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Effect of age of seedlings and planting density on growth and yield of rice under late planting

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Field experiments conducted during *Kharif* seasons of 1979 and 1980 revealed that 40 day old seedlings were superior to 50 and 60 day old seedlings of rice varieties-Pankaj and Masuri. Grain yield was found to decrease with the increase in seedling age. Crop raised from younger seedlings produced higher number of tillers and panicles per unit area, more grains per panicle, greater percentage of filled grains and higher test weight or grains than those raised from older seedlings. Pankaj proved to be the highest yielder. The spacing of 20×10 cm was found optimum for both these varieties as compared to the other spacing 20×15 cm. This spacing also recorded highest panicle population per unit area. The yield loss due to the use of older seedlings was partially compensated with closer spacing. Yield obtained from 50 day old seedlihgs with 20×10 cm spacing (44.1 q/ha) was as good as obtained from 40 day old seedlings with the spacings of 20×10 cm [45.6 q/ha] and 20 x 15 cm [45.7 q/ha].

The age seedling and planting density are considered as the most important aspects in the cultivation of rice crop with a view point of exploiting its production potentiality. The optimum age of seedling in transplanted rice varies according to duration of the variety, season and management practices followed. (Mahapatra and Leelavathi, 1971). Ghosh and Chatterjee (1980) did not observe any difference in the performances of rice varieties due to the age of seedlings (upto 40 days) for transplanting in *kharif* season under lowland situation in West Bengal. Informations regarding age of seedling and planting density for exploiting yield potentiality of rice in *kharif* season are very scanty. In this season large area (about 73% of the total cultivable land) under rice is dependent upon uncertain and erratic rainfall. The farmers sometimes do not receive adequate rainfall needed for puddling their lands in time which ultimately results late transplanting with old seedlings. Keeping this idea in view, an attempt has been made to study the effect of age of seedling for transplanting and planting density on growth and yield of rice under late planting during *kharif* season.

METERIAL AND METHODS

The experiments were conducted at the College of Agriculture Farm (23.39° N Latitude, 87.42° E longitude and 58.9 m altitude) of Visva Bharati, Sriniketan, West Bengal during the *kharif* seasons of 1979 and 1980. The soil of the expermental field was lateritic loam, low in nitrogen available phosphorus and available potassium with a pH of 5.8. The climatic factors prevailing during the course of experimentation are shown in Table 1.

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The experiments were laid out in randomised block design with two varieties (Pankaj and Masuri), three ages of seedlings (40, 50 and 60 day old) and two planting densities (20 × 10 cm and 20 × 15 cm spacing) replicated thrice in 6m × 3m plots. The crop was transplanted taking 2 to 3 seedlings per hill on August 3 and 6 during 1979 and 1980 respectively. All plots received a common dose of 80kg N, 60 kg P_2O_5 and 60 kg K_2O/ha. Nitrogen and potassium in the form of urea and muriate of potash respectively were applied in two equal splits-half at transplanting and remaining half at 30 days after transplanting. Full dose of phosphorus as single super-phosphate was given at transplanting. The crop was adequately protected from weeds, diseases and insect-pests and received irrigations as and when needed. Observations were recorded on number of tillers/m^2 at 40 days after transplanting and height of the plant, number of panicles/m^2, number of grains per panicle, percentage of filled grains and test weight of grains (1000-grain weight) along with grain yield at maturity. Height of the plants were measured from ten randomly selected plants in each plot. Number of tillers and panicles were counted from one meter length row at two locations in each plot for determining the number of tillers/m^2 and number of panicles/m^2 respectively. Ten randomly selected panicles from each plot were tested for number of filled and unfilled grains per panicle from which percentage of filled grains were obtained and the test weights of grains were noted after drying these filled grains. The grain yields were recorded from an area of 5 × 2 cm in each plot. Both the varieties took 140 to 150 days to mature.

RESULTS AND DISCUSSION

Growth attributes :

Height of the plants recorded at maturity showed that it differed markedly between the two varieties under study and Masuri produced taller plants than Pankaj during both *kharif* seasons. But Pankaj produced significantly greater number of tillers per unit area recorded at 40 days after transplanting than Masuri (Table 2). The tallest plants and greatest number of tillers per unit area were observed in plots where younger (40 day old) seedings were transplanted and it was closely followed by the crop raised from 50 day old seedlings. The plant height and number of tillers per unit area decreased sharply with increasing the age of seedlings for transplanting from 50 to 60 days during both the years. The crop established at an early age resulted in comparatively taller plants with more number of tillers per unit area because it exposed to a better environment earlier. The plant height did not differ markedly due to different planting densities although closer spacing tended to increase the height of the rice plants during both the years. Highly significant effect of spacing on tillering was observed in both the years. Spacing of 20 × 10 cm proved to be superior to the other spacing (20 × 15 cm) in respect of number of tillers per unit area. From the above results it appeared that the growth for rice plants with regard to plant height

and tillering tended to decrease with increasing the age of seedlings for transplanting and spacing. Similar results were also observed by Narayaswamy and Nagarathna (1966) and Barthakur and Gogoi (1974).

