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Water management practices and scheduling of irrigation for rice cultivation in DVC command

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ABSTRACT

All India Coordinated Project for Research on Water Management(ICAR), Kalyani Centre of Bidhan Chandra Krishi Viswavidyalaya, West Bengal conducted a series of field trials on sandy clay loam (*Entisol*) at the Experimental Station, Memari in the district of Burdwan under during the years 1985 to 1995 with transplanted rice both in rainy and summer season under DVC command to provide suitable irrigation scheduling for obtaining optimum yield with maximum economy of irrigation water. The surface soil of the experimental site contains 0.62 % organic carbon, 48.7 kg N/ha having pH of 6.7. Average ground water table was near to the surface in the month of August, which recedes gradually and reached to a depth of 2.5 meter around May and major portion of average annual rainfall (1300 mm) falls between July to September. The results of the on-station field trials gave comprehensive recommendations as an integral part of technology generation on water management practices rice cultivation. The results revealed that levels of irrigation during rainy season did not influence the grain yield of rice under normal uniformly distributed rainfall. However, the highest value of WUE was obtained with the irrigation 5 cm three days after disappearance of ponded water. The rice (cv IR36) responded to nitrogen, phosphorous and potassium up to 80, 60 and 120 kg/ha, respectively with an average yield of 4.8 t/ha at water expenses 86 cm, on an average. The same cultivar of transplanted summer rice gave an average yield of 6.1 t/ha with the continuous submergence of 5±2 cm water up to grain filling stage gave the highest grain yield of rice with 100 kg N/ha. However, water use efficiency increased with lesser number of irrigation and was found maximum when irrigation was given 5 days after disappearance of ponded water. Continuous submergence of ponded water up to grain filling stage showed less weed intensity irrespective of growing seasons.

Rice has the largest contribution to sustained self-sufficiency in food grain production. Development of input-responsive varietal introduction capable of achieving high yield potential particularly under irrigated ecology is responsible for this attainment. The area under rice growing eco-systems in India is 44.0 m ha , out of which upland rice shares only 7.0 m ha and lowland covers 17.0 m ha. The productivity of upland and lowland rice are 0.65 and 1.9 t/ha respectively. In west Bengal the total rice growing area is 5.6 m ha, with upland and lowland rice sharing 1.01 and 1.85 m ha, at productivity levels of 0.95 and 2.01 t/ha respectively. The coverage of rice under irrigated eco-system is 21.0 m ha that is 47% of the total rice crop grown with higher production protential. In West Bengal , rice under irrigated eco-system is 2.52 m ha that is 45% of total rice grown area in the state . Not more than 50% of yield potential could be made possible to realize till now from irrigated rice ecology mainly due to managerial gap of integrated input managemant and availability of quality seeds. In view of indispensability of water as natural resource for sustaining the

environment, supporting life and responsible for sustainable agricultural growth and development the series of field experiment was conducted on transplanted rainy and summer season rice under DVC command of West Bengal with objective to provide suitable irrigation scheduling rice for obtaining crop yields with maximum economy of irrigation water. Research to develop suitable water management technology for increasing rice production in determining water requirement and water use efficiency are very much crucial. Hence , a series of field experiment conducted to evolve suitable water management practices for rice cultivation under specific agro – climatic situation.

MATERIALS AND METHODS

The field trials were conducted at the Experimental Research Station, Memari, Burdwan in West Bengal under DVC command. The farm is situated at the southern part of Burdwan district ($23^0$10 N latitude and $88^0$51 E longitude) at an elevation of 21.34 above the mean sea level. The climate is humid tropical wherein summer is hot but winter is mild and short. The area is consisting of major physiographic region alluvial meander plain having alternate beds of compacted clay, silt and sand (Table 1). The soil of the experimental site is sandy clay loam (Entisol) and contains 0.62 % organic carbon, 48.7 kg N/ha having pH of 6.7. average ground water table was near to the surface in the month of August ,which recedes gradually and reached to a depth of 2.5 meter around May and major portion of average annual rainfall (1300 mm) falls between July to September . 25 –day old seedlings of rainy season rice were transplaned in the month July and harvested in late February . The fertilizers were applied in form of urea, single Ssuper phosphate and muriate of potash for N, P and K respectively. Irrigation water through the canal system is usually made available for three months during rainy season and at least 15 days during winter and around 30 days during summer.

