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Soil and Foliar Application of Phosphorus on Rice

K. P. VIJAYAN[1] and J. SAKHARAM RAO[2]

The effect of soil and foliar application of phosphorus at four levels, viz. 20, 40, 60 and 80 kg/ha on Co. 34 rice was studied. The NAR was more at vegetative and tillering stages with higher levels of phosphorus as foliar application. The RGR increased at early stages and thereafter decreased gradually. Medium levels of phosphorus had more influence on tiller production, number of grains per panicle and 1000 grain weight. Medium level of 60 kg/ha through soil and 40 kg/ha through foliage recorded high yields of grain and straw.

Studies on the comparison of the efficiency of soil and foliar application of phosphorus indicated that uptake and absorption of phosphorus is better through foliage than soil (Shrivastava, 1969; Yatazawa, 1954). Application of entire quantity of phosphorus through soil is often associated with its lower utilization whereas maximum absorption and utilization of phosphorus were observed when foliar application was restored to (Rajat, 1971; Okuda and Kawasaki, 1962). The present study was taken up with a view to elucidate certain physiological changes that are brought about by the foliar and soil application of phosphorus in rice variety Co. 34.

MATERIALS AND METHODS

The experiment was laid out in pot culture under glass house conditions. Green manure 5000 kg/ha, 60 kg of N and 20 kg of K_2O/ha, were given as basal dressing. The following treatments of P_2O_5 in the form of monocalcium phosphate were given as top dressing 25 days after transplanting:- 0 (Control), 20, 40, 60 and 80 (kg/ha). Foliar spray of aqueous solution of the above concentrations of phosphate was given at the rate of 50 ml/pot, after adding two drops of teepol to increase the efficacy of foliar spray. Foliar application was done on the same day as soil application.

The NAR, RGR and DMP were studied and economic characters such as number of productive and non-productive tillers, height of the shoot, length of root, shoot/root ratio, length of panicle at harvesting stage, total number of grains and weight of grains, number of spikelets per panicle, number of chaff per panicle and 1000 grain weight were studied on five plants in each treatment selected at random. Conventional methods were adopted for all the factors.

RESULTS AND DISCUSSION

The Net Assimilation Rate (NAR) was generally improved by phosphorus

1-2 : Department of Plant Physiology,
Tamil Nadu Agricultural University, Coimbatore.

levels, foliar application being better than soil application (Power *et al.* 1967). From the present work as well as early reports it was not possible to establish any direct relationship between phosphorus levels and the NAR, because that NAR depresed by phosphorus supply at higher levels of nitrogen and increased at lower nitrogen supply (Williams, 1946) but the data indicated that when nitrogen supply was optimum, moderate supply of phosphorus increased the NAR only upto maturity stage and gradually decreased in the later stage because the dry matter production between two stages was more upto maturity stages (Table I). The relative growth rate (RGR) was the highest at the early stages of growth and then decreased gradually as the crop matured. The observation lends support to the find-

TABLE I. Effect of monocalcium phosphate as soil and foliar application on Net Assimilation Rate (NAR) expressed as mg/sq. cm leaf area/ day and Relative Growth Rate (RGR) expressed as mg/sq. cm leaf area/day.

Mode of application	Treatment	30-45	45-60	60-75	75-90 days after transplanting
NAR					
Soil	Control	0.215	0.154	0.164	0.029
	T_1	0.224	0.181	0.216	0.042
	T_2	0.233	0.198	0.257	0.039
	T_3	0.204	0.221	0.234	0.053
	T_4	0.237	0.246	0.252	0.046
Foliar	Control	0.215	0.154	0.164	0.029
	T_1	0.262	0.219	0.243	0.031
	T_2	0.222	0.221	0.246	0.056
	T_3	0.203	0.247	0.158	0.045
	T_4	0.220	0.232	0.182	0.044
RGR					
Soil	Control	0.071	0.060	0.050	0.006
	T_1	0.76	0.061	0.053	0.008
	T_2	0.074	0.059	0.056	0.006
	T_3	0.076	0.063	0.051	0.010
	T_4	0.073	0.064	0.051	0.008
Foliar	Control	0.071	0.060	0.050	0.006
	T_1	0.082	0.059	0.052	0.006
	T_2	0.077	0.061	0.052	0.006
	T_3	0.069	0.070	0.044	0.009
	T_4	0.070	0.067	0.045	0.010

