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Evaluation of methods of phosphorus fertilisation on the growth and yield components of rice varieties

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Abstract : An experiment was conducted during the samba season (August-December) of 1993 and 1994 with the objective of studying the effect of different methods of phosphorus fertilisation on the growth parameters and yield components of different rice varieties at the Agricultural College and Research Institute, Madurai. Among different methods of P fertilisation, application of recommended dose of phosphorus as enriched farm yard manure (EFYM) influenced the growth and yield attributes followed by the application of DAP to nursery at 2 kg cent^{-1} + one third of recommended dose of phosphorus to main field. Among the varieties tested, variety ADT 39 expressed remarkable superiority over other varieties (*viz.* MDU 2. Co 43, MDU 4 and IR 20) by increased growth parameters and yield attributes. The interaction between the method of P application and genotype was found to be significant. The selection of phosphorous efficient rice varieties like ADT 39 coupled with the application of the recommended dose of phosphorus as EFYM to the main field is found to be suitable for the single crop of rice. *(Key words: Main field, Phosphorus fertilisation, Rice varieties, Yield components)*

With the increasing energy crisis and escalation in the price of commercial fertilisers, the cost of fertiliser bill leads to the enhancement of the cost of inputs. Reducing the cost of inputs without sacrificing the yield of rice is certainly a boon to farmers. Identification of efficient rice varieties in the utilization of applied phosphorus is important. Another way to improve phosphorus use efficiency could be the integrated use of organic manures with inorganic fertilisers. Application of organic manure lowers the phosphorus fixation (Kolambe and Patel, 1994). Application of phosphorus to rice nursery influences rooting and promotes early root growth in the soil by increasing the nutrient uptake of seedlings. Numerous field trials indicate both added benefits and disadvantages of different methods of P fertilisation. But there is lack of information on the evaluation of efficiency of rice varieties in the utilization of phosphorus under diifferent methods of P application. Hence, the present investigation was carried out to evaluate the efficiency of different varieties in the utilization of phosphorus under different methods of application in wetland rice.

Materials and Methods

The field experiment was laid out during the samba season of 1993-94 and 1994-95 in a split-plot design, replicated thrice. The main plot treatments consisted of five varieties *viz.* ADT 39, MDU2, Co 43, MDU 4 and IR 20 and sub-plot treatments consisted of five methods of phosphorus application *viz.* no phosphorus application to nursery and main field (Control) (T1), DAP application to nursery only at the rate of 2 kg cent^{-1} (T2), one third of the recommended dose of phosphorus to main field only (T3), DAP application to nursery at the rate of 2 kg cent^{-1} + one third of the recommended dose of phosphorus to main field (T4) and recommended dose of phosphorus as enriched farm yard manure (EFYM) (T5).

The soil of the experimental site was sandy clay loam in texture with pH 7.40, low in available N (150 kg ha^{-1}) and medium in available P (13 kg ha^{-1}) and K (129 kg ha^{-1}). A preliminary screening test was conducted in petridish to know the phosphorus efficient rice varieties. The petridishes were filled with soil of known phosphorous content and eight medium duration rice varieties *viz.* ADT 39, MDU 2, Co 43, Ponni, White Ponni, MDU 4, ADT 38, and IR 20 were sown separately without any phosphorus application and then petridishes were watered daily with distilled water. After 25 days, the plants were taken and P content was estimated colorimetrically from triple acid extract (Yoshida *et al.* 1976). Among the varieties tested, five varieties *viz.* ADT 39, MDU 2, Co 43, MDU 4, and IR 20 were selected in the descending order of their phosphorus efficiency.

Five kg seed of each rice variety was treated with thiram at 2 g kg^{-1} of seed and then treated with azospirillam at 1 kg ha^{-1} and soaked in water for 24h. The seeds were incubated for 12h and then the sprouted seeds were sown in the nursery bed of one cent area for each variety under puddled condition. Fifty per cent (0.5 cent area) of the area allotted for each variety received a basal application of DAP at

: kg cent^{-1} and the remaining area of each variety received no DAP application. The recommended dose of fertilisers *viz.* 120 and 50 kg ha^{-1} N and K_2O respectively was applied. Nitrogen (120 kg ha^{-1}) was applied as urea in three equal splits (basal, at active tillering and panicle initiation stages) and potassium was applied basally in the form of muriate of potash. Farm yard manure was enriched with recommended dose of phosphorus (50 kg P_2O_5 ha^{-1}) and was applied basally as per the treatments. Phosphorus was applied in the form of single super phosphate and applied basally as per the treatmental schedule. Transplanting was taken up with 30 days old seedlings at a spacing of 15x10 cm at the rate of two seedlings per hill. Pre-emergence application of butachlor was done at 1.5 kg a.i. ha^{-1} three days after transplanting (DAT) followed by one manual weeding at 25 DAT. The crop was harvested at physiological maturity and grain yield was reported at 14 per cent moisture.

