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CONTINUOUS CROPPING OF RICE-INFLUENCE OF TEMPERATURE ON UPTAKE OF N, P, K AND Zn IN RICE

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In a field experiment involving twelve monthly plantings of rice in a calendar year it was observed that the pattern of uptake of NPK and Zn was influenced by temperature prevailing at the growth stages Zinc content at tillering was higher in February planted crop which gave the highest grain yield. The correlation studies of uptake with grain yield pointed out that phosphorous and potash uptake was having positive relationship with available zinc in the soil at the tillering stage of the crop.

Nutrient absorption by crops is greatly influenced by temperature. Study on nutrient uptake as influenced by monthly planting for a year may be useful for proper management and nutrition of rice crop. In this experiment the effect of temperature on nutrient uptake by the effect of temperature on nutrient uptake by rice was investigated.

MATERIAL AND METHODS

In a field experiment twenty four monthly plantings with variety IR 8 were carried out at the Tamil Nadu Agricultural University at Coimbatore during the years 1971-72 and 1972-73. In this paper, the dry matter produced at different stages viz., 30th and 60th day after planting for eight months only* and at harvest for twelve months were computed to hectare basis for the second year of twelve months and expressed in kg/ha. The total N, P, K and Zn contents of the plant samples were analysed as per the procedures described by Yoshida *et al.* (1971). The effect of planting time and uptake of N, P, K and Zn are furnished in Table 1, 2 and 3 and correlation between grain yield and uptake of P and K with and without zinc in Table 5.

RESULTS AND DISCUSSION

N uptake at tillering: Uptake of N at tillering varied with planting months significantly. Planting in March, January and October resulted in higher N uptake than planting in other months. Low or uptake was seen in February planted crop.

N uptake at panicle initiation: The uptake of N was significantly influenced by planting time. Higher N uptake was seen in October planting followed by November and January plantings. Low N uptake was seen in August, December, February and March plantings.

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*This was done because the idea is to compare the behaviour of uptake in a low yield crop in October planting in the series August to November and high yield crop in February planting in the series December to March.

Uptake of N, P, K at maturity :

Nitrogen : Uptake of nitrogen was significantly higher in crop planted in the months of April and June (Table 3). Comparing the N uptake at different stages of growth of the crop planted in October and February, it was seen that major portion of N (56.53 per cent of the total uptake) was taken up after the panicle initiation in February planting and it was only 25.3 per cent of total uptake of N in October planting, the grain yields were 5916 and 2275 kg/ha respectively for February and October planting (Fig. 2 and Table 4).

In the case of crop giving high yield (February planting) the mean temperature that prevailed during the crop growth period gradually increased from 26.5 to 27.4°C from planting to tillering from 27.4 to 29.8°C from tillering to panicle initiation (touching a peak when temperature at panicle initiation) and from 29.8 to 29.5°C from panicle initiation to maturity in February planted crop. In the case of crop yielding low (October planting) the temperature trend was reverse i. e. from planting to tillering the mean temperature was 26.3 to 24.9°C from tillering to panicle initiation, it was 24.9 to 23.3°C from panicle initiation to maturity, it was from 23.3 to 24. 1°C. Thus the mean temperature at different stages of crop growth has greater impact on uptake and grain yield (Table 3).

As the mean temperature at different stages of crop growth affected the uptake of nutrients there is a reduction or increase in grain yield. Imbalanced nutrition to rice crop is seen in October planted crop i. e. with higher uptake of nitrogen at panicle initiation there is a possibility of reduction in carbohydrates reserve and consequent low yield and this is in agreement with views of Chaplin (1972).

Phosphorus uptake : The uptake of phosphorous was significantly higher in February planting resulting in higher grain yield (Table 3). P uptake was higher in plantings made between December and March and this was probably made possible by higher temperature at panicle initiation (25.4 to 30.1°C) and ripening stages (26.8 to 29.5°C). Allen and Englestead (1963) reported that P uptake was more closely related with soil temperature.

Potassium uptake : The highest uptake was seen in planting months of May, April and June. The uptake of K is also seems to be influenced by prevailing temperature and is similar to that of P and N uptake. The K uptake was in low ebb at October planting and it is interesting to note that the temperature at panicle initiation 23.3°C and at tillering 24.9°C.

Uptake of Zn at tillering stage: The plant content of Zn at tillering was the highest at February planting. Uptake of Zn is critical at this stage of crop as a major quantity is absorbed at this stage (Underwood, 1970). There was

positive relationship between Zn and P uptake at tillering. The P/Zn ratio of the plant is affected by temperature. The influence of temperature on P/Zn ratio at tillering was positive (r=0.709) and this is in agreement with findings of Place *et al.* (1971).