Effect of monocalcium phosphate as soil and foliar application on dry matter production (expressed grams per plant)

Mode of application	Treatment	30 days	45 days	60 days	75 days	90 days
				after transplanting		
Soil	Control	0.900	2.920	7.280	17.990	20.000
	T_1	1.050	3.329	8.340	18.490	23.970
	T_2	1.330	4.060	9.970	23.210	25.750
	T_3	1.350	4.220	10.890	23.450	29.040
	T_4	1.250	3.775	10.390	22.520	25.480
Foliar	Control	0.900	2.920	7.280	17.990	20.000
	T_1	1.240	4.269	10.390	22.800	25.050
	T_2	1.320	4.231	10.620	23.300	25.590
	T_3	1.210	3.607	10.390	19.790	22.870
	T_4	1.220	3.535	9.670	19.040	22.210

T_1=20; T_2=40; T_3=60; T_4=80 kg P_2O_5/ha.

ings of Dastur and Pirzada (1933) who recorded that phosphorus stimulates early growth, but how far the phosphorus levels were responsible for the increase in the RGR in each treatment was not clear, since the treated samples behaved differently (Table I). Drymatter production increased with the ageing of the crop and with phosphorus levels of 40 and 60 kg/ha through soil application and 20 and 40 kg/ha through foliage as reported by Khader *et al.* (1970), who showed that the application of labelled monocalcium phosphate on wheat increased the dry matter; the rate of increase gradually progressing from early stages of growth (Table I).

Though the present study indicated the beneficial effect of phosphorus in obtaining maximum number of productive tillers, there has been contradictory reports by previous worker (Ramakrishnan, 1965) (Table III).

Root length :

All treatments increased the root length at all stages of growth (Curtis and Clark, 1950) (Table II). The same trend was observed with regard to the shoot height recording higher values at optimum phosphorus supply. The same view was recorded by Tanka *et al.* (1960). Similarly shoot/root ratio was increased in respect of each treatment from stage to stage (Curtis and Clark, 1950) (Table II).

The increase in panicle length was proportionate to the supply of phosphorus except at the highest level (Table III). In contrary, Chavan *et al.* (1957) observed a decrease in panicle length with increasing levels of phosphorus. With regard to the total number of spikelets per panicle a linear increase was observed in all the treatments except at the higher levels of phosphorus

TABLE II. Effect of monocalcium phosphate as soil and foliar application on root length and shoot height expressed in cm.

Mode of application	Treatment	30 days	45 days	60 days (after transplanting)	75 days	90 days
Root length						
Soil	Control	50.0	16.9	29.8	33.0	35.8
	T_1	15.3	18.9	31.9	33.9	36.5
	T_2	16.0	19.7	33.5	35.9	36.7
	T_3	17.0	20.6	37.0	39.8	40.3
	T_4	16.3	19.0	31.0	36.3	36.8
Foliar	Control	15.0	16.9	29.8	33.0	35.8
	T_1	16.8	19.8	32.9	34.4	37.8
	T_2	17.8	20.7	34.3	35 0	37.3
	T_3	15.8	18.3	30.1	31.5	36.2
	T_4	15.5	17.5	30.0	33.0	36.0
Shoot height						
Soil	Control	48.7	62.9	65.9	76.0	76.6
	T_1	50.3	63.5	68.6	83.2	84.1
	T_2	51.7	63.7	74.1	85.1	85.9
	T_3	55.0	63.9	76.1	87.5	88.3
	T_4	51.3	63.4	69.3	78.1	78.9
Foliar	Control	48.7	62.9	65.9	76.0	76.6
	T_1	54.4	63.4	74.3	82.5	83.3
	T_2	56.8	64.2	75.2	83.5	84.3
	T_3	53.3	63.2	70.5	79.6	80.0
	T_4	50.3	63.1	67.2	78.8	78.9
Soil	Control	3.16	4.05	5.15	6.70	7.80
	T_1	3.20	4.30	5.20	6.90	8.40
	T_2	3.50	4.80	5.90	8.50	9.05
	T_3	3.50	5.10	6.05	8.25	9.50
	T_4	4.00	5.05	6.00	8.10	9.05
Foliar	Control	3.16	4.05	5.15	6.70	7.80
	T_1	3.76	5.85	5.85	8.50	8.50
	T_2	3.88	4.94	5.95	8.50	9.10
	T_3	4.12	4.75	5.80	7.85	8.50
	T_4	4.08	4.65	5.70	7.20	8.30