Results and Discussion

Growth Parameters

The variety ADT 39 recorded increased plant height, root weight, more number of tillers m^{-2}, higher LAI and increased drymatter production over other varieties, while the variety IR 20 recorded the least (Table 1a and b). The next best variety was MDU 2 which also recorded increased growth parameters. The increased growth parameters achieved in ADT 39 might be due to the genetic make up of the variety, and its better efficiency in the absorption and utilization of phosphorous. Application of recommended dose of phosphorus as EFYM was found to be superior to the other methods of phosphorus application in enhancing the growth parameters of the crop. This might be due to the easy and quick release of phosphorus from the soil complex and the least fixation of the applied phosphorus, make more availability of required phosphorus for rice plant (Premkumar *et al.* 1986). The next best was application of DAP to nursery at 2 kg cent^{-1} + one third of the recommended dose of phosphorus to the main field. The combined application of DAP to nursery and phosphorus to main field might have resulted in better initial vigour and establishment of seedings in nursery as well as in main field thereby resulting in higher growth parameter (Rajendran, 1991). The interaction effect between the varieties and methods of phosphorus application was significant. The increased growth parameters in ADT 39 with the application of recommended dose of phosphorus as EFYM might be due to the synergistic effect of the genetic potential of that variety and better availability of phosphorus.

Yield attributes and yield

The variety ADT 39 was superior to other varieties in the production of number of panicles m^{-2}, panicle length, total number of grains per panicle, and had less percentage of sterile grains (Table 2). This might be due to the better utilization of phosphorus and nitorgen by that variety which resulted in increased production of tillers m^{-2}. The increased thousand grain weight and panicle weight recorded in varieties MDU 4 and IR 20, might be due to their bold grain character. Among the different methods, application of the recommended dose of phosphorus as EFYM was found to be superior to other methods in the production of number of panicle m^{-2}, panicle length, panicle weight, thousand grain weight and total number of grains panicle^{-1} (Table 2). This might be attributed to the efficient utilization of available nutrients in the soil with the addition of phosphorus as EFYM (Laskar and De, 1990; Rana and Sharma, 1993). The next best was application of DAP to nursery at 2 kg cent^{-1}+ one third of the recommended dose of phosphorus in the main field. This might be due to increased nitrogen and phosphorus availability in nursery and main field, which in turn resulted in higher uptake of nitrogen and phosphorus by rice plant for better growth and development (Table 2). This was supported by the findings of Reddy and Mittra (1985).

The increased grain and straw yield of ADT 39 (Table 2) might be due to its efficient utilization of native as well as applied phosphorus than other varieties. This was in agreement with the findings of Tandon and Kanwar (1984) who showed that the efficiency of any cultivar in the absorption of applied phosphorus was proportional to the yields produced. The variety IR 20 recorded the less grain and straw yield which might be due to the lower uptake of N, P and K during active tillering, flowering and harvest stages compared to other varieties. Highest grain and straw yield was obtained with the application of recommended dose of phosphorus as EFYM might be due to the improved release of native soil phosphorus by enhancing favourable biochemical changes obtained in the soil with the addition of FYM as EFYM and also due to the least fixation of the applied phosphorus to meet the phosphorus requirements of the rice crop at different growth stages. Hence all the growth and yield parameters as well as yield were increased in the above mentioned method of phosphorus application compared to other treatments (Tripathi and Minhas, 1991). However, the harvest index (HI) values are very low in all treatments which might be due to high dry matter production accounted from more number of unprodutive tillers. In other words, the larger the DMP, the more the HI decreases and the less will be the grain yield

Table 1(a). Influence of varieties and different methods of P application on growth characters of single crop wet land rice

