
T 5	5.35	—	—
T 6	4.62	—	—
T 7	4.99	—	—

Conclusion: Not significant.

Variance Table. Yield of grain.

Source	D.F.	S.S.	M.S.	'F' test
Replications	5	2.65		
Treatments	6	1.84	0.31	1.19
a) Control *vs* Others	1	0.04	0.04	0.2
b) Super *vs* German slag	1	0.005	0.005	0.02
c) Super *vs* Indian slag	1	0.57	0.57	2.08
d) Super *vs* Basic slag	1	0.09	0.09	0.03
e) German slag *vs* Indian slag (equal P_2O_5)	1	0.97	0.97	0.37
f) German slag *vs* Indian slag (equal P_2O_5 and CaO)	1	1.16	1.16	4.4*
Error	30	7.69	0.26	
Total	41	12.18		

*Significant at 5% level

difference in yield between the control plot and the plots treated with the various phosphatic sources.

The yield differences due to the superphosphate and the German slag was not significant as well as the yield differences due to the superphosphate and the Indian basic slag were not significant. There was no significant difference in yield between superphosphate treatment and basic slag. The yield difference was not significant in treatments with German slag *vs* Indian slag (equal P_2O_5):

The treatment of German slag was however, significantly superior to that of Indian slag when applied on equal phosphoric acid and calcium oxide basis.

German slag vs Indian slag (equal P_2O_5 and CaO)

Treatment	Mean Kg per plot	S. E.	C. D. (P=0.05)
German slag	8.87	0.29	0.59
Indian slag	8.25	—	—

Conclusion. German slag, Indian slag.

In the second crop, none of the treatment could cause a significant difference in yield of grain over control. So also there was no significant difference in yield between the control and the plots treated with the various phosphatic sources in increasing the yield of grain.

Discussion: In the first crop, application of phosphatic fertilizers at the rate of 30 lb phosphoric acid per acre did not increase the grain yield significantly over the control. The response of rice to phosphoric application is seen only in soils which are deficient in the phosphorus content. Soils rich in native phosphorus do not generally respond to the application of phosphatic fertilisers. Sethi (1940) had reported that the application of phosphorus singly and in combination did not give any response at Nagina. Ananthan and Srinivasan (1943) did not observe any additional benefits to rice by applying phosphoric acid along with nitrogen. Stewarts (1947) had reported that broadcast application of phosphatic fertiliser in rice had failed to show any response in yield. The fertiliser trials on paddy conducted from 1953 to 1956 under 'fertiliser use project' had shown that rice did not respond to the application of phosphorus in places like Karjat, Shaspur, Burdwan and Mankanda. Mariakulandai (1957) had reported that the yield response of paddy to 30 lb phosphoric acid was not significant at Aduthurai and at different levels at Coimbatore. Iyengar (1963) and Venkatesan (1964) have shown distinctly that the application of 30 lb phosphoric acid per acre did not increase the grain yield. The observation at present made is in agreement with the observations of the earlier workers.

The reason attributed to this at present is that the soil is very rich in available phosphorus having 84.35 lb available phosphoric acid per acre. This has masked the effects of all the phosphatic fertilisers.

(a) *Superphosphate vs basic slags* (equal P_2O_5 and CaO): A comparison was made between superphosphate and basic slags on equal phosphoric acid and calcium oxide basis. There was no significant difference between them. Since it has been found already that there was no significant difference between superphosphate and basic slags on equal phosphoric acid and calcium acid basis the present result showed that the calcium oxide content of basic slags did not contribute effectively in increasing the grain yield.

(b) *German slag vs Indian slag* (equal P_2O_5): It was found that there was no significant difference between them with grain yield on equal P_2O_5 basis. But there was a trend to show that German slag was better than Indian slag in increasing the yield of grain. The better performance of high-soluble slags compared to that of low-soluble slags have been recognised by Russel (1931).

(c) *German slag vs Indian slag* (equal phosphoric acid and calcium oxide): When a comparison was made between German basic slag and Indian basic slag on equal dose of phosphoric acid and calcium oxide the German basic slag was significantly superior to Indian basic slag. The reason is that the Indian slag supplies about 15 lb manganese oxide when it supplies

30 lb phosphoric acid. Early works done at the Agronomy Faculty at Coimbatore have shown that when manganese is supplied at the rate of 15 lb and above per acre it acts adversely on the yield of paddy by reducing the grain yield (Vamadevan, 1964). This may be one of the reasons for the poor performance of the Indian slag. On the other hand German slag supplies 36 lb iron oxide and 10 lb manganese oxide when it supplies 30 lb phosphoric acid which are very much lower to that supplied by the Indian slag. Moreover, the addition of extra calcium to the German basic slag to bring it on equal calcium oxide basis to Indian slag might have had more chances of phosphorus thus fixed by the calcium is only temporarily immobilised unlike the iron phosphate and is released with ease during the crop growth. This may be the probable reason for the superiority of the German slag supplemented with extra calcium oxide over the Indian slag to bring both on equal calcium oxide basis.

