 Oryza Vol. 45. No.1, 2008 (129-132)

Effect of planting dates and soil water regimes on growth and yield of upland rice

H.K. Rai and H.S. Kushwaha*

Department of Soil Science, College of Agriculture, G. B. Pant University of Agriculture and Technology, Pantnagar-263145, Uttarakhand, India

ABSTRACT

The response of rice (cv. Pant Dhan-4) to different planting dates and soil water regimes under upland conditions was studied in tarai region of Uttaranchal at the G. B. Pant University of Agriculture and Technology, Pantnagar . Delay in planting from15 June to 15 July decreased plant height (13 %), leaf area index (10 %), number of tillers (5 %), number of days to panicle initiation (6 to 8 days), 50 per cent flowering (12 to 15 days), maturity (6 to 7 days) and grain yield (5 to 15 %). Application of 7.5 cm irrigation water 3 days after disappearance from the plot reduced the number of tillers by 11 per cent and grain yield by 16 to 20 per cent over continuous submergence of 5.0 $\pm$ 2.5 cm irrigation water. Crop maturity was delayed by 8 to 11 days due to change in soil water regimes from continuous submergence to rainfed conditions.

Key words: *Planting dates, soil water regimes, upland rice, yield*

Production of rice can be increased by scheduling the planting date according to weather conditions. Studies carried out by Hari Om *et al*. (1997) showed significant difference in grain yield of rice due to change in planting dates only. Efficient use of water can increase the rice production through scheduling of irrigation to maintain the optimum soil water regimes. Study made by Saikia and Dutta (1991) under lowland rice showed that under optimum soil water regime rice yield can be improved upon. Present investigation was made to study the main and interactive effects of planting dates and soil water regimes on growth and yield of upland rice.

MATERIALS AND METHODS

Field experiments were conducted during the wet seasons of 1997 and 1998 at Crop Research Centre of the Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (Lat. 29^0 N, Long.79^0 30' E and at an elevation of 243.84 m above mean sea level), having humid sub-tropical climate with an average annual rainfall of 1433.4 mm. The soil of the experimental field was Patherchatta sandy loam. The experiment was laidout in split-plot design with three replications. Three planting dates viz.15 June (D_1), 01 July (D_2) and 15 July (D_3) were allotted to the main plots and four soil water regimes viz. rainfed (I_0), continuous submergence to maintain 5.0 $\pm$ 2.5 cm ponded water (I_1), 7.5 cm irrigation water one day (I_2) and three days (I_3) after disappearance of ponded water to the sub-plots. Rice cv. Pant Dhan-4 was transplanted at a spacing of 20 cm x 10 cm with two seedlings hill^{-1}. During first ten days of rice transplanting, 5.0 $\pm$ 2.5 cm to saturation water level was maintained in all the plots for better establishment of seedlings. To regulate the depth of submergence and to drainout the excess water, bricks of 7.5 cm height were fixed on the bunds towards the buffer channel side of each plot. The brick levels were adjusted carefully marking the upper limit of submergence. Irrigations were stopped 15 days before the harvest of the crop. Observations on growth parameters like plant height, number of shoots per hill and the leaf area index (LAI) were recorded at tillering, panicle initiation, 50 per cent flowering and physiological maturity stages. Number of days for different phenophases was recorded on five consecutive hills.

RESULTS AND DISCUSSION

It is evident from the data (Table 1) that plant height reduced significantly due to delay in planting from D_1

to D_3 treatment during both the years. This reduction may be due to decrease in photoperiod available at active growth phases. Results further indicated that soil water regimes also significantly affected the plant height at all the growth stages. Maximum plant height in I_1 was 22.9 and 19.5 per cent more during 1997 and 25.3 and 18.9 per cent during 1998 than in I_0 and I_3 treatments, respectively at maturity. Similar trends in plant height variations under the influence of different soil water regimes have also been reported by Dongale and Chavan (1982). The interaction effect of planting dates and soil water regimes was found to be significant.

