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Progressive Changes in Phosphorus Availability at Different Stages of Paddy Growth

by

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Introduction: An attempt was made to study the influence of single, double and triple split applications of P on its availability during different stages of paddy growth in three representative paddy soils from Tamil Nadu, *viz.*, clay, loam and sandy loam, collected from Coimbatore, Sirugamani and Tirurkuppam, respectively.

Review of Literature: Bartholomew (1930) studied the changes in the availability of P in irrigated rice soils and concluded that the amounts of soluble calcium, iron and aluminium added annually in the irrigation water could cause a reversion of large amounts of soluble P. Ponnamperuma (1955) found that flooding increased the availability of phosphate due to the reduction of insoluble ferric phosphate to soluble ferrous phosphate. Raychaudhuri

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and Landey (1960) studied the effect of soil reaction on the availability of P and observed that in the case of alluvial saline soils of Punjab and alluvial sandy soils of Rajasthan, the availability of P increased with decreasing pH. Basak and Bhattacharya (1962) found that the availability of P in unmanured rice soils of West Bengal at planting time in 1960 was 44 lb/acre and represented 2.4% of the total P content. The available P content increased by 64% from planting to tillering, remained fairly constant from tillering to pre-flowering stage and decreased to its original content by post harvest time.

Materials and Methods: A pot culture experiment was conducted using the three above mentioned soils. P was applied at the rate of 45 lb P_2O_5/acre as single super phosphate. Green leaf manure in the form of *Gliricidia maculata* was applied at the rate of 5000 lb/acre as basal dressing for all the treatments. In the case of the first treatment (T1) all the P was applied as one single dose at the time of planting the seedlings. Double equal split applications, one at planting and the other 30 days afterwards were adopted in the second treatment (T2). In the case of the third treatment (T3) triple equal split applications were employed, the first at planting and the second and third 30 and 45 days after planting respectively. In all, 72 pots were used for the experiment (3 soils × 3 treatments × 4 times of sampling × 2 replications). CO 29 paddy seedlings were raised in the nursery and 25 day old seedlings were transplanted at the rate of ten seedlings per pot in 5 holes. In each treatment the soils were analysed at the 18th, 37th and 52nd days after planting and also at harvest for the content of available P. P was estimated by the methods of Bray and Olsen. Analysis of variance was worked out for the available P during different stages of paddy growth.

Results and Discussion: The results of analysis for available P by Bray and Olsen methods are given in Table 1 and 2, respectively. The analysis of variance for available P by Bray and Olsen methods are given in Table 3 and 4 respectively.

TABLE 1. *Available Phosphorus (Bray 1 method) during different Stages of Paddy growth*

(ppm P_2O_5, moisture from basis)

Time of sampling after transplantation	Coimbatore Soil			Sirugamani Soil			Tirurkuppam Soil		
	Single	Double	Triple	Single	Double	Triple	Single	Double	Triple
18th day	16	16	17	32	37	40	27	18	24
37th day	34	42	37	38	38	18	17	24	15
52nd day	59	27	27	29	28	27	13	12	15
Harvest	17	17	16	23	22	29	14	11	12

Coimbatore soil refers to clayey soil, Sirugamani soil refers to loamy and Tirurkuppam soil refer to sandyloam.

TABLE 2. *Available Phosphorus (Olsen's method) during different Stages of Paddy growth*

(ppm P_2O_5, moisture free basis)

Time of sampling after transplantation	Coimbatore Soil			Sirugamani Soil			Tirurkuppam Soil		
	Single	Double	Triple	Single	Double	Triple	Single	Double	Triple
18th day	180	162	211	139	150	167	140	133	147
37th day	174	169	169	165	159	156	172	174	171
52nd day	70	68	61	64	49	44	75	59	58
Harvest	79	79	73	50	55	60	67	62	46

TABLE 3. *Analysis of variance for Available Phosphorus (Bray's 1 method) during different Stages of Paddy growth*

(1) Means Table (ppm)

Soils	Mode of application			Means of soils
	Single	Double	Triple	
Coimbatore	31.0	25.1	24.1	26.7
Sirugamani	32.8	31.0	28.2	30.7
Tirurkuppam	17.3	16.0	16.3	16.5

	Soils	Mode of application	Soils × Mode of application
C.D.	1.6	1.6	2.7

Conclusion: (Soils) Sirugamani, Coimbatore, Tirurkuppam

„ (Mode of application) Single, Double, Triple

„ (Soils – Mode of application)

Soils	Mode of application		
Coimbatore	Single,	Double,	Triple
Sirugamani	Single,	Double,	Triple
Tirurkuppam	Single,	Triple,	Double

Mode of application	Soil		
Single	Sirugamani,	Coimbatore,	Tirurkuppam
Double	Sirugamani,	Coimbatore,	Tirurkuppam
Triple	Sirugamani,	Coimbatore,	Tirurkuppam

