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Research Paper

Influence of nursery raising methods, age of seedling and planting dates on rice (*Oryza sativa*) under temperate Kashmir

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ABSTRACT

Field experiments were conducted during 2006 and 2007 to study nursery raising methods, seedling age and transplanting dates of rice (*Oryza sativa* L.) under temperate Kashmir valley. Treatments comprised two transplanting dates (25 May and 20 June), two nursery types (Protected and Modified protected) and three seedling age (20, 35 and 50 days old), which were evaluated by split plot design. Simultaneously in the same medium (as in field conditions) pot study was carried out. All the defined seedling ages along with direct seeding were evaluated under pot conditions by CRD. 25 May transplanting out yielded 25 June transplanting by 58.5% and 58.3% during both the years. Similarly, modified protected nursery out yielded protected nursery by 3.5 % and 4.25 %. 20 and 35 days old seedling recorded grain yield increase over 50 days seedling by 9.78 and 6.14 % in 2006 and 10.64 and 7.51 % in 2007. However, older seedling performed better under late transplanting than younger seedlings. Under pot studies, root length, root weight and root volume recorded significant decreasing trend with increased seedling age. Early transplanting, modified protected nursery and younger seedling recorded less transplanting shock, which in turn increases net profit and B:C ratio.

Key words : Rice nursery type, Seedling age, Transplanting date, Transplanting shock

Rice is cultivated under variable altitude in temperate Kashmir. For higher productivity of rice the main constraint is low temperature especially during nursery period. The minimum temperature at night ranges from as low as 5.0 to 10.6 ^{0}C from 1st April to 15th May (Fig. 1). Consequently nursery growth is slow and nurseries prolong upto 35 to 45 days to attain transplantable seedling. Older seedlings suffer more due to transplanting shock, reducing tillering capacity. Transplanting older seedlings induce a delay in the onset of linear dry matter accumulation and tiller emergence (Pasuquin *et al.*, 2008). Although protected low tunnel nursery technique is successfully used to combat low temperature injury (Shah *et al.*, 2000). Still there is need to standardize new nursery raising method (Modified protected nursery) to raise temperature for speedy nursery growth. It is possible to get younger seedling with less root injury by altering soil medium, which recover fast after transplanting. Seedlings from traditional nursery beds result in reasonable root injury while pulling, as soils of Kashmir valley are predominantly clayey. Further modified protected nursery may save nutrient losses due to leaching as requirement of nitrogen is reported about 200 kg/ha with least N recovery (Singh *et al.*, 2005). Therefore a seedling raising method using polythene under the seed bed medium in addition to low polythene tunnel has been tested in expectation of obtaining young and healthy seedling to increase the yield.

MATERIALS AND METHODS

Field experiment was conducted during 2006 and 2007 on Hapladulfs, Silty clay loam soil at the Shalimar campus of Sher-e-Kashmir University of Agricultural Sciences &

