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Studies on the Nitrogen, Phosphorus and Potash Uptake by ADT-27 Rice

by

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Introduction: A knowledge of the pattern of uptake of essential nutrients by the rice plant at important stages of growth is needed for applying fertilisers judiciously to the crop especially in the context of economising fertiliser use. Such a regulated application of fertilisers will ensure maximum response in yield and quality of the produce.

Material and Methods: A pot culture trial with ADT-27 as test crop was laid out in July, 1966. Three treatments $N_0P_0K_0$, $N_1P_1K_1$ and $N_2P_2K_2$ were replicated 20 times. N_0, N_1 and N_2 represented 0, 45 and 60 lb N per acre applied in two equal doses, first at planting and the next at tillering as ammonium sulphate. P_0, P_1 and P_2; K_0, K_1 and K_2 represented 0, 30 and 45 lb P_2O_5 and K_2O per acre applied as basal dose in the form of superphosphate and muriate of potash respectively. The soil for the trial was collected from the Paddy Breeding Station, Coimbatore. The characteristics of the soil are given in Table 1. Plant samples were collected at eight stages for laboratory analysis. Yield of grain and straw was recorded at maturity. The yield obtained at harvest (8th stage) included only the aerial portions and were recorded separately as grain and straw. The percentage yield was calculated adopting the relationship,

$$\text{Percentage yield} = \frac{\text{Yield without added nutrients}}{\text{Maximum yield}} \times 100$$

N content in plant material was estimated by Kjeldahl method. P and K contents were estimated colorimetrically and flame photometrically respectively (Jackson, 1962). Yield of grain and straw, percentage N, P and K and their uptake at the various stages of observation were statistically analysed. The interrelationships among the uptake of N, P and K were studied by setting up regression equations.

Results and Discussion: 1. *Nitrogen:* The N percentage in the plant decreased with growth. It remained at a comparatively high level upto the tillering phase and declined thereafter steeply. The uptake of N was rapid to start with and the rise was marked during flowering phase (Table 2). The following distribution was worked out. Initial phase 10 per cent; Tillering phase 24 per cent; Flowering phase 40 per cent; Maturity phase 26 per cent. These results are in conformity with Matsushima (1961). The intensive N utilisation at tillering and flowering phase and the consequential need for adequate N supply at these stages, may be inferred.

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TABLE 1. *General Soil Characters*

Soil type 0–6"	Texture	pH	Percentage organic matter	Percentage total			lb / acre available		
				N	P_2O_5	K_2O	N	P	K
Black	Clayey	7.6	0.83	0.0728	0.058	1.02	126	12	224

Straw and Grain Yield in stages (g / pot)

Treatment	Stages								
	1	2	3	4	5	6	7	8	9
T_0	1.27	1.90	2.36	2.96	6.02	8.42	15.20	6.20*	6.12@
T_1	1.72	2.85	4.90	7.98	14.80	15.29	20.22	12.70*	10.50@
T_2	2.02	4.28	8.27	12.17	21.09	25.90	31.00	15.97*	13.75@

Conclusions : 1. Treatments T_2 T_1 T_0 S.E. = 1.26, C.D. = 3.82

2. Stages S_7 S_8 S_6 S_5 S_4 S_3 S_2 S_1 S.E. = 2.05, C.D. = 6.22

Nitrogen per cent in stages

Treatments : £ T_2 1.70, T_0 1.52, T_1 1.30 S.E. = 0.16, C.D. = 0.48

Stages : S_1 2.35, S_4 1.83, S_3 1.81, S_2 1.73, S_5 1.22, S_8 1.18, S_6 1.09, S_7 0.09 S.E. = 0.26, C.D. = 0.79

£ Not Significant * Straw @ Grain

TABLE 2. *Nitrogen uptake in stages (mg / pot)*

Treatments	T_2	T_1	T_0	S.E. = 14.38					
	219.17	136.36	73.50	C.D. = 43.61					
Stages	S_8	S_7	S_6	S_5	S_4	S_3	S_2	S_1	S.E. = 23.48
	254.91	197.30	182.55	162.01	149.11	105.49	56.35	37.85	C.D. = 71.22