The uptake of N was highest in the planting month April to July whereas the uptake of P was higher in the planting months December to March and uptake of K was significantly higher in April to June planted crop. The uptake of all the three major nutrients were in moderately high level in the planting month February. The balanced uptake of major nutrients probably made possible by the liberal availability of micronutrient zinc in the soil and enriching the plant content of zinc (Table 2, 3) in the February planted crop. Khan (1973) also points out the importance of balanced nutrition in rice wh ch reduces sterility in rice and paves way for higher grain yield.

Correlation studies

Phosphorus and Potash relationship with zinc in rice nutrition

Uptake of nutrients N, P and K were correlated to grain yield. N uptake was not correlated to grain yield. Whereas P and K uptake was positively correlated to grain yield. This may probably due to high nitrogen content in the soil and as pointed by Matsuo (1952) there may not direct relationship between absorption of nitrogen and yield in a rich medium of N in soil.

Uptake of P and K with and without available Zn in soil at tillering stage of crop had varying influence on grain yield (Table 5). An uptake increase of 14 per cent and 27 percent respectively for P and K seems to be influenced by the presence of available zinc in the soil at tillering stage of the crop.

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Table 1 Uptake of nitrogen at tillering and panicle initation (kg/ha)

Planting months	30 days after planting (tillering)	60 days after planting (panicle initiation)
August	13.2	28.7
September	18.5	44.0
October	25.2	56.6
November	12.9	54.4
December	10.7	23.4
January	23.0	49.6
February	10.4	29.0
March	27.2	30.6
C. D. (P=0.05)	8.3	22.8

Table 2 Uptake of nutrients nitrogen, phosphorus and potash in kg/ha and Zn content of soil and Plant

Planting month	Mean uptake of nutrients (kg/ha)			Zinc content	
	N	P	K	Soil (availeble) Mean ppm	Plant Mean Mean ppm
April	149.6	16.14	119.4	0.50	25
May	107.6	15.39	128.4	0.50	24
June	134.1	15.63	118.3	0.71	40
July	110.6	12.96	81.5	0.64	30
August	114.1	15.42	61.5	0.70	49
September	95.3	15.81	44.5	0.56	42
October	75.8	13.62	30.9	0.20	25
November	72.0	13.17	46.1	0.20	25
December	55.6	16.95	68.8	0.28	50
January	76.7	20.94	83.3	0.70	49
February	90.9	25.68	99.7	0.84	66
March	67.0	25.65	94.1	0.35	25
C. D. (P=0.05)	25.00	3.00	14.95	0.407	15.1

Table 3 Mean temperature °C prevailed at different growth stages of rice crop (IR 8) in 12 planting months

Planting month	Planting	Stages of crop			
		Tillering	panicle Initiation	Flowering	Flowering to maturity
April 72	30.4	27.4	28.3	28.9	27.8
May	27 4	28.7	24.8	27.1	26.1
June	28.9	25.5	26.3	27·5	26.4
July	24.8	27.1	27.0	25.3	26.1
August	26.3	27.8	26.7	25.2	24.6
September	27.5	26.7	24.9	24.4	24.1
October	26.3	24.9	23.3	23.6	24.1
November	25.2	23.3	23.6	25.4	25.7
December	24.9	23.6	25.4	28.1	26.8
January 73	23.6	25.4	26.8	28.1	26.5
February	26.5	27.4	29.8	30.3	29.5
March	26.5	30.1	30.1	29.2	28.0

Table 4

Stages of crop	Percentages of uptake of N of total uptake of N at maturity at stages of crop growth		Temperature or availad at stage of crop growth	
	Planting months		Mean (Average of maximum—minimvm) in plantihg months	
	Februaty	October	February	October
i) 30 days after	11.54	33 21	26.4°C to 27.4°C	26.3°C to 24.9°C
ii 60 days after planting (plenicle initiation)	31.23	41.51	27.4°C to 29.8°C	24.9°C to 23.3°C
iii) Panicle initiation to Maturity	56.53	25.28	29.8°C to 29.5°C	23.3°C to 24.1°C

Table-5 Showing R^2 values and regression equation of grain yield and uptake of P and K with and without available zinc in soil (ppm)

Relationship	R^2 value	Regression equation
Grain yield (Y) to P uptake kg/ha (X)	0.3379	Y = 2030.9510 + 297.1530X*
Grain yield (Y) to K uptake kg/ha (X)	0.4565	Y = 5925 + 18.737**
Grain yield (Y) to Zn in soil ppm (X_1) P uptake (X_2) (kg/ha)	0.4770	Y = 1753.1044 + 1151.344X_1* 251.6561 X_2**
Grain yield (Y) to Zn available in soil in ppm (X_1) and K uptake (X_2)	0.7260	Y = 2270.8577 + 986.5935X*

** Significant at 1% level
* Significant at 5% level