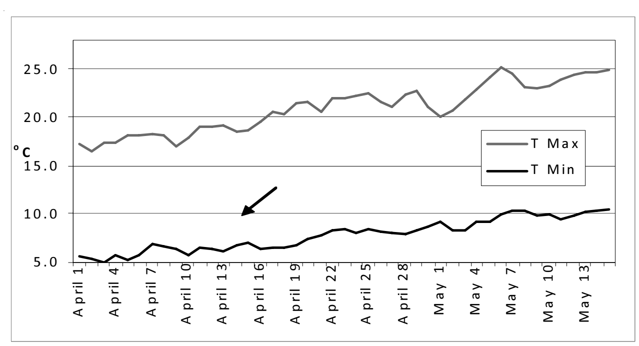

Fig. 1. Long term temperature during nursery raising methods

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Technology of Kashmir (34°-05' N 74°-89' E; 1587 m above mean sea level). Soil contained 1.15% organic carbon and available N, P and K of 280, 19.1, 268 kg/ha, respectively. Treatments comprised two transplanting dates (25 May and 25 June), two nursery types (protected and modified protected) in main plots and three ages of seedling (20, 35 and 50 day-old) in subplots. These treatments were replicated thrice and randomized statistically by split plot design. For modified protected nursery, soil was removed from the nursery beds up to 15 cm depth and mixed with FYM, sand and ash (2:2:1 ratio) @ 10 kg/m^2. Mixed soil was replaced back in the bed on the polythene sheet placed underneath. Pre-germinated seed @ 120 g/m^2 of rice ‘Jhelum’ were sown on 5 May, 20 April and 5 April to get 20, 35 and 50 days old seedlings for 25 May transplanting date in both types of nurseries. Similarly seed was sown on 5 June, 20 May and 5 May for 25 June transplanting of 20, 35 and 50 days old seedlings, respectively. After sowing polythene cover was used to make low tunnel over bent willow sticks. Polythene was unrolled during day time when the weather permitted. However, nurseries remained under polythene during night hours. As the ambient temperature improves polythene was not used at all even during night. Water temperature was regularly recorded during nursery growing period of both nursery types. Pots filled with soil (as in field conditions) were also used to study transplanting shock and root growth due to differential seedling ages. Seedling were transplanted as per treatment simultaneously in the pots as it was done in the field, with the exception of an additional treatment of direct seeding (Zero aged seedling) on the same day of 25 May and 25 June. Root parameters and days to heading for calculating transplanting shock were analyzed by CRD. Growth and yield attributes were recorded under field conditions, while days to heading under pot conditions were recorded to assess transplanting shock in terms of more days taken to heading with variable seedling age as compared to direct sowing.

RESULTS AND DISCUSSION

Temperature

Compared with open nursery, the water temperature in polythene low tunnel and modified protected nursery was higher during early growth periods, indicating that temperature holding capacity of the protected and modified nursery was high as polythene cover was used. Water temperature of protected and modified protected nurseries was more in the evening hours than open nursery, where corresponding difference during morning hours was less. Evidently water temperature in both types of these nurseries was higher than ambient temperature of the open nursery (Fig 2&3). Variation between water temperature of protected and modified protected nurseries and open nursery decreased at later stages of sowing because polythene cover use was restricted upon improvement in ambient temperature.

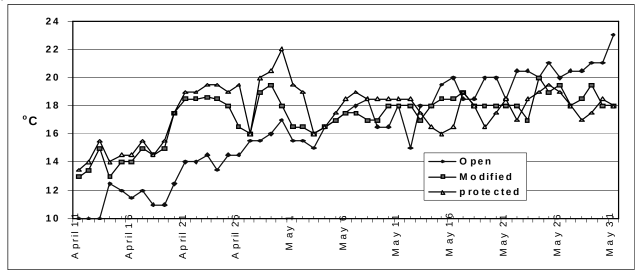

Fig 2. Temperature variation under different nursery raising methods (morning)

Yield and yield attributes

Early transplanting (25 May) recorded significantly higher values of yield attributing characters over late transplanting date (20 June). Grains/panicle decreased drastically by late transplanting which is mainly due to exhibition of low temperature to anthesis and grain filling phonological stages of rice. Kumar and Mahajan, 2007 also reported that low temperature at anthesis and grain filling period reduced grain filling, which ultimately resulted less grains/panicles, due to which significant increase in grain yield, biological yield and harvest index was observed with 25 May transplanting than in 25 June transplanting during both years (Table 1). Transplanting on 25 May recorded 58.5% and 58.2% more grain yield over 20 June transplanting in 2006 and 2007, respectively. Similar results were reported by Singh *et al.*, (2005). Modified protected nursery recorded significantly higher yield attributes and yields than protected nursery during both the years. Magnitude of increase was to the tune of 3.5% and 4.2% during both the years. All the yield attributing parameters decreased significantly with 50 days old seedling than transplanting younger seedling. The grain yielding trend during both the years was in the order of 20 days > 35 days > 50 days. 20 and 35 days old seedlings recorded an increase of 9.78 and 6.4% over 50 days seedlings in 2006

