Agric. Res. J. Kerala 1988, 26 (1) 143—148

EFFECT OF MOISTURE REGIMES AND PHOSPHATIC FERTILIZER APPLICATION ON THE GROWTH AND YIELD OF WINTER RICE

With the introduction of photoperiod insensitive varieties of rice, it has become possible to grow this crop throughout the year but this has got some limitations in terms of their thermosensitivity. Therefore, one of the main problem to grow rice during winter months in the sub-tropical climate is the cold weather damage to the crop. • However, because of the diffference in water temperature from that of air, it is possible to protect the crop against high or low temperature during the critical periods of growth by maintaining a layer of standing water. Phosphorus is an important component of fertilizer particularly for *boro* rice. Uptake of nutrients particularly uptake of phosphate is severely affected due to cool temperature (Bhattacharyya and Chatterjee, 1978). Hence an experiment was conducted to study the performance of rice planted in November and December with three moisture regimes and three levels of phosphate.

A field experiment was conducted in 1981-82 at 'C' Block Farm of BCKV, Kalyani. The soil was clay loam; organic carbon percentage of 0.67; total N content 0.065%, CEC 14.02 me/100g soil; available P content 19 kg/ha and available K content 145 kg/ha. Plot size was 5 m x 3 m. Two dates of planting (18 November and 17 December) were distributed in the main plots, three moisture regimes i. e., continuous submergence, phasic submergence (intermittent irrigation upto maximum tillering stage) and intermittent irrigation were randomly distributed in the subplots and three doses of phosphorus (0, 60 and 120 kg P_2O_5/ha) were randomly placed in sub-sub plots. There were 18 treatment combinations with three replications which were studied in a splitplot design. The plots received uniformly a dose of 60kg N and 50 kg K_2O/ha as basal dressing in the form of urea and muriate of potash. Another 60 kg N/ha was top dressed in two equal splits at active tillering and panicle initiation stage. Phosphorus was applied as basal in the form of single super phosphate. Variety used was Kalinga 1 with 20 x 10 cm spacing. Soil temperatures were recorded at weekly interval at 13.00 h throughout the growing period by using soil thermometers inserted at 5 cm depth. Tiller counting was made at 20, 40 and 60 days after planting. Plants from 8 m^2 area were harvested at ground level and grain yields were calculated at 14% moisture basis. Number of matured panicles were counted from 50 hills (1 m^2 area); number of filled grains/ panicle was counted from 20 randomly selected panicles. The optimum dose of phosphorus for higher yield of grain was estimated through response curve ($y=a+bx+cx^2$).

The number of tillers/m^2 at 20, 40 and 60 days after planting did not differ significantly due to the application of phosphatic fertilizer. But there was significant difference in the number of tillers/m^2 at 20 and 40 but not at 60 days after planting due to three moisture regimes (Table 1). November planted crop significantly recorded higher number of tillers/m^2 at 20 and 60 days after planting than the

December planted crop. Phosphatic fertilizer application significantly increased LAI at panicle initiation and at flowering compared to control. Similarly, continuous submergence recorded significantly higher LAI at panicle initiation and at flowering, than phasic submergence and intermittent irrigation. December planted crop recorded higher LAI at flowering and at maturity than November planted crop (Table-1).

Grain yield was appreciably and significantly increased by the application of phosphate (Table 2). Highest grain yield (4354 kg/ha) with respect to P_2O_5 application was recorded in plots where the crop was fertilized with 120 kg P_2O_5/ha. Comparison of moisture regimes showed that maximum grain yield (4797 kg/ha) was

Table 1

Effect of phosphate levels, moisture regimes and dates of planting on some growth attributes of Kalinga 1

Treatments	Number of tillers/m²			Leaf area indices at			
Dose of P_2O_5 (kg/ha)	20 DAT	40 DAT	60 DAT	PI	Flowering	15 DAF	maturity
0	146	510	673	2.40	2.88	2.58	0.61
60	147	536	689	2.80	3.23	2.87	0.39
120	157	512	693	2.73	3.22	2.65	0.38
SEm(±)	6.5	7.8	35.0	0.07	0.09	0.10	0.02
CD (0.05)	NS	NS	NS	0.22	0.26	NS	0.06
Moisture regimes							
Continuous submergence	163	519	689	3.09	3.56	2.95	0.53
Phasic submergence	134	545	692	2.52	2.81	2.94	0.53
Intermittent irrigation	136	537	674	2.31	2.95	2.21	0.32
SEm (±)	5.7	4.2	12.4	0.09	0.09	0.07	0.02
CD (0.05)	18.5	13.7	NS	0.30	0.29	0.24	0.05
Dates of planting							
November	158	506	751	2.34	2.30	2.75	0.22
December	142	532	619	2.94	3.92	2.64	0.70
SEm (±)	0.7	4.4	0.8	1.12	0.06	0.10	0.02
CD (0.05)	4.2	NS	4.8	NS	0.36	NS	0.15