The effect of planting dates and soil water regimes on leaf area index (LAI) was also found to be significant (Table 1). Crop attained highest LAI (3.30) in D_2 treatment as compared to D_1 (3.29) and D_3 (3.26) at 50 per cent flowering stage. Leaf Area Index under I_0 was significantly lower than in I_1 and I_2 during both the years. Lal (1991) reported maximum LAI of 5.17 under continuous submergence compared with other treatments applying irrigations 2 or 3 days after disappearance of ponded water or rainfed plots. The Interaction effects of planting dates and soil water regimes on LAI proved to be significant only at 50 percent flowering stage during the years and a highest LAI (5.55) was observed in D_1I_2 and lowest (3.95) in D_3I_0 treatment combinations at this stage.

The data pertaining to number of shoots m^{-2} at maturity stage (Table 1) showed a marked difference in D_3 as compared with D_1 and D_2 and it was significant during both the years. This difference may be due to longer photoperiod and low minimum temperature experienced by the crop planted on 15 July (D_3) as compared to D_1 and D_2 treatments which restricted the vegetative phase causing less tiller production. The results further revealed that the number of shoot m^{-2} in I_0 and I_3 soil water regimes were less than in I_1 and I_2 during both the years. Continuous submergence of 5.0 $\pm$ 2.5 cm water (I_1) produced maximum number of shoots m^{-2} (281) compared to irrigation treatments. The difference in number of shoots m^{-2} under I_0 and I_3 treatments was also significant. Significantly higher numbers of shoots m^{-2} under continuous submergence as compared to 5 cm irrigation one and three days after disappearance of ponded water under low land rice have also been reported by Packiaraj and Venkataraman (1990).

The data on days taken to panicle initiation, 50 per cent flowering and physiological maturity of the rice crop as presented in Table 1 indicated that the number of days taken to panicle initiation were 69 in D_3 which was significantly lower than 75 (D_1) during

Table 1. Effect of transplanting date and soil water regime on growth and development of upland rice

Treatment	1997						1998					
	Plant height (cm) at 50 % Fl.#	No. of shoots m^{-2}at 50 % Fl.#	Leaf Area Index at 50 % Fl.#	PI* (days)	50% Fl.# (days)	Maturity (days)	Plant height (cm) at 50% Fl.#	No. of shoots m^{-2}at 50% Fl.#	Leaf Area Index at 50% Fl.#	PI * (days)	50% Fl.# (days)	Maturity (days)
D_1	94.0	260	3.29	74.6	94.8	130.6	91.6	262	3.49	75.1	94.9	129.8
D_2	92.6	256	3.30	71.8	93.8	129.6	92.2	258	3.52	73.1	93.1	127.9
D_3	78.3	245	3.26	69.0	79.7	127.3	79.3	247	3.42	67.7	80.7	122.5
CD (P = 0.05)	7.6	4.9	0.04	2.7	4.4	4.9	1.4	6.2	0.09	3.8	4.9	7.7
I_0	76.3	215	2.30	75.4	93.6	133.3	74.7	219	3.17	77.1	93.7	132.8
I_1	99.0	281	3.81	68.9	86.8	125.1	99.7	281	3.78	67.6	86.9	122.3
I_2	98.1	275	3.75	69.7	87.4	128.1	95.7	277	3.71	69.0	83.3	123.6
I_3	79.7	243	2.27	73.1	89.8	130.0	80.8	244	3.25	74.1	89.6	128.2
CD (P = 0.05)	3.3	4.4	0.08	2.7	4.4	4.9	1.9	7.9	0.09	3.8	4.9	7.7

* PI- Panicle Initiation stage # Fl- Flowering stage

Planting dates D_1 - 15 June, D_2 - 01 July, D_3 - 15 July; Soil water regimes I_0- Rainfed, I_1- Continuous 5.0+ ponded water, I_2 - 7.5 cm irrigation water 1 day after disappearance of ponded water, I_3 - 7.5 cm irrigation water 3 day after disappearance of ponded water