Second crop: The residual effect of different sources of phosphates were not significant in increasing the yield of grain. A comparison between German slag and Indian slag in their residual value treated on the basis of equal phosphoric acid in the previous crop showed no significant differences. However, there was a trend to show that the Indian slag to be better than the German slag.

The residual effects of German slag *vs* Indian slag (equal P_2O_5 and CaO) were not significant in grain yield. However, there was a trend to show that the Indian slag to be better than the German slag on equal dose of phosphoric acid and calcium oxide. The better performance of the Indian slag cannot be attributed to the better availability of phosphorus because the soil analysis data showed that the available phosphorus content was better in the plots treated with German basic slag. The better performance cannot be attributed to the calcium content also because the addition of calcium to the German slag did not improve the available phosphorus content over either the Indian basic slag or the German slag. The possible answer is the better micronutrient supply such as iron, manganese, magnesium and copper that the Indian slag has in greater amounts than the German slag which were in toxic amounts for the first crop but probably in the correct proportion on a residual basis for the second crop. This, however, needs confirmation by further studies.

In general, the crop response to the application of phosphorus was not significant because of the fact that the soil in which the experiment was conducted had moderately high content of available phosphorus (84.35 lb of available phosphoric acid per acre as analysed by Olsen's method).

Summary and Conclusions: A study was made to assess the relative merits of three different sources of phosphatic fertilizers namely superphosphate, high-soluble German basic slag (90.51% solubility) and low-soluble Indian basic slag (46.03% solubility) as direct fertiliser on paddy and their residual effect on the succeeding crop of paddy. The fertilisers were compared at the rate of 30 lb phosphoric acid per acre. They were also supplemented with lime to compare them on equal calcium oxide basis. The experiment was conducted at the Agricultural College and Research Institute, Coimbatore. The residual effects of the treatments were studied in the succeeding crop of paddy.

The following are the conclusions drawn from the above study.

Direct crop (first crop): (1) The application of any of the phosphatic forms of fertilisers at the rate of 30 lb phosphoric acid per acre did not significantly increase the yield of grain over control. (2) There was no significant difference in yield of grain between superphosphate and basic slags on equal phosphoric acid basis. However, there was a trend to show that superphosphate was better than Indian basic slag. (3) Calcium content of basic slags did not have significant influence on the yield of grain. (4) German basic slag when applied on equal phosphoric acid and calcium basia was significantly superior to the Indian basic slag.

Residual effect (second crop): (1) The residual effect caused by various treatments were not significant with regard to grain yield. (2) There was no significant difference between the basic slags and superphosphate in their residual action in increasing the grain yield. However, there was a trend to show that basic slags were superior to superphosphate in their residual effect. (3) There was no significant difference between the German slag and Indian slag on equal calcium oxide basis. However, there was a trend to show that the Indian slag was better than the German slag.

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Soil and Plant P & K Indices for Sugarcane in Thiru Arooran Sugar Farms

by

T. R. SUBRAMANIAN[1], T. P. MAHADEVAN[2] and T. V. OBLI[3]

Introduction: Soil tests are valuable guides for determining the available nutrient status of the soil so that fertilisation can be planned on a sound basis. But, as has been pointed out by Nelson *et al* (1953), no one method of determination of available P is satisfactory for all soils, varying in physico-chemical characteristics. Anon (1956) has emphasized the necessity of placing soils into different groups based on their $\frac{C.E.C.}{A.E.C.}$ ratios for satisfactory correlation of soil tests with crop responses having different values for soil tests for full availability or 100% yield in the different groups.

Studies on the sugarcane plant itself as in index for fertiliser practices are fairly well developed in other countries and particularly so in Hawaii. The relative merits of various methods of foliar diagnosis in sugarcane have been discussed by Samuels (1959). Very little work has been done on sugarcane in India on the use of plant tests for P and K for commercial fertiliser practices. There is thus need for study of comparative merits of soil and plant tests for P and K for the cane crop under the conditions prevailing in Tiru Arooran Sugar Farms, Vadapathimangalam in Thanjavur District.

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1. Agricultural Chemist, Central Coffee Res. Institute, Coffee Res. Station P. O., Mysore State.
2 and 3. Soil Testing Laboratory, Vadapathimangalam.