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Influence of Modes of Fertilizer Application on the Uptake of Nitrogen, Phosphorus and Potassium by CO 29 Paddy during different Stages of Growth*

by

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Introduction: The rational application of fertilizers is one of the vital factors which control rice yield. The objective behind the rational application of fertilizers is to supply a reasonable amount of nutrients, synchronizing with the requirements of the crop at different stages of growth. The absence of information regarding the uptake of nutrients by rice has led to haphazard application of fertilizers regardless of the actual requirements of nutrients during different stages of growth. This has not only reduced the advantages of fertilizer application but sometimes depressed the yields also, when fertilizers were applied without taking into consideration the actual plant needs at different stages of growth. Hence, the present investigation was planned and carried out with a view to furnish information on this aspect.

Review of Literature: Tanaka *et al.* (1959) examined N uptake of *indica* varieties of different maturation periods and found two peaks in the rate of N uptake, one at the maximum tillering stage and the second at panicle development stage. Ishizuka and Tanaka (1951) observed that the absorption of N by rice plants supplied with a moderate amount of N (40 to 80 kg/ha) reached its maximum at flowering time; afterwards the absorption slowed down. On the other hand, absorption by the rice plant supplied with an excessive amount of N (160 kg) remained vigorous after flowering. Ishizuka (1960) observed that P was absorbed from the beginning of growth to earing stage, but after this stage absorption was slight or absent. He stressed the necessity of synchronizing the application of P with this period of maximum efficient of plant utilization.

Materials and Methods: A pot culture experiment was conducted using representative paddy soils of Tamil Nadu collected from three places *viz.*, the experimental fields of Paddy Breeding Station, Coimbatore, Sugarcane Research Station, Sirugamani and Rice Research Station, Tirurkuppam. N, P and K were applied at the rate of 60 lb, 45 lb and 30 lb / acre respectively as ammonium sulphate, single super phosphate and potassium sulphate. Besides fertilizers, green leaf manure in the form of *Gliricidia maculata*

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was supplied at the rate of 5000 lb/acre as basal dressing for all the treatments. Three different modes of fertilizer application were employed for all the three soils. In the case of the first treatment (T1) all the fertilizers were 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 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 days old seedlings were transplanted at the rate of ten seedlings per pot in 5 holes. In each treatment, the seedlings in one pot were pulled out completely when they were 18, 37 and 52 days old and also at harvest and analysed for the content of important nutrient elements. For analysis a composite plant sample consisting of all the parts were used. The Mechanical analysis of the soils revealed that the textures of Coimbatore, Sirugamani and Tirurkuppam soils were clay, loam and sandy loam, respectively. N was estimated by Kjeldahl method (AOAC, 1962). P was determined colorimetrically by vanadomolybdate method (Jackson, 1962) while K was estimated by using Perkin - Elmer Flame Photometer.

Analysis of variance was worked out for the uptake of N, P and K by paddy during different stages, *viz.*, 18th, 37th and 52nd days after transplanation and also at harvest. Simple correlations were also worked out to find the extent of relationship among the uptake values for different plant nutrients.

Results and Discussion : The uptake values for N, P and K are presented in Tables 1, 2, and 3 respectively. The relationships among the uptake values for N, P and K were calculated and are given in Table 4.

TABLE 1. *Uptake of N by paddy plant at different stages of growth*

(mg N/plant, moisture free basis)

Time of sampling after transplantation	Coimbatore soil			Sirugamani soil			Tirurkuppam soil		
	T1	T2	T3	T1	T2	T3	T1	T2	T3
18th day	13.7	8.8	7.5	18.0	12.5	11.8	16.0	9.8	8.5
37th day	19.7	14.8	11.7	22.0	16.7	16.2	20.4	15.0	13.0
52nd day	23.6	17.5	17.6	29.8	22.7	30.7	25.2	21.8	19.3
At harvest (grain and straw)	26.4	21.2	18.0	33.6	24.6	33.9	29.2	23.1	21.2

T1 Single application. T2 Double split application T3 Triple split application

TABLE 2. *Uptake of P by paddy plant at different stages of growth*

(mg P_2O_5/plant, moisture free basis)

Time of sampling after transplantation	Coimbatore soil			Sirugamani soil			Tirurkuppam soil		
	T1	T2	T3	T1	T2	T3	T1	T2	T3
18th day	2.9	2.3	1.8	4.1	3.2	3.1	3.4	2.7	2.1
37th day	9.7	8.1	6.4	13.4	9.8	9.5	10.3	7.9	7.0
52nd day	14.6	11.9	9.6	21.4	14.1	19.0	18.6	13.1	11.5
At harvest (grain and straw)	18 9	14.8	11.9	26.0	17.0	24.2	20.9	16.9	12.9

TABLE 3. *Uptake of P by paddy plant at different stages of growth*

(mg K_2O/plant, moisture free basis)