1997. However, during 1998 it was significantly lower under D_3 (68) compared to D_1 (75) and D_2 (73). Most probably it may be due to favourable thermal and photo periods available for D_1 as compared to D_2 and D_3. Similar trend in variation in respect of days to panicle initiation in lowland rice has also been reported by Gohain and Saikia (1996). Days taken to 50 per cent flowering in D_3 were significantly less compared to D_1 and D_2 during both the years (Table 1). This difference may be due to forced flowering caused by photo thermal conditions. Also days taken to maturity of crop was significantly reduced by 2 to 7 days with delay in planting from 15 June to 15 July and this reduction was significant. It may be due to availability of more photo thermal time to the crop in shorter duration. Days to panicle initiation were also found to be significantly higher (75.4 and 77.1) under I_0 than those in I_1 (68.9 and 67.6), I_2 (69.7 and 69.0) and I_3 (73.1 and 74.1) soil water regimes during 1997 and 1998, respectively. However, the difference between I_1 and I_2 was non-significant, may be due to limiting effect of water in I_0 and I_3 treatments. Delay in panicle initiation by 3-6 days due to increase in soil moisture stress from field capacity to 75 per cent of available soil moisture was also reported by Sahu and Raut (1969). The results also showed that days taken to 50 per cent flowering were significantly higher (93.6 and 93.7) in I_0 compared to I_1 (86.8 and 86.9) and I_2 (87.4 and 87.3) during 1997 and 1998, respectively. The decrease in days to flowering with increase in water supply from rainfed to 5 cm soil saturation has also been reported by Naidu (1974). There was significant reductions in days to crop maturity from I_0 (133.3 and 132.8) to I_1(125.1 and 122.3) and I_2 (128.1 and 123.6) during 1997 and 1998, respectively. Early maturity in rice crop with increase in soil moisture levels as compared to rainfed treatments has also been observed by Singh (1985).

The data pertaining to yields and yield attributes in terms of number of panicles m^{-2}, number of grains per panicle and 1000 grain weight are presented in Table 2. Results clearly indicated that the number of panicles m^{-2} was reduced by 8.9 and 4.2 per cent due to delay in planting from 15 June to 15 July during 1997 and 1998, respectively, although these reductions were statistically non-significant. It may be due to less number of effective tillers caused by late planting of the crop. Gangwar and Sharma (1998) have also observed similar results. The number of panicles m^{-2} were maximum (252 and 263) under I_1 followed by I_2 (228 and 236) and lowest (191 and 200) in I_0 treatment during both the years. Number of grains per panicle in 15 July planting was significantly less than observed in 15 June and 1 July planted crop treatments, which in turn were at par. It might be due to greater accumulation of photosynthates in early planted crop. Gohain and Saikia (1996) have also reported reduction in number of grains per panicle in rice due to delay in planting from 20 July to 5 September. The highest number of grains (153 and 149) panicle^{-1} of were obtained under continuous submergence (I_1) during 1997 and 1998, respectively, where as, the lowest of 112 and 115 grains panicle^{-1}were found in rainfed (I_0) treatment. 1000-grain

Table 2. Effect of planting date and soil water regime on yield and yield attributes of rice

Treatment	1997					1998				
	No. of panicle m^{-2}	No. of grain panicle^{-1}	1000-grain weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	No. of panicle m^{-2}	No. of grain panicle^{-1}	1000-grain weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
D_1	222	142	27.2	4606	5597	227	133	27.3	3951	5629
D_2	221	143	26.9	4323	5991	243	135	27.5	4226	5671
D_3	212	115	25.2	3900	5215	218	121	26.0	3738	5044
CD (P = 0.05)	NS	25.0	1.5	284	525	NS	4.9	NS	177	239
I_0	190	112	21.5	2667	6108	200	117	23.6	2595	5736
I_1	253	153	27.7	4932	6111	263	149	28.1	4830	5590
I_2	226	145	27.6	4718	5479	236	137	27.5	4604	5204
I_3	203	123	29.0	4121	4706	217	116	28.6	3858	5262
CD (P = 0.05)	34.3	15.3	2.7	338	511	36	19.5	1.5	369	786