RESULTS AND DISCUSSION

The transplanted rice during rainy season is commonly kept deep submergence under assured rainfall or irrigation in apprehension of non –availabilty of water or possibility of rainless period . The results of many experiments revealed that intermittent cyclic shallow submergence for optimum yield and higher water use efficency . Efficient management of water in relation to specific soils and enviromental conditions appear to be major factors to increase rice production . The results of field trials revealed that though continuous submergence of 5 cm water out yielded the other practices 5 cm irrigation , 1 day after disappearance of ponded water gave the grain yield of rice statistically at par. Mid-season drainage appeared to be suitable for increasing panicle production and grain filling . Subbalah *et al.* (1992) also corroborated the findings with the results of the field experiments. Mallick *et al.* (1995) also reported the similar findings while working on rice irrigation in alluvial soils of West Bengal . The results also revealed that could be withheld upto 3 days of disappearance of ponded water without affecting the grain yield of rice during rainy season. However, continuous submergence of 5 cm water was required upto flowering in summer season rice to give highest grain yield.

Application of fertilizers in form of N, P and K from inorganic sources may marginally justify extra materials added with cost especially considering uncertainty of season –to –season rainfall variation and availability of irrigation . However, 80 kg N,

60 kg P_2O_5 and 120 kg K_2O were found responsive to give significantly highest grain yield of rice. Sharma *et al.* (1992) and Zaman *et al.* (1992) also repoted that improved technology required for fertilizer application from inorganic sources in combination with irrigation to get higher nutrient use efficiency.

Table 1 Physical properties of soil profile at experimental site

Soil depth	Bulk density (g/cc)	Mechanical composition			Saturated hydraulic conductivity (cm/day)
		Sand %	Silt %	Clay %	
0-15	1.59	32.5	22.5	45.0	2.64
16-30	1.52	40.0	15.0	45.0	3.84
31-60	1.61	43.5	22.5	34.0	8.16
60-90	1.60	60.0	11.5	28.5	17.52

Table 2 Effect of irrigation scheduling on grain yield and irrigation requirement of rainy season rice (cultivar IR 36)

Irrigation schedule	Grain yield (t/ha)	Straw yield (t/ha)	Total water applied (cm)	Water use efficiency (kg/ha/cm)
Continuous submergence (5 cm)	4.7	6.8	86	54.4
5 cm water, one day after disappearance of ponded water	4.6	6.7	73	63.8
5 cm water, three days after disappearance of ponded water	4.5	6.6	68	66.5
5 cm water, five days after disappearance of ponded water	4.2	6.4	63	66.1
SEm (±)	0.063	0.187		
CD at 5%	0.190	NS		

NB : Excluding water required for puddling and nursery; including rainfall

Table 3 Effect of irrigation scheduling on grain yield and irrigation requirement of summer season rice (cultivar IR 36)

Irrigation schedule	Grain yield (t/ha)	Straw yield (t/ha)	Total water applied (cm)	Water use efficiency (kg/ha/cm)
Continuous submergence (5 cm)	6.1	8.2	132	50.6
5 cm water, one day after disappearance of ponded water	5.4	7.1	93	62.6
5 cm water, three days after disappearance of ponded water	4.8	6.5	64	81.4
5 cm water, five days after disappearance of ponded water	4.5	6.0	49	97.6
SEm (±)	0.132	0.148		
CD at 5%	0.403	0.514		

NB : Excluding water required for puddling and nursery; including rainfall

Table 4 Recommendations for irrigation application in rice cultivation under DVC command of West Bengal

Rice	Condition	N, P_2O_5 & K_2O – response (kg/ha)	Recommendation(s) for irrigation
Transplanted rice	Medium land	80 : 60 : 120	Continuous submergence upto flowering stage
Summer rice (Transplanted)	Medium Land	100 : 60 : 60	Continuous submergence of 5 ± 2 cm of water upto flowering stage

Levels of irrigation during rainy season did not influence the grain yield of rice under normal uniformly distributed rainfall. The water regime should be kept upto not more than 5 cm with intermittent drained out of water at mid-season to get higher grain yield of rice. Irrigation or water application may be done at 1 to 3- day disappearance of ponded water. The highest value of water use efficiency was obtained with the irrigation 5 cm three days after disappearance of ponded water. The crop responded to nitrogen, phosphorus and potassium upto 80, 60 and 120 kg /ha, respectively.

The continuous submergence of 5± 2 cm water upto grain filling stage gave the highest grain yield of rice during summer season with 100kg N/ha .However , the WUE increased with lesser number of irrigation and was found maximum when irrigation was given 5 days after disappearance of ponded water . It was observed that continuous surmergence of ponded water up to grain filling stage showed less weed intensity irrespective of growing seasons.

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