DAT = days after transplanting, PI = Panicle initiation DAF = days after flowering

Table 2

Effect of phosphate levels, moisture regimes and dates of planting on yield and yield components of Kalinga 1

Treatments Dose of P_2O_5 (kg/ha)	Grain yield (kg/ha)	Harvest index	No. of matured panicles m^2	No. of filled grains/ panicle	Test weight of grains (g)
0	3253	36.69	329	52	20.04
60	4233	39.96	357	60	20.86
120	4354	42.16	365	59	20.52
SEm (±)	29.4	0.54	5.3	0.5	0.15
CD (0.05)	85.9	1.581	15.3	1.3	0.46
	Moisture regimes				
Continuous submergence	4797	42.92	403	59	21.11
Phasic submergence	4414	40.67	374	59	21.14
Intermittent irrigation	2629	35.21	274	53	19.17
SEm (±)	25.1	0.384	9.3	0.48	0.13
CD (0.05)	81.9	1.251	30.2	1.6	0.43
Dates of planting					
November	3142	34.57	335	50	19.58
December	4752	44.65	366	64	21.36
SEm (±)	22.0	0.165	3.3	0.2	0.14
CD (0.05)	133.9	1.001	20.3	1.4	0.86

obtained with continuous submergence followed by phasic submergence (4414 kg/ha) and lowest (2629 kg/ha) in intermittent irrigation. Crop planted on December recorded significantly higher grain yield (4752 kg/ha) compared to November planted crop (3142 kg/ha). Harvest index, number of matured panicles/m², number of filled grains/panicles and test weight of grains were appreciably and significantly influenced by the application of phosphatic fertilizer, moisture regimes and date of planting (Table 2). Soil temperature was 1 to 2.5°C higher upto panicle initiation in plots where continuous submergence was maintained than the other two and there was no difference in soil temperature between continuous and phasic submergence from panicle initiation to maturity; while at later stage of growth when there was high air temperature towards mid to end of March, continuous and phasic submergences registered 1.5° to 2.8°C lower soil temperature than intermittent irrigation (Table 3). The optimum dose for higher yield was 105 kg P_2O_5/ha in both the dates of planting (Fig. 1). There was a positive response to higher level of applied fertilizers on rice crop when planted in winter months although the available P_2O_5 content of soil was in the medium range (19 kg P/ha).

Number of tiller was higher in November planted crop as tillering continued in former case for a longer period due to cool temperature. Phosphatic fertilizer application along with continuous submergence favoured higher LAI due to increased tolerance and gave protection to the crop against cold. Similar observation was made by Sato (1974) and Moriwaki (1979). Application of P fertilizer also induced early flowering and early maturity. Continuous submergence increased the availability of phosphorus than intermittent irrigation and it protected the developing panicles against the adverse effect of cool temperature. Moreover, the plots under intermittent irrigation were infested by different categories of weeds which in turn competed with rice plants for nutrients and thereby decreased grain yield of rice. Similar observations were made by several workers (Vamadevan. 1971 and El-Aishy, 1979).

Table 3

Variation of soil temperature under three moisture regimes

Dates of observation		Maximum soil temperature (°C)		
		Continuous submergence	Phasic submergence	Intermittent irrigation
December	7	22.0	21.0	21.0
	15	22.2	21.2	21.0
	21	20.5	18.2	18.0
	28	21.0	19.8	19.8
January	6	22.0	19.5	19.5
	13	21.5	22.0	22.0
	20	22.0	21.2	20.8
	27	22.5	20.5	20.5
February	3	22.5	22.5	23.5
	10	22.5	22.5	23.0
	17	22.5	22.5	20.0
	23	23.0	23.0	20.0
March	3	23.0	23.0	23.5
	10	22.5	22.5	22.5
	17	25.0	25.0	26.5
	24	28.2	28.2	31.0
	31	28.5	28.4	30.8