Varieties/ Treatments	Plant height (cm)						Root weight (g. per 10 plants)					
	1993-94			1994-95			1993-94			1994-95		
	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT
ADT 39	57.6	92.5	115.4	60.1	95.2	118.3	4.7	5.9	7.1	5.7	6.9	8.1
MDU 2	54.8	90.3	113.1	57.5	93.1	117.1	4.3	5.6	6.6	5.4	6.6	7.6
Co 43	53.2	88.3	111.2	55.3	91.2	114.7	4.1	5.3	6.3	5.2	6.3	7.3
MDU 4	50.9	86.3	109.2	53.2	89.2	112.9	3.9	5.0	5.7	5.0	6.0	6.8
IR 20	48.4	82.4	106.9	50.9	84.8	109.3	3.7	4.7	5.5	4.8	5.6	6.5
Treatments												
T_1 No P application to nursery and mainfield (control)	44.3	76.1	92.5	46.7	78.9	95.9	3.2	3.9	4.7	4.2	4.9	5.7
T_2 DAP application to nursery @ 2 kg cent^{-1}	53.4	89.6	114.5	55.9	92.4	117.6	4.4	5.7	6.3	5.3	6.7	7.4
T_3 1/3 of recommended dose of phosphorus to main field	50.5	87.6	112.9	52.9	90.3	114.8	3.9	5.1	5.7	5.0	6.1	6.7
T_4 DAP application to nursery @ 2 kg cent^{-1} + 1/3 of recommended dose of P to main field	57.2	92.3	116.5	59.3	95.3	120.1	4.6	5.8	6.9	5.6	6.8	7.9
T_5 Recommended dose of P as Enriched FYM to main field	59.6	94.1	119.4	62.0	96.9	123.9	4.8	6.0	7.3	6.0	6.9	8.3
CD (P=0.05)												
V	1.08	1.35	1.22	1.02	1.45	0.98	0.07	0.10	0.11	0.07	0.11	0.09
T	0.78	0.58	0.42	0.90	0.90	0.95	0.06	0.06	0.08	0.08	0.04	0.08
V at T	1.90	1.72	1.46	2.05	2.28	2.15	0.14	0.17	0.19	0.16	0.14	0.16
T at V	1.75	1.30	0.94	2.00	2.02	2.16	0.16	0.15	0.18	0.14	0.13	0.18

Table 1(b). Influence of varieties and different methods of P application on growth characters of single crop wet land rice

Varieties / Treatments	No.of tillers m^{-2}						Leaf are index		Dry matter production (kg ha^{-1})					
	Days after Transplanting													
	1993-94			1994-95			1993-94	1994-95	1993-94			1994-95		
	30	60	90	30	60	90	60	60	30	60	90	30	60	90
ADT 39	488	535	575	493	552	586	5.8	6.1	3572	8887	12321	3861	9187	12704
MDU 2	461	501	551	466	505	556	4.9	5.8	3412	8614	11755	3744	8921	12038
Co 43	431	475	525	435	480	530	4.6	5.6	3216	8375	11278	3494	8675	11339
MDU 4	401	444	95	405	449	500	4.6	5.4	3011	8102	10529	3397	8398	11094
IR 20	374	421	469	379	426	474	4.4	5.2	2826	7664	10306	3150	7964	10572
Treatments														
T_1 No P application to nursery and main field (control)	342	403	469	347	408	480	4.4	4.7	2477	6718	8818	2782	7018	9151
T_2 DAP application to nursery @ 2 kg $cent^{-1}$	436	463	499	441	468	504	5.3	5.6	3345	8771	11465	3645	9071	11986
T_3 1/3 of recommended dose of phosphorus to main field	394	439	473	399	456	478	4.9	5.2	3132	7977	10889	3487	8280	11522
T_4 DAP application to nursery @ 2 kg $cent^{-1}$ + 1/3 of recommended dose of P to main field	477	525	576	482	530	581	5.9	6.2	3465	8973	12264	3785	9273	12212
T_5 Recommended dose of P as Enriched FYM to main field	504	546	599	509	551	604	6.2	6.5	3619	9203	12754	3917	9503	12876
CD (P=0.05)														
V	3.7	7.4	7.2	3.7	7.4	7.3	0.16	0.14	95.1	110.7	137.7	83.7	112.8	91.5
T	4.9	4.9	6.6	4.9	6.9	6.6	0.18	0.20	48.9	61.9	89.9	57.2	61.0	224.8
V at T	10.6	11.2	15.0	10.5	15.0	14.5	0.38	0.41	118.9	165.8	226.1	141.5	165.7	531.4
T at V	11.1	12.2	14.7	11.1	15.3	14.7	0.30	0.32	80.6	138.6	201.1	128.1	136.6	502.7

Table 2. Influence of varieties and different methods of P application on yield attributes and yield of single crop wet land rice.

