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Influence of Forms and Doses of Phosphorus on Content and Uptake of Phosphorus in Grain and Straw of Co. 7 *Ragi* *

by

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Introduction: Optimum fertilizer application to soil is one of the well-established methods for increasing crop production. But the requirements of nutrients differ considerably for different crops and for the same crop on different soil types.

Phosphorus influences plant growth and yield markedly. With the recent trends in producing high yields using nitrogenous fertilizers, crop removal of all nutrient elements, including phosphorus, increases considerably, and consequently the need arises for making substantial phosphorus applications. Phosphorus availability in individual soils by employing different phosphate carriers, was therefore investigated.

Review of Literature: Houghland *et al* (1942) observed that dicalcium phosphate was comparable to superphosphate in acid soils.

Williams (1948) visualised the major determinants of phosphorus uptake by plants as being (1) the demand set up by the growth and normal functioning of various plant parts and (2) the external concentration or supply of the nutrient. McAuliffe *et al* (1949) observed little difference between manure and superphosphate with regard to the availability of phosphorus. Glenn *et al.* (1950) found that citrate-soluble form of phosphorus did not increase plant growth or raise the available phosphorus level in calcareous soils. Olsen *et al* (1950) showed that dicalcium or tricalcium phosphates were poorer sources of phosphorus on calcareous soils. Mahapatra and Sahu (1961) suggested that response to the lighter phosphate applications was as good as to heavy ones.

Unnikrishnan (1961) observed that phosphorus content of grain and straw reflected the doses of the phosphorus applied; Valera (1962) showed increased phosphorus content by the application of superphosphate to soils normally high in available phosphorus. Indira Raja and Sree Ramulu (1963) observed increased uptake of phosphorus by increasing the dosage of the fertilizer. On equal phosphorus basis, Sree Ramulu and Mariakulandai

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(1964) found superphosphate to be more effective than farm yard manure. Indira Raja *et al.* (1965), compared four phosphatic fertilizers at three doses and found that the uptake of phosphorus was highest in the case of superphosphate and was commensurate with the dosage.

Materials and Methods: Three representative South Indian soils, namely, red and black soils from Coimbatore district and laterite soil from Nilgiris were used. Experiment was conducted in pot culture with two replications with the following treatments under each soil.

1. Control
2. 20 lb. P_2O_5 as superphosphate
3. 40 lb. P_2O_5 as superphosphate
4. 20 lb. P_2O_5 as dicalcium phosphate
5. 40 lb. P_2O_5 as dicalcium phosphate
6. 20 lb. P_2O_5 as Ammophos.
7. 40 lb. P_2O_5 as Ammophos.

A common basal dressing of 40 lb. N. as ammonium sulphate and 20 lb potassium as potassium chloride was given for all the treatments. *Ragi* (Co. 7) was used as the test crop. The grain and straw yield were recorded and analysed for phosphorus content and uptake of phosphorus calculated. Statistical significance of the results was assessed.

Results and Discussion: The grain and straw yield is given in Table 1. Soil types significantly differ from each other in influencing the phosphorus content of grain. Maximum phosphorus content was recorded in red soil. This was significantly superior to laterite and black soils, both of which were on par. The influence of other factors on the phosphorus content of the grain was not significant.

Regarding straw analysis, laterite soil brought about the maximum phosphorus content followed by black and red soils which were on par. Variation in phosphorus content due to other factors was not significant.

Regarding uptake of phosphorus by grain and straw, all the treatments recorded a higher uptake compared to control (Table 1). In red and laterite soils, the maximum uptake by grain was from ammonium phosphate treatments. Control showed the least uptake by grain and straw. This is in agreement with the observation that in both grain and straw phosphorus content reflected the doses of phosphorus applied (Unnikrishnan, 1961). In

black soil, the maximum uptake in grain was observed in ammonium phosphate treatment, at 40 lb. dose. Dicalcium phosphate followed next in order. Comparing the control and superphosphate at 20 lb. dose, control recorded more uptake. But the trend was reversed in 40 lb. dose, a finding parallel to that of Beaton and Read (1962) with mono-ammonium phosphate. The trend of uptake was similar in red soil. Here also the dose of phosphate reflected the uptake in both grain and straw.