(2) Means Table (ppm)

Stages	Soils			Means of stages
	Coimbatore	Sirugamani	Tirurkuppam	
18th day	15.8	35.8	22.7	24.8
37th day	37.3	31.3	18.3	29.0
52nd day	37.5	31.0	13.0	27.2
Harvest	16.3	24.5	12.0	17.6

	Stages	Soils × Stages
C.D.	1.8	3.1

Conclusion: (Soils × Stages)

Soils	Stages			
Coimbatore	52nd day,	37th day	Harvest	18th day
Sirugamani	18th day,	37th day	52nd day,	Harvest
Tirurkuppam	18th day,	37th day	52nd day,	Harvest

Stages	Soils		
18th day	Sirugamani,	Tirurkuppam,	Coimbatore
37th day	Coimbatore,	Sirugamani,	Tirurkuppam
52nd day	Coimbatore,	Sirugamani,	Tirurkuppam
Harvest	Sirugamani,	Coimbatore,	Tirurkuppam

(3) Means Table (ppm)

Stages	Mode of application			C.D.
	Single	Double	Triple	
18th day	24.5	23.2	26.7	
37th day	29.3	34.5	23.2	3.1
52nd day	36.5	22.2	22.8	
Harvest	17.7	13.0	18.8	

Conclusion: (Stages - Mode of application)

Mode of application	Stages			
Single	52nd day,	37th day,	18th day,	Harvest
Double	37th day,	18th day,	52nd day,	Harvest
Triple	18th day,	37th day,	52nd day,	Harvest

Stages	Mode of application		
18th day	Triple,	Single,	Double
37th day	Double,	Single,	Triple
52nd day	Single,	Triple,	Double
Harvest	Triple,	Single,	Double

TABLE 4. *Analysis of variance for Available Phosphorus (Olsen's method) during different Stages of Paddy growth*

	Coimbatore	Sirugamani	Tirurkuppam	C.D.
Soil Means (ppm)	124.4	104.5	108.4	10.4
Conclusion	Coimbatore	Tirurkuppam	Sirugamani	

Stages Means (ppm)	18th day,	37th day,	52nd day,	Harvest	C.D.
	158.4	167.4	60.8	63.2	12.0
Conclusion	37th day,	18th day,	Harvest	52nd day	

Bray's 1 method recorded the maximum available P in loam and the least in sandy loam, with clayey soil coming in between. The reason for the low content of available P in clayey soils compared to loam might be that the former contained higher amounts of calcium carbonate than

the latter. Boischot *et al.* (1950) stated that the particles of calcium carbonate fixed phosphate from dilute solutions by adsorption. Broeshart *et al.* (1964) showed that flooding significantly increased the availability of soil phosphate in rice soils from which calcium carbonate was absent. These findings might explain the cause for the low content of available P in clayey soil.

Bray's method recorded the maximum amount of available P at the 18th day after planting in loam and sandy loam soils whereafter there was a progressive decline upto harvest. This was in agreement with the report of Basak and Battacharya (1962) who stated that the available P in rice soils showed about 64% increase from planting to tillering stage and gradually dropped after pre-flowering stage to its original level. The absorption of P by paddy was rather slow until the formation of flower primordia (Ishizuka 1964); this slow uptake of P in earlier stages might also be responsible for the high available P content at the 18th day after planting.

Due to high content of clay fixation of P would be expected to be more in the case of clayey soil compared to loamy soil, which contained only smaller amounts of clay. Conversely the availability of P would be more in loam than in clayey soil. The observations recorded in the present study were in accordance with these considerations. Even though the available P in sandy loam was less than that of clay soil, the uptake of P from the former was significantly greater than the latter. This has been reported by Wiersum (1961) also and could be due to the fact that clayey soil due to its impervious nature would induce sparse rooting, while in loam and sandy loam dense root growth would result. Understandably sparse rooting would diminish P uptake while dense rooting would cause higher absorption of P.

The pH of clayey and loamy soils was found to be about 8 and of sandy loam 7.6. Since there was no appreciable difference in pH in the three soils, observed difference in P availability could not be explained on the basis of pH.

Summary and Conclusions: The available P content was estimated during different stages of paddy growth in clay, loam and sandy loam soils collected from Coimbatore, Sirugamani and Thirurkuppam respectively. Three modes of P application were employed using a constant dose of 45 lb of P_2O_5/acre in all the cases. In the case of the first treatment all the P was applied at the time of planting. Double and triple equal split applications were employed in the second and third treatments, respectively. Bray's 1 method recorded the maximum amount of available P in Sirugamani loamy soil and least in Tirurkuppam sandy loam soil. The available P content was maximum when all the P was applied as one single dose at planting.

Olsen's method recorded more available P in Coimbatore clayey soil than the other two soil types. The mode of application made no difference in the available P content by this method.

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