Time of sampling after transplantation	Coimbatore soil			Sirugamani soil			Tirurkuppam soil		
	T1	T2	T3	T1	T2	T3	T1	T2	T3
18th day	12.8	10.2	7.7	16.5	13.0	12.0	14.4	10.5	8.0
37th day	23.4	18.7	14.7	30.6	21.1	21.8	23.1	18.1	14.7
52nd day	26.5	20.8	17.9	36.7	24.1	31.0	30.0	23.6	19.7
At harvest (grain and straw)	31.5	23.9	21.2	42.2	27.5	35.9	33.7	27.6	21.8

TABLE 4. *Relationship among the uptake values for N, P and K*

Independent variable X	Dependent variable Y	Correlation co-efficient	Regression equation
Uptake of N	Uptake of P	0.958 ***	Y=0.92X+6.40
Uptake of N	Uptake of K	0.966 ***	Y=1.18X−0.08
Uptake of P	Uptake of K	0.971 ***	Y=1.23X+8.00

*** Significant at 0.1 % level

The uptake of N, P and K was highest in loam, followed by sandy loam, the least being recorded by clayey soil. This according to Wiersum (1961) was due to the dense root growth in loam and sandy loam compared to coarse rooting in clayey soil. It was seen from the graph (Fig. 1) that almost 90% of the total uptake of N took place up to 52nd day after planting, beyond which only 10% of the total uptake was recorded up to harvest stage. It was also observed that there was a tendency for flattening in the uptake pattern graph for N after 52nd day of planting, suggesting that split applications at later stages were not advantageous. The pattern of uptake