Yield components:

The results presented in Table 3 revealed that Pankaj produced significantly higher number of panicles per unit area and greater test weight of grains than Masuri while Masuri contai ned more number of grains per panicle and greater percentage of filled grains than Pankaj during both the years. Such varietal differencer in yield components were also obtained by Barthikur and Gogoi (1974) in Assam. The number of panicles per unit area, number of grains per panicle, percentage of filled grains and test weight of grains decreased gradually as the age of seedlings for transplanting incresed from 40 to 60 days and the maximum values of all these characters were obtained using 40 days old seedlings for transplanting during both the years. However the yield components did not very markedly between the plants raised from 40 and 50 day old seedlings. Very poor performances in all these characters were recorded in crops raised from older (60 day old) seedings. This was perhaps due to the fact that the crop raised from older seedings faced severe plant competition in the crowded environment of the nursery for a longer time. This result is in conformity with the findings of Narayanaswamy and Nagarathna (1966). Closer spacing (20 × 10 cm) resulted in greater number of panicles per unit area than wider spacing (20 × 15 cm) but the crops raised from wider spacing produce heavier grains in their panicles than those raised from close spacing during both the *kharif* seasons. The number of grains per panicle and percentage of filled grains were not influenced markedly due to different planting densities. The interaction effects of different factors were found not significant.

Grain Yield

The data presented in Table 4 clearly showed that the two varieties differed significantly in respect of grain yield and Pankaj out yielded Masuri during both the *kharif* seasons. This was also confirmed in their pooled analysis. The differential varietal response was also obtained by Barthakur and Gogoi (1974). The effect of seedling age on grain yield was highly significant during both the years. It was observed that yield decreased with the increase in seedling age and crop raised from older (60 day old) seedling produced significantly lower yields (33.15 and 36.43 q/ha) as compared to those of 50 day old seedlings (40.26 and 44.40 q/ha) and 40 day old seedlings (43.50 and 47.79 q/ha) during both the the years. This was also observed in their combined analsis. Similar results were also observed by Narayanswamy and Nagarathna (1966) from October planting in Tamil Nadu and Barthakur and Gogoi (1974) from spring planting in Assam. The lower yield of crop raised from older seedlings was mainly due to the fact that they faced sereve plant competition for a longer period in the croweded envirenement of the nursery bed while the plants trans-

planted at an early age established in a better environment earlier and ultimately produced higher yield. Highly significant effect of spacing on grain yield was observed during both the years and highest grain yield was obtained under 20 x 10 cm spacing. Have (1971) also reported that under good management and adequate nitrogen application, the optimum spacing in high yielding varieties in *kharif* season should be around 20 x 10 cm. The interaction effect of seedling age and spacing on grain yield of rice was found significant during both the years. Older (60 day old) seedlings when transplanted with closer spacing (20x10 cm) produced higher yield than wider spacing (20 x 15 cm). Similar trend of results were also observed when 50 day old seedlings were transplanted, but in case of 40 days old seedlings, the grain yield obtained from different planting densities did not vary during both the years. Crop raised from 50 days old seedlings with close spacing (20 x 10 cm) produced as high yield as obtained from the crop of 40 days old seedlings with both the spacings. This results clearly showed that the yield loss due to transplanting older seedlings was partially compensated with closer spacing. Younger (40 days old) seedlings may be transplanted safely at wider spacing (20 x 15 cm) but the older (50 or 60 days old) seedling should be transplanted at closer (20 x 10 cm) spacing in order to obtain the highest possible yield. Under conditions when season is advancing, the seedlings of both Pankaj and Masuri upto 50 day old may safely be used for transplanting with closer spacing (20 x 10 cm) for obtaining high crop yield.

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Table 1 : Weather during crop growth.

