

Optimization of Plant Spacing for Higher Seed Yield in Rice (*Oryza sativa* L.) Cultivar Pusa Sugandh-5

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Rice (*Oryza sativa* L.) is the staple food for more than two billion people in Asia and many millions in Africa and Latin American countries. The demand of quality rice like *Basmati* varieties of rice in India has increased not only because of increase in purchasing power of the middle class but also due to increased consciousness and preference for good quality scented rice. However, one of the important factors which affect the production of good quality seed in rice is the maturity stage of the crop, which in turn is prone to modifications in agronomic practices. Optimum plant spacing influences the availability of sunlight and nutrients for growth and development of plants. Among the different factors of crop productivity, desired number of plants per unit area is an important parameter for achieving higher yields [1]. Improper spacing reduced yield up to 20-30% [2] while optimum spacing ensured better plant growth through efficient utilization of solar radiation and nutrients [3, 4]. 'Pusa Sugandh-5' is a semi-dwarf, medium duration, high yielding aromatic rice variety and it is characterized by broader leaf than other *Basmati* varieties in the field conditions. Therefore, keeping in view, the specific plant type of 'Pusa Sugandh-5', an experiment was conducted to determine the optimum spacing for this rice variety.

The field experiment was conducted at Seed Production Unit Farm of ICAR-Indian

Agricultural Research Institute, New Delhi during two *kharif* seasons of 2008-09 & 2009-10. The rice cultivar 'Pusa Sugandh-5' (Pusa 2511) was used for transplanted experiment with six different hill spacing treatments *i.e.*, T-1 (30 cm x 20 cm), T-2 (30 cm x 15 cm), T-3 (30 cm x 10 cm), T-4 (20 cm x 20 cm), T-5 (20 cm x 15 cm) and T-6 (20 cm x 10 cm) cm. The experiment was designed in Randomized Block Design (RBD) with three replications. Gross plot size was kept at 3 m x 3 m. The crop was raised with all the recommended package of practices for growing seed crop of rice. The observations on various growth parameters like plant height, number of days to 50% flowering, number of days to 50% maturity, panicle exertion (%) and yield contributing characters like spikelet fertility (%), number of productive tillers per hill and number of filled grains were recorded on ten randomly selected panicles from each plot. Seed yield, total biological yield and harvest index were recorded on plot basis and given in t/ha. All the collected data were analyzed according to [5] and mean values were estimated by using least significant differences (LSD) test at 5% level of significance.

The results revealed that among all treatments, plant spacing of 20 cm x 10 cm significantly influenced the plant height, days to 50% flowering and days to 50% maturity and a significant reduction in the values of all these three parameters was recorded (Table 1). There

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Table 1. Effect of different hill spacing on growth parameters of Pusa Sugandh-5

Treatments (cm)	Days to 50 % flowering (No.)		Days to 50 % maturity (No.)		Plant height (cm)		Panicle exertion (%)	
	2008	2009	2008	2009	2008	2009	2008	2009
	T-1 (30x20)	103	103	144	144	113.8	114.8	95.9(78.4)
T-2 (30x15)	101	100	143	143	109.8	110.9	95.3(77.5)	95.6(78.0)
T-3 (30x10)	99	99	143	141	102.9	103.8	94.8(76.8)	94.2(76.2)
T-4 (20x20)	102	100	144	143	107.4	108.5	95.2(77.4)	95.1(77.2)
T-5 (20x15)	99	99	143	143	107.5	108.2	94.8(76.9)	94.4(76.3)
T-6 (20x10)	97	98	139	139	95.3	96.3	94.3(76.4)	94.8(76.8)
Mean	100	100	143	142	106.1	107.1	95.1(77.3)	95.0(77.1)
LSD (5 %)	1.40	1.51	0.83	1.14				

*Figures in the parentheses are angular transform values

Table 2. Effect of different spacing on yield attributing characters in Pusa Sugandh-5

Treatments (cm)	Spikelet fertility (%)		Productive tiller/ hill (No.)		Filled grain panicle (No.)		Harvest index (%)		Seed yield (t/ha)	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
	T-1 (30x20)	92.2(73.9)	92.4(74.0)	17	16	167	170	46.6	47.9	6.62
T-2 (30x15)	92.6(74.5)	93.2(74.9)	15	14	160	163	45.8	46.7	6.40	6.82
T-3 (30x10)	90.2(72.0)	91.8(73.4)	13	13	152	155	42.0	43.2	6.09	6.25
T-4 (20x20)	93.1(74.9)	94.5(76.4)	16	15	159	162	47.0	48.6	5.71	5.95
T-5 (20x15)	87.2(69.9)	92.8(74.5)	13	13	148	151	44.3	45.5	6.05	6.27
T-6 (20x10)	91.1(73.0)	92.6(74.3)	13	12	147	150	41.2	42.5	5.21	5.44
Mean	91.4(73.0)	90.8(72.4)	14	14	156	159	44.48	45.73	6.01	6.29
LSD (5 %)	2.17	1.14	5.88	3.71	0.322					

*Figures in the parentheses are angular transform values

was a decrease in days to 50% flowering, days to 50% maturity and plant height in accordance with the decrease in plant spacing. The spacing of 20 cm x 10 cm was characterized by lesser number of productive tillers, filled grains per panicle and low harvest index (HI) as well as seed yield (Table 2). There was no significant ($P < 0.05$) difference in panicle exertion and

spikelet fertility among treatments. Significantly higher number of productive tillers per hill (17 & 16) and number of filled grains per panicle (167 & 170) was observed in T₁ (30 cm x 20 cm spacing) during 2008 and 2009, respectively (Table 2). On the other hand, closer spacing of 20 cm x 10 cm resulted in lowest number of productive tillers per hill (13 & 12), number of filled grains

per panicle (147 & 150) and lowest seed yield (5.21 t/ha & 5.44 t/ha) during 2008 and 2009, respectively. Highest seed yield of 6.62 and 7.01 t/ha was recorded in the spacing of 30 cm x 20 cm during the year 2008 and 2009, respectively which was significantly higher than all other plant spacing treatments. This spacing represented the optimum hill population of 20 hills per m² for cv. 'Pusa Sungadh-5' under the Delhi conditions. The wider plant spacing resulted in considerably vigorous plant growth and caused a significant ($P \leq 0.05$) increase in number of productive tillers per hill and number of filled grains per panicle [6] also reported similar results. Harvest index (HI) of 'Pusa Sungadh-5' was not significantly affected by any plant spacing treatment. However, an increasing trend was observed in HI with the increase in plant spacing. This may be due to mutual shading of plants resulting in reduced availability of sunlight for photosynthesis and dry matter production. In present study, individual plants grown with wider spacing exhibited better performance as compared to the plants with closer spacing.

It may be concluded that the wider plant spacing of 30 cm x 20 cm resulted in highest seed yield as compared to other plant spacing treatments, which might be attributed to better ability of plants to take up nutrition from the soil and optimum utilization of solar radiation for photosynthetic activity, resulting in superior

performance. Hence, hill spacing of 30 cm x 20 cm should be followed for getting higher seed yield in transplanted rice variety 'Pusa Sugandh-5' under Delhi conditions.

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