FIG. Uptake of Nitrogen by Paddy during different stages of growth

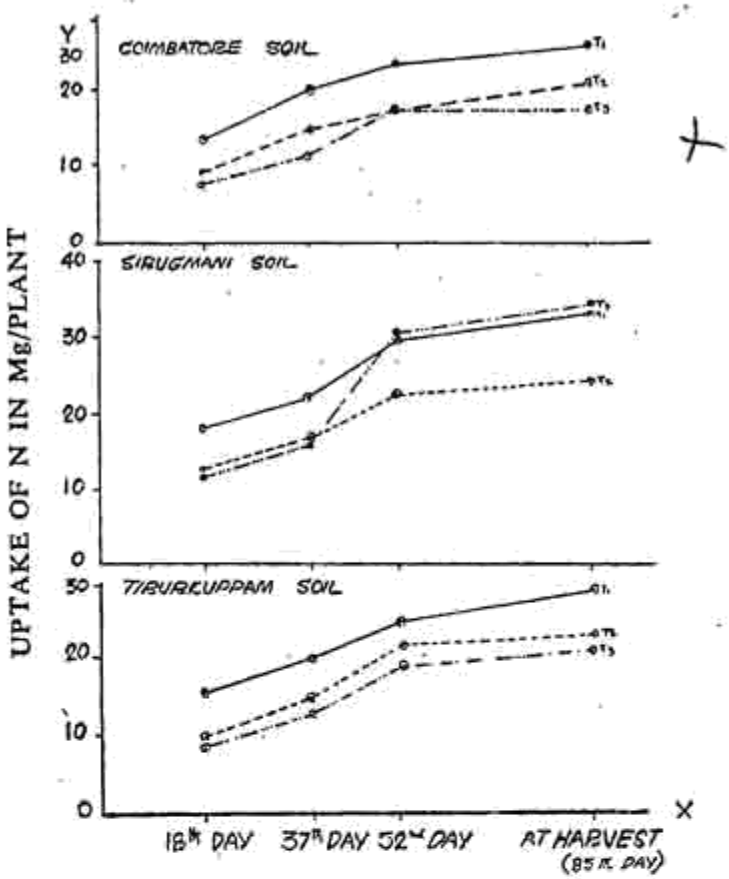


FIG. 2. Uptake of Phosphorus by Paddy during different stages of growth

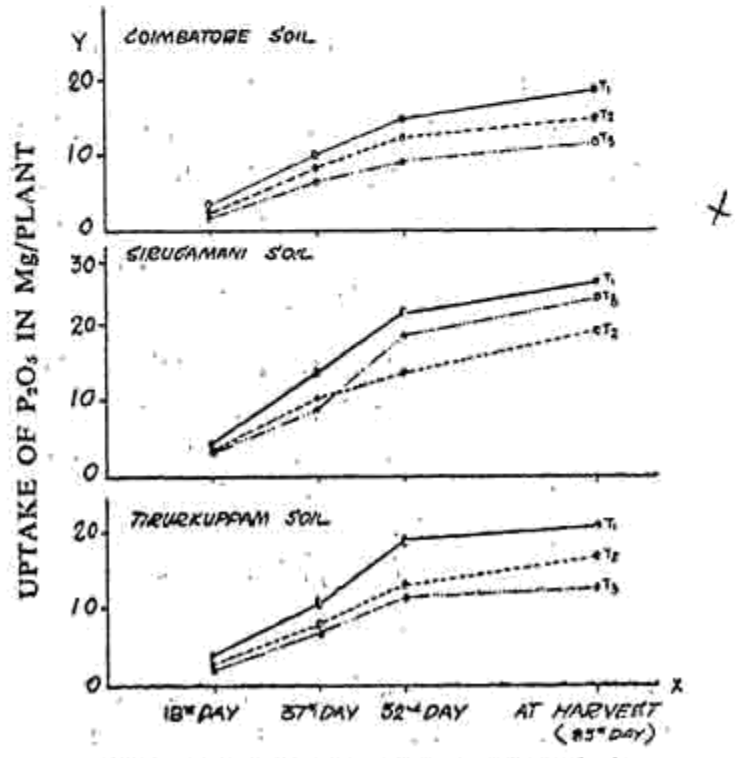
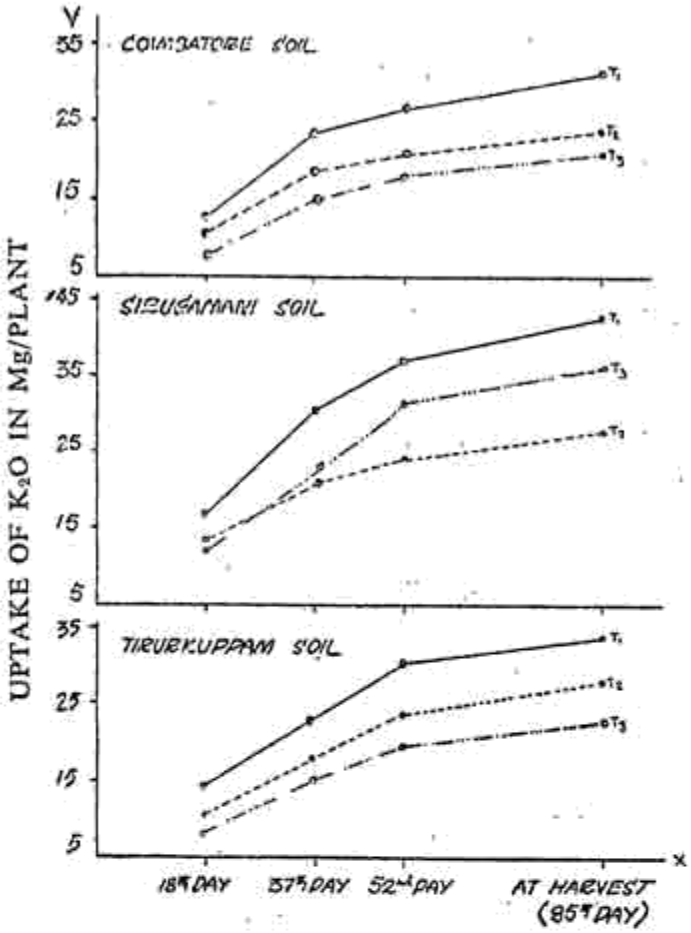


FIG. 3. Uptake of Potassium by Paddy during different stages of growth



of K (Fig. 3) was similar to that of N. Though the absorption of P (Fig. 2) was rather slow during earlier stages of growth, nearly 75% to 80% of the total P was absorbed up to 52nd day after planting, and thereafter there was a tendency for flattening in the uptake pattern graph, revealing the inefficacy of split application of P at later stages. This was in conformity with the findings of Reyes and Davide (1962) who stated that 93% of the total uptake of P occurred from transplanting to booting stage.

Single application seemed to increase the uptake of N, P and K over split applications at all the stages of growth, except in case of P where single application recorded a significant increase in uptake over split application only after the third week of planting, The differences in P uptake among the three modes of application were not apparent up to the third week, presumably because the absorption of P was rather slow until the formation of flower primordia (Ishizuka, 1964).

The uptake values for N, P and K increased progressively comparing successive stages of growth regardless of the mode of application. Double split application recorded greater uptake of N than the triple split application

up to the 6th week, and this trend was reversed in the subsequent stages. In case of P uptake, double and triple split applications recorded almost similar uptake values at all stages. Regarding the uptake of K double split application was superior to triple split application only up to the 5th week after planting.

The close relationships among the uptake values of N, P and K would make it possible to predict with reasonable accuracy the uptake of one nutrient from a knowledge of the other.

Summary and Conclusions: The influence of single, double and triple split applications of fertilizers on the uptake of N, P and K by CO 29 paddy during different stages of growth was investigated by conducting a pot culture experiment with three soil types, namely, clay, loam and sandy loam collected from Coimbatore, Sirugamani and Tirurkuppam respectively. Paddy plants were analysed on the 18th, 37th and 52nd day after planting and also at harvest to determine their contents of plant nutrients.

The uptake values for N, P and K were highest in Sirugamani loamy soil and least in Coimbatore clayey soil, with Tirukuppam sandy loam coming in between. Single application at planting seemed to increase the uptake of all the nutrients over double or triple split applications. Correlations worked out to determine the degree of relationship among the uptake values for the above nutrients indicated very close relationships among the uptake figures for these nutrients.

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