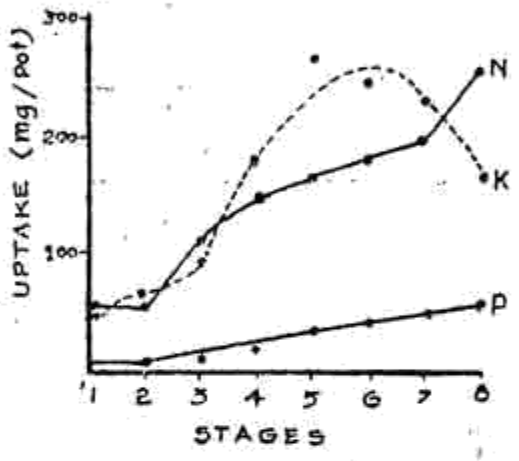
Phosphorus per cent in stages

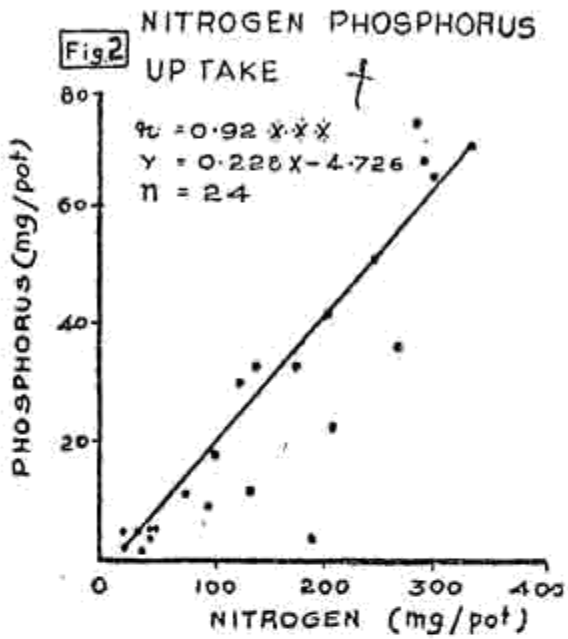
Treatments £	T_2	T_1	T_0	S.E. = 0.015					
	0.240	0.227	0.213	C.D. = 0.045					
Stages	S_8	S_7	S_6	S_5	S_4	S_3	S_2	S_1	S.E. = 0.024
	0.257	0.250	0.240	0.237	0.233	0.223	0.197	0.183	C.D. = 0.073

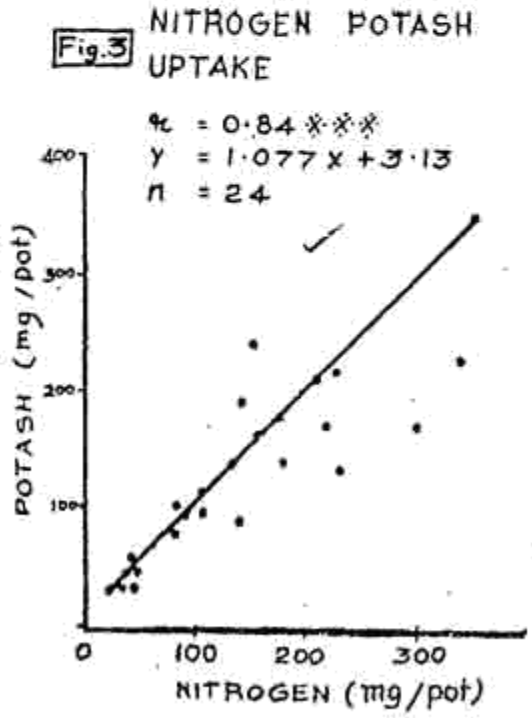
Phosphorus uptake in stages (mg / pot)

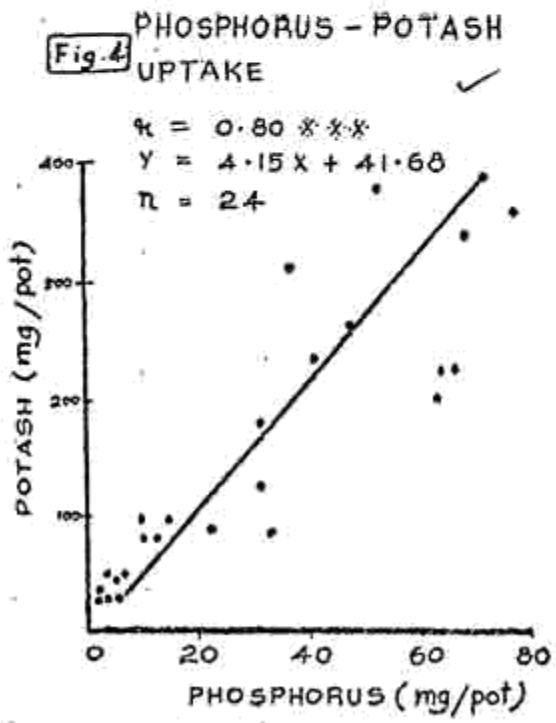
Treatments	T_2	T_1	T_0	S.E. = 3.82					
	40.20	29.11	14.3	C.D. = 11.59					
Stages	S_8	S_7	S_6	S_5	S_4	S_3	S_2	S_1	S.E. = 6.23
	55.43	51.76	41.52	34.61	17.54	12.28	6.05	3.04	C.D. = 18.90

2. *Phosphorus:* The variation in the P percentage at different stages failed to attain statistical significance. The P uptake pattern (Fig. 1) was quite similar to N but at a subdued level.