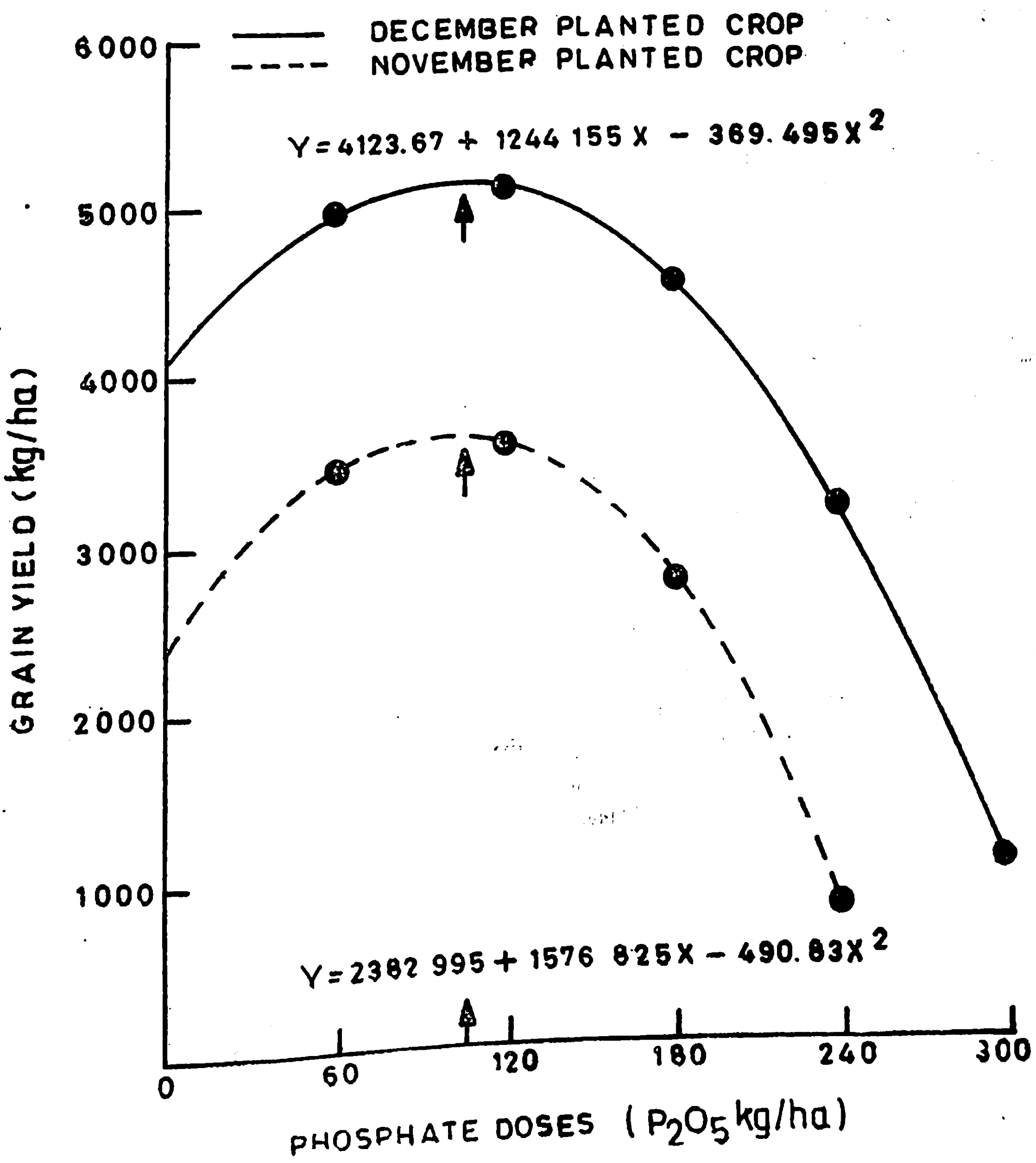

Fig 1. Response curve

The application of high dose of phosphorus in winter months helped quick establishment of seedlings, accelerated plant growth, encouraged early flowering and increased grain yield. Without application of phosphate, the uptake of nitrogen was reduced and it would have prevented the synthesis of protein from nitrogenous materials which was more pronounced in November planted crop due to prolonged cool temperature.

From this investigation it may be concluded that continuous and phasic submergences with higher dose of phosphorus (around 100 kg P_2O_5/ha) were found to be effective for obtaining higher yield of rice during winter.

Bidhan Chandra Agricultural University
Kalyani 741235, Nadia, West Bengal, India

B. K. Mandal
K. G. Ghosh

References

Bhattcharyya, K. K. and Chatterjee, B. N. 1978. Growth of rice as influenced by phosphorus. *Indian J. agric. Sci.* 48:589.597.

El-Aişhy, S. M. 1979. Effect of water regime on growth, yield and anatomical root structure of rice plants. Dept. Agron. Fac. Agric. Tanta Univ. Kofv. El-Sheikh, Egypt, 4:310-317.

Moriwaki, T. 1979. Effects of soil temperature on the vegetative growth of rice. *Japan agric. Res. Quarterly* 13:16-21.

Seto, K. 1974. Growth responses of rice plant to environmental conditions:3. The effects of photoperiod and temperature on growth and chemical composition. *Proc. Crop. Sci. Soc. Japan* 43:402-409.

Vamadevan, V. K. 1971. Temperature regimes under different water depths and their effects on the growth and yield of rice. *Riso* 20:21-29.