Planting dates D_1 - 15 June, D_2 - 01 July, D_3 - 15 July; Soil water regimes I_0- Rainfed, I_1- Continuous 5.0+ ponded water, I_2 - 7.5 cm irrigation water 1 day after disappearance of ponded water, I_3 - 7.5 cm irrigation water 3 day after disappearance of ponded water weight (g) in D_1 (27.2 and 23.3) were significantly greater than that obtained in D_3 (25.16 and 26.0) during 1997 and 1998, respectively. It could be due to longer period available to allocate the photosynthates in the grains. Dhiman and his associates (1997) also observed 18.4 per cent reduction in 1000-grain weight of rice due to delay in planting from 25 June to 5 August. The highest 1000-grain weight was obtained in I_3 water regime and lowest in I_0. This might be due to less number of grains panicle^{-1} in I_3 than in I_1 and I_2 treatments, and due to soil water stress causing limitation in translocation of food materials toward grains in I_0. The grain yield was 5.4 and 15.3 per cent higher in 15 June planting than in 15 July, which might be due to optimum period available for growth and development resulting in more storage of photosynthates in the grains in early planted rice. Similar results have also been reported by Babu (1987). The grain yields in I_1 compared to I_3 and I_0 were 16.4 and 45.9 per cent higher during 1997 and 20.1 and 46.3 per cent higher during 1998, respectively. It might be due to water stress during different phenophases under I_3 and I_0 treatments. Saikia and Dutta (1991) have also reported 11.6 and 15.1 per cent higher grain yield in continuous submergence as compared to 7 cm irrigation 1 day and 3 days after disappearance of ponded water, respectively. The straw yield in D_1 was 13.0 and 11.1 per cent higher than in D_3 during 1997 and 1998, respectively, for the same reason as in grain yield. Straw yield in I_1 was 10.3 and 23.0 per cent higher than in I_2 and I_3 but was at par with I_0 treatment. It might be due to maximum vegetative growth in I_1 treatment and poor translocation of food materials from vegetative parts to grains in I_0.

REFERENCE

Babu AM 1987. Effects of planting dates and variety on growth and yield of rice. *Oryza* 25 (3): 319-322

Dhiman SD Nandal DP and Hari Om 1997. Performance of scented, dwarf rice (Oryza sativa) varieties under different time of transplanting Indian J Agron 42 (2): 253-255

Dongale JH and Chavan AS 1982. Effect of moisture regimes on rice yields in Alfisols and Vertisols. *Int Rice Res Newsl* 7 (3): 18

Gangwar KS and Sharma SK 1998. Effect of planting dates on productivity of scented rice (*Oryza sativa*) and wheat (*Triticum aestivum*) varieties in rice-wheat cropping system. Indian J Agron., 43 (1): 1-6

Gohain T and Saiskia L 1996. Effect of date of transplanting on growth and yield of rainfed lowland rice (*Oryza sativa*) Indian J Agron 41 (3): 488-490

Hari Om Katyal SK and Dhiman SD 1997. Effect of time of transplanting and rice (Oryza sativa) hybrids on growth and yield. Indian J Agron 42 (2) : 261-264

Lal B 1991 Effect of nitrogen and irrigation on water use and yield of rice. Thesis, M.Sc., G. B. Pant University of Agriculture and Technology, Pantnagar. pp80.

Naidu CVR1974. Studies on the response of transplanted rice to different irrigation schedules. Thesis, M.Sc. G. B. Pant University of Agriculture and Technology, Pantnagar. pp90

Packiaraj SP and Venkataraman NS 1990. Influences of irrigation regimes, organic amend- ments and source of phosphorus on low land rice (*Oryza sativa*). Indian J Agron 36 (1): 14 - 17

Sahu BN and Raut SB 1969. Water requirement and response of low land rice to nitrogen and phosphate at different soil moisture regimes. Indian J Agron 34 (1): 35 – 39

Saikia M and Dutta TC 1991. Response of rice to different irrigation on sandy loam soil of Assam. *Oryza* 28 (2):359-362.

Singh R 1985. Irrigation studies in rice. *Thesis*, M.Sc. G.B.PUA&T, Pantnagar. pp100