3. *Potassium:* A high K percentage was observed in the plant in the important growth phases, thereby indicating the magnitude of K requirements

TABLE 3. *Potash per cent in stages*

Treatments	T_2	T_1	T_0	S.E. = 0.082					
	1.83	1.46	1.42	C.D. = 0.25					
Stages	S_1	S_3	S_2	S_5	S_9	S_6	S_7	S_4	S.E. = 0.133
	2.19	2.15	1.88	1.77	1.61	1.36	1.00	0.73	C.D. = 0.40

Potash uptake in stages (mg/pot)

Treatments	T_2	T_1	T_0	S.E. = 22.83					
	261.87	140.70	69.59	C.D. = 69.24					
Stages	S_5	S_6	S_7	S_1	S_9	S_3	S_2	S_4	S.E. = 37.29
	260.13	241.29	227.72	180.96	162.06	91.68	58.70	36.55	C.D. = 113.10

at tillering and flowering phases (Table 3). The K uptake (Fig. 1) rose steadily and reached a maximum at flowering, remained steadily at that level till flowering was completed and declined thereafter towards maturity. These trends are in line with Reyes *et al.* (1962) who concluded that K uptake occurred throughout the growth phase.

4. *Treatments:* Among the treatments, $N_2P_2K_2$ was superior statistically to $N_1P_1K_1$ and $N_0P_0K_0$ in increasing the K percentage and the N and K uptake. P-uptake study revealed that $N_2P_2K_2$ and $N_1P_1K_1$ were on par, indicating that it is needless to apply over 30 lb P_2O_5 per acre. This observation is in line with that of Tanaka *et al* (1959) who showed that above a particular level (40 ppm), P has no significant influence in increasing either grain yield or P uptake.

5. *Nutrients inter-relationships:* Uptake of N was significantly correlated with uptake of P and K ($r = 0.92^{**}$ and 0.84^{**}) respectively (Fig. 2 and 3). P uptake was also significantly correlated with K uptake ($r = 0.80^{**}$, Fig. 4). Similar results were reported by Matsuki *et al* (1941) and Chandrashekaran (1967). These results indicate that K uptake is positively influenced by N uptake and similarly with P uptake.

6. *Yield:* The yield data revealed that $N_2P_2K_2$ (60 lb N, 45 lb P_2O_5 and 45 lb K_2O) was the best among the treatments tested to augment yield. This treatment increased the yield by 45 per cent over control. This result is in line with Eujiwara and Ohira (1951). They found that basal dressing of rice with ammonium sulphate followed by top dressing three weeks before heading, to be the best.

Summary and Conclusion: The progressive variation in the percentage content and uptake of nutrients, N, P and K by ADT-27 rice, were investigated in a pot culture trial in July, 1966. The objective was to fix the stages of maximum absorption of nutrients and their interactions. The study indicated: 1. Uptake of N increased with increased N application. 2. The nutrients per cent decreased with growth while their uptake increased. 3. Maximum utilization of N occurred during the tillering and flowering phases. 4. Utilisation of P did not improve when fertilisation above 30 lb P_2O_5 per acre was applied. 5. The uptake pattern for P closely followed N, but at a subdued level. 6. The percentage content and uptake of K, significantly increased with higher dose of K fertilisation. The maximum K uptake was observed at the flowering phase. 7. Yield increased significantly with increase in the dose of N and K. 8. The uptake of N and P, N and K and P and K were significantly correlated.

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REFERENCES

Chandrashekaran, M. 1967. Studies on the progressive uptake of principal plant nutrient elements by paddy under flooded conditions. M. So. (Ag.) Dis. Univ. of Madras (Uupubl.)

Eujiwara, A. and K. Ohira. 1951. Studies on the Nitrogen nutrition of rice plant. *Tohoku J. agric. Res* , 2: 141–52.

Jackson, M. L. 1962. *Soil Chemical Analysis*. Asia Publishing House, Madras.

Matsuki, G., S. Katsutani and R. Hotta. 1941. On the time of top dressing in rice cultivation. *J. Sci. Soil and Man. Japan* , 15 : 419–26. Quoted by Ishizuka, Y. Nitrogen requirements at different stages of growth. *The Mineral Nutrition of the Rice* 1964. *Plant, I.R.R.I* , John Hopkins Press, Baltimore, Maryland 165.

Reyes, E. D., J. G. Davide and L. Orara. 1962. Nitrogen, phosphorus and potassium uptake by a low land rice variety at different stages of growth. *Philipp. agric.*, 46 : 7–19.

Tanaka, A., S. Patnaik and C. T. Abichandani. 1959. Studies on the nutrition of rice plant. VII. Influence of increasing levels of Phosphate and Potash on growth, yield and nutrient uptake by rice plant. (*O. sativa* var. *indica*). *Proc. Indian Acad. Sci.*, 50 : 305–18.

STATE PRIZE WINNER IN THE SUGARCANE YIELD COMPETITION 1967—'68

Thiru V. M. Kailasam, S/o. Thiru Muthuswamy Gounder of Erode has won the State Prize in the Sugarcane Crop Yield Competition held in Tamil Nadu during 1967–68. He has produced an acre yield of 112 tonnes and 370 kg. Our congratulations to him.
