Indian Journal of Agronomy **45** (3) : 555–559 (September 2000)

Effect of nursery seeding density on seedling vigour and yield of summer rice (*Oryza sativa*) under varying seedling rates

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Received: December 1999

ABSTRACT

A field experiment was conducted at Chiplima, Sambalpur, Orissa, to find out the effect of nursery seeding density on seedling vigour and yield of summer rice (*Oryza sativa* L.) under varying seedling rates. The seedlings became taller, thinner and lighter with less leaf and root growth due to increase in the nursery seeding density. Seedling damage at uprooting, pulling time, weed density in the nursery and cost of raising seedling for unit area transplanting became less under higher nursery seeding density. Growth and yield-attributing characters and yield of the crops did not vary significantly due to difference in the nursery seeding density. Two seedlings/hill were optimum for getting maximum yields of summer rice.

Key words : Nursery seeding density, Rice, Seedling rate, Seedling vigour, Yield

Rice–rice is the major crop sequence adopted in command area of the major and medium irrigation projects in Orissa. Rice transplanting is the most common stand-establishment technique adopted in both the seasons. Wet-bed nurseries are invariably used for raising seedling for transplanting. Sparse nursery sowing with 40–50 g seeds/ m^2 results in strong and sturdy seedlings which give rise to better yield (Singh *et al.*, 1987; Lal and Roy, 1996). But dense nursery sowing with 125–150 g seeds/m^2 is a common practice in the command area of the Hirakud major irrigation project. The benefits of dense nursery sowing are claimed to be less weed infestation, easier uprooting of seedlings, less seedling damage at uprooting and low operational cost. To study the effect of nursery seeding density on seedling vigour and yield under varying seedling rates, the present study was initiated.

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MATERIALS AND METHODS

The experiment was conducted at Chiplima, Sambalpur, during dry season of 1995–96 and 1996–97. The soil of the nursery and the experimental field was sandy clay loam with pH 6.4, organic carbon 0.43% and available N ($KMNO_4$ method), P (Olsen) and K (NH_4 OHC method) content of 272, 13.8 and 136 kg/ha respectively. The treatments consisted of 4 seeding densities (50, 75 , 100 and 150 g seeds/m^2) in the nursery and 3 seedling rates (1,2 and 3 seedlings/hill) in the main field. The experiment was laid out in randomized block design with 5 replications in the nursery and 3 replications in the main field. Rice cultivar 'Lalat' maturing in 125 days was grown as the test crop. Sprouted seeds were sown on wet-bed nursery on 11 and 23 January of 1996 and 1997 respectively using 10 g N, 15 g P_2O_5 and 20 g K_2O/m^2 at the time of bed preparation, besides uniform dose of farmyard manure @ 2 baskets/40 m^2. Observations on weed count, pulling time, seedling damage and seedling vigour, in terms of height, number of fully open leaves and biomass accumulation were recorded at the time of uprooting of the seedlings.

Seedlings from each treatment, imposed in nursery were transplanted in separate plots in the main field on 22 and 27 February 1996 and 1997, respectively, using a spacing of 15 cm × 15 cm and common fertilizer dose of 80 kg N, 40 kg P_2O_5 and 40 kg K_2O/ha.

RESULTS AND DISCUSSION

Seedling vigour

Seedling vigour of summer rice was affected significantly by seeding density in

Table 1. Effect of nursery seeding density on seedling characters at transplanting in summer rice (mean data of 1995–96 and 1996–97)

Particulars	Nursery seeding density (g/m^2)				
	50	75	100	150	CD (P=0.05)
Height (cm)	19.6	20.4	20.5	21.1	0.7
Fully open leaves/seedling	4.8	3.9	3.8	3.7	0.5
Biomass/plant (mg)	73.0	62.5	57.5	47.5	10.4
Shoot : root	1.6	1.8	2.1	2.3	0.15
Damaged seedling (%)	7.6	3.2	2.5	0.9	0.8
Pulling time (labour hr/ha planting)	192.0	184.0	156.0	120.0	18.6
Weeds/m^2					
Grasses	96	71	43	34	12.4
Sedges	77	48	35	26	8.5
Broad-leaved	28	10	12	10	6.7
Total	201	129	90	70	20.0
Cost of raising seedling/ ha planting (Rs)	2,250	2,000	1,650	1,390	125.0

the nursery (Table 1). Minimum plant height with maximum dry matter and leaves/seedling were recorded with the seeding density of 50 g/m^2 and the seedlings became taller, lighter and less leafy with increase in the nursery seeding density. Root growth was more affected than shoot growth with higher seeding density in the nursery. Each increment in the nursery seeding density reduced the root growth significantly which has been reflected in the shoot : root ratio. Consequently seedling damage at uprooting and pulling time for transplanting unit area of the main field decreased significantly with progressive increase in the nursery seeding density.

Weed density in the nursery decreased significantly with progressive increase in the nursery seeding density. The decrease was 36,55 and 65% with seeding density of 75, 100 and 150 g/m^2, respectively, compared with weed density of 50 g/m^2. There was abrupt decrease in the dicot population (64%) due to increase in the nursery seeding density from 50 g to 75 g/m^2. Further increase in the nursery seeding density exhibited no adverse effect on dicot population. But in grasses and sedges each increment in the nursery seeding density reduced its population significantly. Shrivastava and Tripathi (1993) reported similar significant decrease in weed population due to increase in seeding density.