Particulars	Months			
	August	September	October	November
Maximum temperature (°c) :				
1979	32.7	33.1	32.1	31.2
1980	32.4	32.7	31.3	29.8
Normal	32.0	32.0	31.4	31.4
Minimum temperature (°c) :				
1979	26.1	24.5	22.7	20.2
1980	26.1	25.6	22.4	16.8
Normal	25.6	25.3	22.7	17.3
Rainfall (mm).				
1979	165.7	286.5	86.1	44.0
1980	339.1	193.1	283.1	–
Normal	294.9	257.4	116.7	16.2
Relative humidity (%) :				
1979	84.2	84.2	78.9	72.9
1980	86.3	84.3	81.3	68.5
Normal	87.2	86.1	80.5	73.8
Sunshine Hours :				
1979	4.4	5.7	8.2	7.5
1980	4.7	5.6	7.3	9.1

Table 2 : Effect of age of seedling for transplanting and spacing on growth attributes of rice.

Particulars	Plant height (cm) at maturity		No of tillers/m²	
	1979	1980	1979	1980
Variety:				
Pankaj	91.4	99.7	292	324
Masuri	89.8	128.5	245	286
S. Em (±)	2.8	3.7	6.8	7.5
C. D. at 5%	8.1	10.8	19.9	22.0
Age of seedling at transplanting (days) :				
40	102.1	120.3	293	330
50	97.8	117.7	277	312
60	88.9	104.2	236	273
S. Em (±)	3.4	4.5	8.3	9.2
C. D. at 5%	9.9	13.3	24.4	26.9
Spacing (cm)				
20 × 10	97.0	115.7	280	318
20 × 15	94.2	112.8	257	292
S. Em (±)	2.8	3.7	6.8	7.5
C. D. at 5%.	–	–	19.9	22.0
C. V.	12.2	13.9	10.7	10.4

Table : 3 Effect of age of seedling for transplanting and spacing on yield components of rice

Particulars	No. of panicles/m²		No. of grains/panicle		% of filled grains		Weight of 1000-grains (g)	
	1979	1980	1979	1980	1979	1980	1979	1980
Variety:								
Pankaj	225	273	96	101	72.7	82.2	22.01	23.50
Masuri	205	248	131	141	80.5	86.7	15.65	18.48
S. Em	44	6.2	2.6	3.2	1.7	1.4	0.26	0.23
C.D. at 5%	12.9	18.2	7.7	9.3	5.0	4.1	0.76	0.67
Age of seedling at transplanting (days)†								
40	232	274	119	130	80.7	87.2	19.46	20.43
50	221	266	116	127	78.1	85.9	18.82	20.06
60	192	242	106	115	71.1	80.2	18.21	19.51
S.Em	5.4	7.8	3.2	3.9	2.1	1.7	0.32	0.28
C. D. at 5%	15.8	22.3	8.3	11.4	6.2	5.0	0.93	0.82
Spacing (cm)								
20×10	222	270	113	120	76.0	83.7	18.42	19.52
20×15	208	251	114	128	77.2	85.2	19.24	20.46
S Em	4.4	6.2	2.6	3.2	1.7	1.4	0.26	0.23
C.D. at 5%	12.9	18.2	—	—	—	—	0.76	0.67
C. V.	8.7	10.1	9.8	10.9	9.5	7.0	5.8	4.7

Table 4 : Effect of age of seedling at transplanting and spacing on grain yield of rice (q/ha)

Age of seedling at transplanting (days)	Varieties		Mean	Spacing (cm)	
	Pankaj	Masuri		20 x 10	20 x 15
1979 :					
40	44.9	42.0	43 5	43.7	43 3
50	42 0	38.4	40.2	41.6	38 8
60	34.6	31.6	33.1	35 6	30.6
Mean	40 5	37 3		40.3	37 6
	Variety	Seedling age	Spacing	Sp. x seedling age	
S. E.	0.9	1.0	0.8	1.5	
C. D. at 5%.	2.6	3.1	2 6	4.5	C.V. 9.7
1980 :					
40	51.9	43 6	47.7	47.6	47.9
50	48.1	40.6	44 4	46.6	42.1
60	39.3	33.5	36.4	39.6	33.2
Mean	46.4	39.2		44.6	41.1
	Variety	Seedling age	Spacing	Sp. x seedling age	
S. Em	1.1	1.4	1.1	2.0	
C. D. at 5%.	3.4	4.2	3.4	5.9	C. V. 11.6
Pooled Analysis :					
40	48.4	42.8	45.6	45.6	45.6
50	45.0	39.5	42.3	44.1	40.5
60	36.9	32.5	34.7	37.6	31.9
Mean	43.5	38.3		42.4	39.3
	Variety	Seedling age	Spacing	Sp. x seedling age	
S. Em	1.1	1.2	1.0	1.7	
C. D. at 5%.	2.9	3.6	2.9	5.1	