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Research Communication

Effect of planting geometry and weed-management practices on yield of scented rice (*Oryza sativa*) varieties

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ABSTRACT

A field experiment was conducted at the Shaheed Gundadhur College of Agriculture and Research Station, of the Indira Gandhi Krishi Vishwavidhyalaya, Jagdalpur, Chhattisgarh during rainy season (*Kharif*) of 2019, to evaluate the effect of planting geometry and weed-management practices in transplanted scented rice varieties. Treatments consisting combination of 2 varieties, 2 planting geometry and 4 weed management practices were replicated thrice in a split-split plot design. The dominant weeds in transplanted rice were: *Ludwigia peploides* (Kunth) P.H. Raven., *Spilanthes acmella* (L.) C.B. Clarke ex Hook. f., *Echinochloa colona* L., *Cyperus difformis* L., *Cyperus iria* L., *Commelina benghalensis* L. and *Fimbristylis miliacea* (L.) Vahl. Significantly lowest population of different weed species, and the highest grain and straw yields, and harvest index were found with variety, 'Tarunbhog Selection 1' while the maximum test weight was observed with 'Dubraj Selection 1'. The planting geometry of 20 cm × 20 cm recorded the minimum weed population and the highest yield and benefit cost ratio. Application of pyrazosulfuron ethyl 10% WP @ 20 g/ha at 3 Days after transplanting (DAT) + 1 hand weeding (HW) at 25 DAT was found the most effective for broad-spectrum weed control and increased the rice grain yield. The highest net returns and benefit cost were recorded with the pre-emergence application of pyrazosulfuron ethyl 10 % WP @ 20 g/ha.

Key words: Benefit: cost ratio, 'Dubraj selection 1', Harvest index, Planting Geometry, 'Tarunbhog Selection 1', Weed

Rice (*Oryza sativa* L.) is the most important foodgrain crop of India and a major source of energy for about 60% of the global population. Asia's food security mainly depends on the irrigated rice which contributes one-third of total rice production. About 90% rice is produced and consumed in Asian country (Basha *et al.,* 2017). Among the paddy producing countries, India has the largest acreage (43.39 million ha) and is the second largest producer (104.32 million tonnes) next to China (207 million tonnes). The productivity of rice in India is quite low 2.39 t/ha, while the world's average productivity is 4.25 t/ha. Chhattisgarh occupies an area of 3.84 million ha with production and productivity of 6.09 million tonnes and 1.5 t/ha respectively (MAFW, 2016).

Chhattisgarh is very popular for growing short slender/medium slender aromatic rice i.e. 'Dubraj', 'Tulsi Manjari', 'Badshahbhog', 'Vishnubhog', 'Gopalbhog', 'Kubrimohar', 'Laxmibhog' and 'Jawaphool'. More than 100 local landraces of scented rice with pleasing aroma are grown in different parts of the Chhattisgarh state. Among the scented rice, 'Dubraj' occupies ~10 % of the total rice growing area of the Chhattisgarh state (Sharma *et al.,* 2017).

An ideal plant population influences the use of solar radiation and nutrients for their growth and development. For the higher rice productivity, desired number of plant population per unit area is an important one for getting maximum yield (Das *et al.,* 2016; Choudhary *et al.,* 2022).

Weeds are the major biotic constraint to reduce the rice productivity worldwide (Das *et al.* 2016; Choudhary *et al.,* 2022). In transplanted rice, about 60% of the weeds emerge in the period between 1 week to 1 month after

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transplanting. These emerging weeds are competing with rice at effective tillering stage and decline the quantity of panicles leading in reduction of grain yield. Weed management can be achieved by either application of pre-emergence or post - emergence or combination of both or manual weeding. The herbicides offer the most effective, economical and practical way of weed management (Sureshkumar and Durairaj, 2016).

A field experiment was conducted at the Shaheed Gundadhur College of Agriculture and Research Station, of the Indira Gandhi Krishi Vishwavidhyalaya, Jagdalpur, Chhattisgarh during rainy season (*kharif*) of 2019. The experiment was laid out in a split split plot design with 3 replications. The main plot treatment consisted of 2 scented rice varieties, viz. 'Dubraj Selection 1' (V_1) and 'Tarunbhog Selection 1' (V_2), sub plot treatments comprised 2 planting geometry, viz. 20 cm × 15 cm (G_1) and 20 cm × 20 cm (G_2), and sub- subplot consisted of 4 weed management practices, viz. pyrazosulfuron ethyl 10% WP @ 20 g/ha at 3 days after transplanting (DAT) + 1 Hand wedding (HW) at 25 DAT (W_1), bispyribac sodium 10% SC @ 20 ml/ha at 25 DAT + 1 HW at 50 DAT (W_2), 2 HW at 25 and 50 DAT (W_3) and absolute control (W_4). Soil of the experimental site was clay loam, (*Alfisol*) slightly acidic and medium in organic matter and available NPK. During *kharif* 2019, the normal average annual rainfall of the area was, 1,440 mm during cropping season but its distribution was very erratic. Major amount of precipitation occurs between June and September, a total of 1,740.20 mm rainfall was received with 78 rainy days. The maximum temperature varied from 31.7°C in 4th week of June to 30.7°C in 4th week of November, whereas the minimum varied from 13.8°C in 1st week of November to 13.1°C in 2nd week of December.

