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Effect of Phosphorus Fertilization on the Physiology of Rice

By

V. THANDAPANI [1] and J. SAKHARAM RAO [2]

ABSTRACT

The net assimilation rate of ADT. 27 rice at different growth stages was not influenced by phosphorus levels. The relative growth rate was more influenced by the lower levels of 30 and 45 kg P_2O_5/ha than the higher levels. The effect of P_2O_5 levels was more on the shoot/root ratio at tillering stage, and dry matter production was associated with phosphorus supply at all the stages studied. P_2O_5 at 45 kg/ha recorded the maximum 1000 grain weight.

INTRODUCTION

Phosphate nutrition is important next to nitrogen for the growth of higher plants, its role being realised much due to its involvement with economic attributes of the plant. Studies were therefore made on the influence of different levels of phosphorus on the growth correlations such as net assimilation rate (NAR), relative growth rate (RGR), shoot/root ratio, dry matter production and 1000 grain weight in ADT. 27 rice.

MATERIALS AND METHODS

The design adopted was randomised block design with four replications of six treatments viz., 0, 15, 30, 45, 60 and 75 kg P_2O_5/ha given as basal dressing. N and K were given at 60 and 45 kg/ha respectively along with 5000 kg of green leaf manure/ha. The NAR and RGR were recorded at three stages viz., 15 – 30, 30 – 45 and 45 – 60 DAT. The NAR was calculated as per the modified method of Williams (1946). The RGR was calculated by collecting the plant materials at 15, 30, 45, 60 and 75 DAT. At each time, dry weight of whole plant was recorded. The RGR was calculated by using the formula and expressed in mg/day:

$$RGR = \frac{(\log_e W_2 - \log_e W_1)}{T_2 - T_1}$$

where

W_1, W_2 = Dry weight of whole plant at T_1 and T_2 respectively.

T_1, T_2 = Time in days.

For estimating the S/R ratio, entire plants were pulled out at tillering, flowering and harvesting stages and the dry weight recorded. For dry matter production, the weight of four plants was taken into account in respect of each treatment and expressed in grams. The 1000 grain weight was arrived on dry weight basis.

RESULTS AND DISCUSSION

(i) **Net assimilation rate:** The maximum NAR was recorded at the

1. Instructor, Department of Agricultural Botany, Agricultural College and Research Institute, Madurai - 625 104

2. Associate Professor of Plant Physiology, Tamil Nadu Agricultural University, Coimbatore-641003.

second stage of 30-45 DAT of the crop and at 45 kg P_2O_5/ha (Table I). There was slight difference in NAR between 15-30 and 45-60 DAT. However, the highest level of phosphorus was not favourable. Thorne (1960) observed that NAR of barley leaves remained constant for four weeks and then declined. She also stated that generally phosphorus fertilization increased the NAR which was confirmed here in rice.

(ii) **Relative growth rate:** The RGR was increased by all the treatments in the first stage and the lowest P_2O_5 level gave the maximum values (Table I). The RGR in the second and third stages was naturally lower. The phosphorus levels enhanced the RGR as compared to the control in the first stage, the maximum value being recorded in the treatment 15 kg P_2O_5/ha and 45 kg P_2O_5/ha. Power *et al.* (1967) found that RGR was the greatest at early stage of development. During these early stages RGR was usually increased by high phosphorus fertilization.

(iii) **Shoot/root ratio:** The shoot/root ratio was increased in respect of each treatment from stage to stage. Both at tillering and flowering stages the treatment increased the shoot/root ratio which was directly proportional to the level of treatment (Table II). Medium level of 45 kg P_2O_5/ha was optimum at the harvesting stage. It is interesting to note that all levels of phosphorus increased the shoot/root ratio at all stages studied. Turner (quoted by Curtis and Clark, 1950) indicated that in wheat an increase in phosphorus level was likely to increase the shoot/root ratio.

(iv) **Dry matter production:** This showed an increasing trend from tillering to flowering stage. But the subsequent increase from flowering to harvesting stage was negligible. The maximum level of phosphorus of 75 kg P_2O_5/ha increased the highest dry matter content of plant at tillering, flowering and harvesting stages. Boatwright and Viets (1966) found that supply of phosphorus for the first five

TABLE I. Effect of P levels on NAR and RGR

P_2O_5 level kg/ha	Net Assimilation Rate — Days After Transplanting			Relative Growth Rate — Days After Transplanting		
	15-30	30-45	45-60	15-30	30-45	45-60
Control	0.08	0.16	0.09	52.5	25.2	20.7
15	0.09	0.21	0.08	69.4	22.4	23.5
30	0.08	0.18	0.11	62.4	25.8	26.5
45	0.08	0.23	0.10	67.0	25.3	22.6
60	0.09	0.15	0.20	54.4	20.5	22.8
75	0.08	0.19	0.10	59.6	17.6	20.8

TABLE II. Effect of P levels on S/R ratio, dry matter production and 1000 grain weight

P_2O_5 level kg/ha	Shoot / Root Ratio			Dry Matter content (g)			1000 grain weight (g)
	Tillering stage	Flowering stage	Harvesting stage	Tillering stage	Flowering stage	Harvesting stage	
Control	2.40	6.63	9.34	3.93	25.78	26.75	15.69
15	2.48	7.33	9.87	4.46	26.99	28.48	16.13
30	2.62	7.94	12.02	4.99	28.60	29.26	16.18
45	2.82	8.40	10.48	4.98	28.88	30.65	17.07
60	3.06	8.39	10.33	5.06	29.31	31.99	15.86
75	3.26	8.48	10.34	5.47	30.96	32.56	15.70

weeks was adequate to produce maximum dry matter and grain production of wheat.

(v) **1000 grain weight:** The phosphorus levels increased the 1000 grain weight (Table II). The maximum weight was recorded in samples which received 45 kg P_2O_5/ha when compared to other treatments. This result was supported by Ramakrishnan (1965) in rice. He stated that phosphorus application increased the 1000 grain weight of rice. Saric *et al.* (1969) observed that deficiency of individual element during vegetative period affected the grain weight, the effects being prominent in the case of nitrogen, phosphorus and calcium.

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