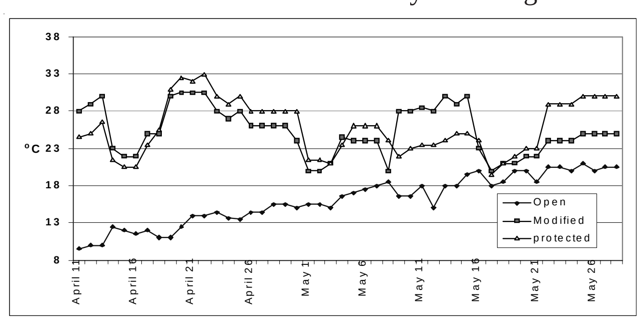

Fig. 3. Temperature variation under different nursery raising methods (Evening)

and corresponding values in 2007 were 10.64% and 7.51%, respectively. Pannoswamy and Sathi, (2002) also reported enhanced yield of rice when younger seedlings are transplanted. Biological yield of rice decreased significantly by increasing seedling age from 20 to 50 days. Though, difference between 20 and 35 days old seedling was at par with regard to biological yield in 2006. Although yield of old age seedling decreased significantly, but there was significant increase in harvest index. Transplanting younger seedlings in irrigated rice fields caused early and higher tiller production which ultimately increase yield (Pasoquin *et al.*, 2008). However, variation in spikelet number by 20 and 35 days old seedlings were at par but significantly superior over 50 days old seedlings. Thus young seedlings were reported to hasten seedling establishment after transplanting which ultimately increases growth and yield attributes. Jian and Wang, (2005), also reported similar findings. On 20 June transplanting (Late), 20 days old seedling recorded less grain yield than 35 and 50 days old seedlings during both the years. 50 days old seedling transplanted on 20 June recorded highest yield over younger seedlings. Similar trend

Table 1. Grain yield, biological yield, harvest index and relative economics of rice as affected by transplanting date, nursery method and seedling age

Treatment	Grain yield (t/ha)		Biological yield (t/ha)		Harvest Index (%)		Relative economics	
	2006	2007	2006	2007	2006	2007	Net Returns (₹)	B: C ratio
Transplanting date								
25 May	6.69	6.19	16.08	15.32	41.6	40.3	50,872	2.29
25 June	4.22	3.91	12.79	12.37	32.4	31.5	39,917	1.19
SEm±	0.050	0.049	0.172	0.102	0.17	0.18	1237	0.09
CD (P=0.05)	0.172	0.169	0.595	0.353	1.06	1.12	7,111	0.51
Nursery method								
Protected	5.39	4.94	14.32	13.82	37.10	35.2	45,075	2.29
Modified protected	5.58	5.15	14.55	13.87	37.41	36.6	45,713	2.15
SEm±	0.050	0.049	.0172	0.102	0.04	0.04	322	0.0135
CD (P=0.05)	0.172	0.169	NS	NS	0.12	0.12	1008	0.0045
Seedling age (days)								
20	5.72	5.30	15.67	14.83	35.0	34.0	46,683	2.17
35	5.53	5.15	14.90	14.33	36.61	35.4	46,076	2.16
50	5.21	4.79	12.98	12.48	40.11	38.4	43,423	2.10
SEm±	0.049	0.047	0.220	0.231	0.05	0.05	204	0.15
CD (P=0.05)	0.147	0.142	0.660	0.493	0.15	0.15	594	NS

MSP of rice grain = ₹)1,200/t; Rice straw =₹)250/t

Table 2. Yield attributes of rice (Jhelum) as influenced by transplanting date, nursery method and seedling age

Treatment	Plat height(cm)		Effective tillers/m^2		Spikelets/panicle		Grains/panicle	
	2006	2007	2006	2007	2006	2007	2006	2007
Transplanting Date								
25 May	120.5	117.6	372.8	370.2	106.3	101.5	90.9	90.3
25 June	108.5	99.1	368.7	363.0	98.4	93.5	62.2	59.4
SEm±	0.79	0.76	0.97	2.08	1.35	0.71	0.40	1.17
CD (P=0.05)	2.72	2.63	3.37	7.20	4.68	2.47	1.39	4.06
Nursery Method								
Protected	114.5	107.5	368.2	361.2	102.2	97.5	76.2	74.4
Modified protected	114.5	106.2	373.3	372.0	102.5	97.6	76.9	75.5
SEm±	0.79	0.76	0.97	2.08	1.35	0.71	0.40	1.17
CD (P=0.05)	NS	NS	3.37	7.20	NS	NS	NS	NS
Seedling age (days)								
20	116.5	111.9	387.5	382.8	104.2	99.9	72.9	72.6
35	114.4	106.0	370.8	368.5	103.1	98.1	77.7	75.7
50	112.7	107.1	354.0	348.5	99.9	94.6	79.1	76.5
SEm±	1.92	1.81	2.55	2.91	1.16	1.39	1.19	1.19
CD (P=0.05)	NS	NS	7.64	8.95	3.49	4.16	3.57	3.57

was predicted by using Oryza-1N model under temperate Kashmir (Singh *et al*, 2003).