The major weeds found in association with transplanted rice during *kharif* 2019 were: *Ludwigia peploides* (Kunth) P.H. Raven, *Echinochloa colona* L., *Cyperus difformis* L., *Cyperus iria* L., *Commelina benghalensis* L. and, *Fimbristylis miliacea* (L.) Vahl.

Data pertaining to the total weed density on different weed species in Table 1. Rice field was infested with *Ludwigia peploides* and *Spilanthes acmella* (21%) *Cyperus iria* (14%), *Fimbristylis miliacea* (10%), *Commelina benghalesis, Cyperus difformis* (8%) in *Echinochloa colona.* (7%) and other weeds (11%).

Data relating to grain and straw yield are presented in Table 2. Grain yield of scented rice was not affected significantly not 2 varieties; however higher grain yield was observed in variety V_2 than the variety V_1. Planting geometry of G_1 resulted in higher grain yield than the G_2, because of greater weed suppression, which resulted in higher of crop dry matter, more effective tillers and less yield due to less dry matter accumulation, and less number of tillers/m^2. In case of different weed management practices, W_1 exhibited significantly higher grain yield, being at par with W_3 and W_2 treatments. Minimum crop-weed competition resulted in higher grain as also reported by Ghosh *et al.,* (2016).

Likewise, straw yield was significantly superior in W_2 treatment and it was at par with W_3 in among the weed management practices.

Table 1. Density of total weed density (m^2), weed control efficiency (%) weed index of rice as influenced by different variety, planting geometry and weed management practices

Treatment	Total weed density/m^2 (number)				Weed-control efficiency (%)				Weed Index
	At 25 DAT	At 50 DAT	At 75 DAT	At harvesting	At 25 DAT	At 50 DAT	At 75 DAT	At harvesting	
Variety									
V_1	54.88 (7.06)	39.13 (5.26)	53.43 (6.01)	57.33 (6.33)	25.66	68.40	68.78	67.96	-0.82
V_2	41.25 (6.18)	35.51 (5.16)	45.60 (5.72)	49.18 (5.94)	29.29	66.02	67.50	67.46	3.25
SEm±	0.17	0.09	0.03	0.03	3.52	0.81	0.49	0.33	1.60
CD (P=0.05)	NS	NS	0.15	0.18	NS	NS	NS	NS	NS
Geometry									
G_1	37.18 (5.87)	33.54 (4.99)	45.28 (5.59)	50.03 (6.00)	30.21	66.58	68.33	67.41	-0.79
G_2	58.94 (7.37)	41.10 (5.43)	53.74 (6.13)	56.47 (6.27)	24.73	67.84	67.95	68.01	3.22
SEm±	0.05	0.03	0.07	0.03	1.32	0.30	0.20	0.24	3.00
CD (P=0.05)	0.20	0.11	0.27	0.11	5.17	1.51	NS	NS	NS
Weed-management									
W_1	10.97 (3.34)	7.77 (2.82)	23.86 (4.76)	26.25 (5.01)	82.80	93.05	85.23	84.66	-2.55
W_2	58.48 (7.58)	12.82 (3.57)	9.75 (3.12)	11.45 (3.38)	12.03	88.62	93.80	93.18	-6.94
W_3	56.55 (7.45)	14.39 (3.76)	10.23 (3.17)	11.81 (3.41)	15.06	87.17	93.52	93.00	0.00
W_4	66.26 (8.10)	114.31 (10.68)	154.21 (12.39)	163.51 (12.75)	0.00	0.00	0.00	0.00	14.35
SEm±	0.13	0.13	0.13	0.14	1.87	1.01	0.96	0.90	2.96
CD (P=0.05)	0.37	0.38	0.37	0.39	7.31	2.95	2.81	2.61	8.63

V_2, 'Tarunbhog Selection 1'; G_1, 20 × 15 cm; G_2 20 cm × 20 cm; W_1, Pyrazosulfuron ethyl 10% WP @ 20 g/ha at 3 DAT + 1 hand-weedings HW at 25 days after transplanting (DAT); W_2, bispyribac sodium 10% SC @ 20 ml/ha at 25 DAT + 1 HW at 50 DAT; W_3, 2 HW at 25 and 50 DAT and W_4, Absolute control

Table 2. Test weight, grain yield, straw yield, harvest index, cost of cultivation, net returns and benefit: cost ratio of rice as influence by different variety, planting geometry and weed-management practices