Varieties / Treatments	No.of panicles m^{-2}		Panicle length (cm)		Panicle weight (g)		Thousand grain wt (g)		Total No. of grains $panicle^{-1}$		Sterility percentage		Grain yield (kg ha^{-1})	
	93-94	94-95	93-94	94-95	93-94	94-95	93-94	94-95	93-94	94-95	93-94	94-95	93-94	94-95
ADT 39	434	441	20.6	20.6	2.00	2.25	17.68	20.44	134.6	137.2	19.2	16.3	5400	5667
MDU 2	406	413	19.9	20.2	2.26	2.51	18.54	20.79	129.0	129.6	22.1	18.5	5081	5369
Co 43	390	394	18.2	18.5	2.44	2.68	20.70	21.12	124.8	126.4	24.1	20.8	4716	4987
MDU 4	363	369	17.5	17.8	2.80	3.05	23.96	21.91	121.4	122.4	26.1	22.7	4429	4843
IR 20	342	352	16.8	17.1	2.62	2.85	22.02	21.44	116.2	122.6	27.8	24.4	4204	4683
Treatments														
T_1 No P application to nursery and main field (control)	340	311	17.2	17.5	1.92	2.17	17.90	18.69	115.0	118.6	29.4	25.7	3623	3991
T_2 DAP application to nursery @ 2 kg $cent^{-1}$	359	374	18.6	18.9	2.23	2.50	20.42	21.55	128.2	128.4	23.4	20.5	1932	5277
T_3 1/3 of recommended dose of phosphorus to main field	357	368	17.8	17.9	2.12	2.35	19.24	20.69	122.4	122.2	25.9	22.7	4679	5133
T_4 DAP application to nursery @ 2 kg $cent^{-1}$ + 1/3 of recommended dose of P to main field	420	441	19.3	19.6	2.85	3.10	22.12	22.32	128.2	130.8	22.6	18.5	5232	5423
T_5 Recommended dose of P as Enriched FYM to main field	458	476	20.1	20.4	3.00	3.25	23.22	22.80	132.2	134.0	18.6	15.3	5366	5725
CD (P=0.05)														
V	6.9	8.4	0.57	0.39	0.09	0.09	0.74	0.28	2.9	2.9	1.8	1.8	128	143
T	18.9	18.6	0.56	0.23	0.06	0.06	0.26	0.38	3.0	2.9	0.9	0.6	57	113
V at T	38.3	22.6	0.65	0.58	0.15	0.20	0.88	0.83	5.3	4.4	1.6	1.7	170	266
T at V	42.3	28.6	0.68	0.51	0.13	0.14	0.59	0.86	5.4	4.0	1.8	1.4	126	250

Cassman, 1994). Interaction effect between the varieties and P application was found to be significant.

The study conclusively proved that selection of phosphorus efficient rice varieties like ADT 39 coupled with best method of P application i.e., recommended dose of phosphorus as enriched farm yard manure increases the yields of rice. The superiority of ADT 39 over other varieties and P application as enriched farm yard manure was maintained throughout the crop growth period in all aspects. The combined use of organic manures with P fertiliser instigates the release of available P by reducing fixation. This increases the P uptake resulting in higher yields. In addition to this the application of phosphorus to both nursery and main field produces higher yields due to increased nitrogen and phosphorus availability in nursery and main field which in turn resulted in higher uptake of N and P. All methods of P application performed better than control. On the other hand the variety IR 20 recorded least in all growth parameters, yield attributes and yield.

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Mulberry leaf maturity as a stress factor in rearing of CSR hybrid silk worms and its impact on cocoon characters and incidence of diseases

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Abstract : The rearing of newly evolved productive bivoltine hybrid (CSR 2 x CSR 5) was conducted with different leaf maturity (50, 65, 80, 90 days after pruning) during fifth instar. The rearing performance and the incidence of diseases were studied under optimum rearing conditions as well as in the presence of 1% infextious source of flacherie and grasserie. The results revealed that the cocoon characters were significantly improved, diseases incidence and spread of diseases were minimised in leaf fed wtih 65 days matured leaf. (*Key words : Cocoon characters, Disease incidence,Disease spread, Flacherie, Grasserie, Leaf maturity.*)