TABLE 1. *Analysis of grain and straw and uptake of phosphorus*

Soil and treatment		Chemical analysis (per cent phosphorus as P_2O_5)		Uptake of phosphorus as P_2O_5 (mgm./pot)	
		Grain	Straw	Grain	Straw
Red soil —	Treatment 1	0·483	0·204	49	41
	Treatment 2	0·553	0·204	68	43
	Treatment 3	0·543	0·212	77	46
	Treatment 4	0·546	0·107	73	22
	Treatment 5	0·514	0·092	86	20
	Treatment 6	0·504	0·094	80	22
	Treatment 7	0·512	0·204	87	48
Black soil —	Treatment 1	0·300	0·207	53	43
	Treatment 2	0·310	0·207	48	44
	Treatment 3	0·315	0·200	58	50
	Treatment 4	0·300	0·125	51	29
	Treatment 5	0·390	0·138	86	32
	Treatment 6	0·349	0 069	62	16
	Treatment 7	0·400	0·204	88	51
Laterite soil —	Treatment 1	0·460	0·207	23	45
	Treatment 2	0·545	0·204	88	61
	Treatment 3	0·509	0·204	66	50
	Treatment 4	0·369	0·204	82	57
	Treatment 5	0·312	0·204	65	67
	Treatment 6	0·305	0·253	48	66
	Treatment 7	0·399	0·281	83	91

With regard to the laterite soil, the maximum uptake was from superphosphate 20 lb. P_2O_5 dose and dicalcium phosphate at the same dose. Rajagopal and Idnani (1963) observed the same trend in the case of Nanjanad laterite soil and obtained roughly twice the uptake from superphosphate treatments than from dicalcium phosphates.

Ammonium phosphate 40 lb. P_2O_5 dose recorded consistently higher uptake followed by superphosphate 40 lb. dose in the case of black and red soils. The trend of uptake was different in the case of laterite soil. Here

also the maximum uptake was from ammonium phosphate 40 lb. dose followed by dicalcium phosphate 40 lb. dose. The uptake from superphosphate was more from 20 lb. dose than from 40 lb. dose. These findings are in agreement with the findings of Olsen *et al.* (1950) who showed with fertilizers tagged with radio active phosphorus that water insoluble materials such as dicalcium or tricalcium phosphates were relatively poor sources of phosphorus than the more water soluble forms on calcareous soils.

In all the above cases only the control *versus* the rest of the treatments was statistically significant. All the other factors like carrier-form, doses, soils, treatments and their interactions were not significant (*vide* Table 2 and 3).

TABLE 2. *Analysis of variance for phosphorus content of grain and straw expressed as percentage P_2O_5 (Means in percentage)*

Source	D. F.	'F' value for grain	F value for straw
Soils	2	14·07*	5·88*

Comparison of soils (Grain):

Red	Black	Laterite	S. E.	C. D.
0·522	0·338	0·414	0·035	0·076

Conclusion : Red, Laterite, Black

Comparison of soils (Straw):

Red	Black	Laterite	S. E.	C. D.
0·160	0·164	0·222	0·021	0·046

Conclusion : Laterite, Black, Red.

TABLE 3. *Analysis of variance for uptake of phosphorus by grain and straw (Means in mgm. per pot)*

Source	D. F.	'F' value for grain	F value for straw
Soils	2	1·16	13·11**
Control vs. Rest	1	12·00**	...

TABLE 3. *(Contd.)*

Comparison of control vs. rest (Grain):

Control	Rest	S. E.	C. D.
41·48	72·05	8·83	19·24

Conclusion: Rest, Control.

Comparison of soils (straw):

Red	Black	Laterite	S. E.	C. D.
34·41	38·09	62·24	5·91	12·88

Conclusion: Laterite, Black, Red.

With regard to straw uptake, only the effect due to soil types was significant. Laterite soil was significantly superior to black and red soils which were on par.

Summary and Conclusion: Three major soil groups of South India namely, black, red and laterite soils were used in a pot culture with the three common phosphate and ammonium phosphate in two doses of 20 and 40 lb. P_2O_5 per acre. *Ragi* (Co. 7) was used as the test crop.

Grain and straw were analysed separately for phosphorus and uptake of phosphorus calculated.

Maximum phosphorus content, in the case of the grain was from the red soil. Laterite soil brought about the maximum phosphorus content in the case of the straw.

Regarding the uptake of phosphorus by grain there was no statistical difference between the various treatments. But all the treatments were significantly superior to the control.

In the case of straw uptake only the soil types were significant and the laterite soil recorded the maximum uptake followed by black and red soils.

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