Treatment	Test weight (g)	Grain yield (t/ha)	Straw yield (t/ha)	Harvest index (%)	Cost of cultivation	Net returns (₹/ha)	Benefit: cost ratio
Variety							
V_1	18.28	4.12	5.44	4.30	129296	83599	1.82
V_2	14.43	4.40	5.67	4.35	137448	91750	2.01
SEm±	0.05	0.64	0.82	0.03			0.043
CD (P=0.05)	0.29	NS	NS	NS			NS
Geometry							
G_1	16.33	4.40	5.63	4.35	137335	91012	1.96
G_2	16.38	4.13	5.45	4.35	129409	84336	1.87
SEm±	0.14	0.61	0.75	0.31			0.040
CD (P=0.05)	NS	2.37	NS	NS			NS
Weed-management							
W_1	16.48	4.61	5.39	4.60	143638	98252	2.16
W_2	16.80	4.41	6.14	4.22	138594	91458	1.94
W_3	16.63	4.50	5.67	4.42	140874	92989	1.94
W_4	15.49	3.51	5.13	4.14	110383	67997	1.60
SEm±	0.16	0.71	1.06	0.29			0.048
CD (P=0.05)	0.48	2.92	2.53	0.85			0.14

V_1- 'Dubraj Selection 1', V_2- 'Tarunbhog Selection 1', G_1- 20 × 15 cm, G_2 - 20 cm × 20 cm, W_1- .Pyrazosulfuron ethyl 10% WP @ 20 g/ha at 3 DAT + 1 HW at 25 DAT, W_2- bispyribac sodium 10% SC @ 20 ml/ha at 25 DAT + 1 HW at 50 DAT, W_3- 2 HW at 25 and 50 DAT and W_4- Absolute control.

Harvest index was significantly superior in planting geometry of G_1 over the G_2. It might be the consequential effects of maximum tillers/hill and grains/panicle. In case of different weed management practices, treatment W_1 resulted in significantly higher harvest index. The herbicidal treatment had similar effect as that of hand-weeding in controlling weeds scented rice, which might be attributed to long term effective control of weeds during the growing period of crop as reported by Hasanuzzaman *et al.,* (2008).

Data presented in Table 3. Interaction effects of varieties × planting geometry × different weed management practices were found significant. The interaction of $V_1 \times G_1 \times W_1$ resulted in significantly higher grain yield than at par with $V_1 \times G_1 \times W_2$ and $V_1 \times G_1 \times W_3$. Interaction of $V_2 \times G_1 \times W_1$ resulted in significantly higher grain yield than at par with $V_2 \times G_1 \times W_3$, and $V_2 \times G_1 \times W_2$ showed statisti-

Table 3. Interaction effect on grain yield of rice as influence by different variety, planting geometry and weed management practices

Treatment	Grain yield (t/ha)				Mean
	Variety				
	V_1		V_2		
	Geometry				
	G_1	G_2	G_1	G_2	
Weed-management					
W_1	4.80	4.50	4.74	4.43	4.61
W_2	4.53	4.00	4.64	4.45	4.42
W_3	4.55	4.31	4.71	4.47	4.51
W_4	3.51	2.84	3.64	4.10	3.51
Mean V	4.13	4. 39			
Mean G	4.40	4. 13			
	V	G	W	G × W	V × G × W
SEm±	0.64	0.61	0.71	1.00	1.42
CD (P=0.05)	NS	2.37	2.07	NS	4.13

V_1, 'Dubraj Selection 1'; V_2, 'Tarunbhog Selection 1'; G_1, 20 × 15 cm; G_2, 20 cm × 20 cm; W_1, Pyrazosulfuron ethyl 10% WP @ 20 g/ha at 3 DAT + 1 hand-weedings HW at 25 days after transplanting (DAT); W_2, bispyribac sodium 10% SC @ 20 ml/ha at 25 DAT + 1 HW at 50 DAT; W_3, 2 HW at 25 and 50 DAT and W_4, Absolute control

cally higher economic yield.

Different varieties and geometries showed higher gross and net returns, and benefit cost ratio, though not significantly in variety 'Tarunbhog selection 1' and planting geometry of 20 cm × 15 cm than the other treatments. Pyrazosulfuron ethyl 10% WP @ 200 g/ha at 3 DAT + 1 HW at 25 DAT also recorded significantly higher net returns, and benefit: cost ratio.

The variety 'Tarunbhog Selection 1' was found batter variety than 'Dubraj Selection 1' for grain yield. The planting geometry of 20 cm × 15 cm proved better in weed control and grain yield than the geometry 20 cm × 20 cm. Pyrazosulfuron ethyl 10% WP @ 200 g/ha at 3 DAT + 1 HW at 25 DAT also controlled all the weeds at initial stages and produced higher yield and yield attributing characters among all the weed management practices.

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