T_1=20; T_2=40; T_3=60; T_4=80 kg P_2O_5/ha.

which recorded lower value.

As regards the total number of whole grains and less number of chaffs per panicle, optimum level of 60 kg/ha

TABLE III. Effect of monocalcium phosphate as soil and foliar application on tiller numbers

Mode of application	Treatment	30 days	45 days	65 days	Harvesting stage	
					Productive tillers	Non-productive tillers
Soil	Control	7.1	10.1	10.2	7.1	3
	T_1	7.1	10.2	10.2*	7.2	2
	T_2	7.4	11.2	11.2***	8.2	1
	T_3	8.4	13.1	12.1***	8.1	1
	T_4	7.3	10.4	10.4	7.4	2
Foliar	Control	7.1	10.1	10.1	7.1	3
	T_1	7.2	10.5	10.5**	7.5	1
	T_2	7.2	11.1	11.1**	8.1	1
	T_3	7.2	11.3	11.3**	7.3	2
	T_4	7.1	11.2	11.2*	7.2	3

T_1=20; T_2=40; T_3=60; T_4=80 kg P_2O_5/ha
* indicate death of one tiller, **2 tillers, *** 3 tillers.

Effect of monocalcium phosphate as soil and foliar application on total number of grains, whole grains and chaffs per panicle.

Mode of application	Treatment	Panicle length in cm.	Total No.of grains/ panicle	Total No. of whole grains/ panicle	Total No.of chaffs/ Panicle
Soil	Control	15.9	75.7	65.2	10.5
	T_1	17.0	82.3	75.2	7.1
	T_2	17.5	83.2	76.2	7.0
	T_3	17.8	85.0	78.9	6.1
	T_4	16.9	82.0	74.0	8.0
Foliar	Control	15.9	75.7	65.2	10.5
	T_1	17.4	83.2	77.0	6.2
	T_2	17.6	84.8	78.8	6.0
	T_3	16.8	81.0	74.2	6.8
	T_4	16.1	80.3	73.1	7.2

Effect of mono-calcium phosphate as soil and foliar application on weight of grain and straw and 100 grain weight expressed in grams.

Mode of application	Treatment	Weight of grain/plant	1000 grain weight	Straw weight per plant
Soil	Control	9.900	19.05	19.500
	T_1	10.513	19.55	21.420
	T_2	12.282	19.90	23.230
	T_3	12.462	20.05	26.260
	T_4	10.465	19.45	22.950
Foliar	Control	9.900	19.05	19.500
	T_1	11.449	19.80	20.630
	T_2	12.245	20.15	23.050
	T_3	10.440	19.40	20.400
	T_4	10.065	19.21	20.012

T_1=20 T_2=40 T_3=60 T_4=80 kg P_2O_5/ha

(T_3) through soil and 40 kg/ha (T_2) through foliage recorded higher values.

Regarding 1000 grain weight, there was a very little influence between the modes of application. Soil application of 60 kg of P_2O_5/ha (T_3) and foliar application of 40 kg. P_2O_5/ha (T_2) recorded maximum yield of grain and straw. (Abdul Samad *et al.* 1956; Shrivastava 1969). Most reports of the earlier workers like Sethai *et al.* (1952) suggested that phosphorus is not much involved in the nutrition of rice crop. Most of these results have been obtained by these workers in low fertility strains of rice and other cereals, as against to high fertility strain (Co.34) used for this study which may account for the differences in results (Table III).

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