Cost of raising seedlings for transplanting unit area of the main field decreased with increase in the nursery seeding density. This has been due to progressive decrease in the nursery area, input use and pulling time with increase in the seeding density in the nursery.

Yield-attributing characters

Table 2. Effect of nursery seeding density and seedling rate on yield-attributing characters (mean data of 1995–96 and 1996–97)

Treatment	Plant height at harvest (cm)	Tillers/hill (No.)		Panicle weight (g)	Panicle length (cm)	Grains/ panicle (No.)	1,000-grain weight (g)
		Maximum	Effective				
Nursery seeding density (g/m^2)							
50	69.8	10.5	7.3	2.8	24.0	119	21.6
75	69.4	11.0	7.6	2.7	23.9	119	21.5
100	70.0	11.3	7.8	2.8	23.6	122	21.9
150	69.6	10.8	7.8	2.6	23.1	129	21.8
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS
Seedlings/hill							
1	69.1	9.4	6.9	2.9	24.8	127	21.8
2	70.2	10.9	7.7	2.7	23.8	122	1.7
4	69.8	12.0	8.4	2.6	22.5	118	1.6
CD (P = 0.05)	NS	0.9	0.4	0.2	1.2	NS	NS

Growth and yield-attributing characters, viz. plant height, maximum and effective tillers/hill, panicle length and weight, grains/panicle and 1,000-grain weight did not very significantly due to nursery seeding density (Table 2), indicating that significant variation in seedling characters has no marked effect on ultimate plant characters. Raju *et al.* (1989) also reported similar non-significant variation in the ultimate plant characters due to significant variation in seedling characters of rice.

Most of the growth and yield-attributing characters, however varied significantly due to difference in seedlings/hill. Maximum number of total and effective tillers/hill were recorded with planting of 4 seedlings/hill. Four seedlings/hill increased the maximum tillers number by 28 and 10% and the effective tillers number by 22 and 9% over planting of 1 and 2 seedlings/hill respectively. About 73% of the total tillers became effective with planting 1 seedling/hill, which declined to 71 and 70% with planting 2 and 4 seedling/hill. Panicle length and weight, on the other hand, were maximum with planting of 1 seedling/hill and decreased significantly with the increase in the seedlings/hill. Grains/panicle and 1,000-grain weight were also maximum with planting of 1 seedling/hill but differences in these attributes due to differences in seedlings/hill were not significant.

Yield

Grain and straw yields remained unaffected by the nursery seedling density (Table 3) indicating that higher seeding density of 100 and 150 g/m^2 though produced less vigorous seedlings but the plants in the main field compensated the initial loss in vigour and gave as much yield as the vigours seedlings obtained from low

Table 3. Effect of nursery seeding density and seedling rate on yield of summer rice

Treatment	Grain yield (q/ha)			Straw yield (q/ha)		
	1995–96	1996–97	Pooled	1995–96	1996–97	Pooled
Nursery seeding density (g/m^2)						
50	65.30	68.90	67.10	55.20	67.20	61.20
75	64.60	70.00	67.30	47.90	69.20	58.60
100	63.70	69.30	66.50	49.00	69.70	59.40
150	62.60	69.40	66.00	45.50	69.40	57.50
CD (P = 0.05)	NS	NS	NS	NS	NS	NS
Seedlings/hill						
1	56.00	64.70	60.40	44.90	64.40	54.70
2	67.00	71.50	69.30	47.20	68.50	57.90
4	69.30	72.10	70.70	52.30	72.80	62.60
CD (P = 0.05)	3.50	3.90	3.60	4.40	5.50	4.85

nursery seeding density. The results are in line with those of Rao (1985) and Raju *et al.* (1989). The advantage of better start of plants obtained from low nursery seeding density probably continues for sometime and disappears in course of time and is therefore not reflected in final yield.

Grain and straw yields, however responded significantly to variation in seedling rate. Planting of 2 and 4 seedlings/hill, being at par recorded significantly more grain yield than planting of 1 seedling/hill, the increase in yield being 19.6 and 23.7% during the first year and 10.5 and 11.4% during the second year due to planting of 2 and 4 seedlings hill respectively over 1 seedling/hill. The result confirmed the findings of Pandey *et al.* (1993). Chandrakar and Chandravansi (1988) also reported that in a medium-duration variety yield difference due to 2 and 4 seedlings/hill was not significant.

Response of straw yield to seedling number/hill was similar to that of grain yield. Planting of 2 and 4 seedlings/hill being at par gave significantly more straw yield than planting of 1 seedling/hill. Higher grain and straw yields with 2 and 4 seedlings/hill over 1 seedling/hill are attributed to more total and effective tillers/hill under these treatments.

The interaction effect of nursery seeding density and seedling rate on grain and straw yields of summer rice was not found to be significant, indicating that effect of one factor on the yield is independent of the other factor.

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