Pot studies

Studies indicated that day to heading decreased by about 3 to 4 days by variable transplanting dates. Late planting forced early heading by 3 to 4 days (Table 4). Older seedlings took more days to heading than direct seeded rice indicating that older seedling were subjected to more transplanting shock. Irrespective of sowing dates, as age of seedling at transplanting was more, days to heading also increased significantly. Kotera *et al.* (2004) reported delay in heading due to transplanting (transplanting shock), defined as the difference in the number of days from emergence to heading between transplanted and direct-sown rice, ranged from 1 to 9 days. Increasing age of seedling increased more transplanting shock. At heading stage root length, root weight and root volume recorded statistically significant decreased trend as seedling age increased. Further these parameters also decreased with delay in sowing (Table 5). Similar findings were reported by Kumar *et al.*, (2003). Overall, the increase in seedling age prolongs days to 50% flowering and maturity (Villela and Junior 1996, Tahir 2004). Root length decreased by 20.5 and 16.8% by 50 days seedling over direct sowing (0 age of seedling) and 20 days old seedling, respectively. Root length has been reported to be one of the most important parameters closely related to the ability of a plant in acquiring nutrients and water, lodging and drought tolerance, and productivity (Ichii, 2003). The corresponding value for root weight and root volume was 28.6 and 17.6% and 28.6 and 21.9%, respectively.

Relative economics

Different treatments showed different net returns and B: C ratio (Table 3). Transplanting on 25 May recorded higher net returns (₹ 50, 872) and B: C ratio (2.29) as compared to their corresponding late transplanting. It causes ₹10, 955 of profit per hectare if rice seedlings were transplanted on 25 May. Modified protected nursery was found superior over protected nursery both in terms of net profit and B: C ratio. Similarly 20 and 35 days old seedlings were found superior over 50 days old seedlings.

Modified protected nursery can be used to get healthy and young (20 days) transplantable seedlings under temperate conditions. Where young seedling record higher

Table 3. Grain yield (t/ha) as influenced by interaction between transplanting date and age of seedling

	Seedling age (days)					
	2006			2007		
Transplanting date						
25 May	20 days	35 days	50 days	20 days	35 days	50 days
	7.81	6.79	5.48	7.17	6.41	4.98
25 June	3.44	4.28	4.95	3.23	3.89	4.60
		SEm±	CD (P=0.05)		SEm±	CD (P=0.05)
Transplanting date at same level of seedling age		0.075	0.241		0.073	0.235
Seedling age at the same transplanting date		0.069	0.208		0.067	0.201

Table 4. Days to heading as affected by seedling age and transplanting date.

Seedling age (days)	Heading date	Days to heading	Transplanting shock(days)in terms of more days taken to heading
25 May transplanting			
0	6 August	73	0
20	23 July	79	06
35	13 July	84	11
50	1 July	87	14
SEm±		2.63	–
CD (P=0.05)		3.72	–
20 June transplanting			
0	1 September	69	0
20	18 August	76	07
35	10 August	81	12
50	28 July	83	14
SEm±		2.52	–
CD (P=0.05)		3.57	–

Table 5. Effect of seedling age on rice root system at heading stage (mean over transplanting dates) at heading stage**.**

Seedling age	Root length (cm)	Root weight(g)	Root volume(g/cc)
0	51.6	10.5	35
20	49.3	9.1	32
35	44.2	7.7	25
50	41.0	7.5	25
SEm±	1.52	0.28	0.95
CD (P=0.05)	2.15	0.40	1.35

yield and B: C ratio under early transplanting date and if somehow transplanting is late older seedlings should be used.

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