

Growth and productivity of direct seeded upland rainfed rice as influenced by integrated weed management

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ABSTRACT

A field experiment was conducted during *kharif* seasons of 2007 and 2008 at the Birsa Agricultural University farm, Ranchi on sandy loam soil to study the effect of integrated weed management on growth and productivity of direct seeded upland rainfed rice. Results showed that *Sesbania* intercropped and incorporated at 4 weeks after sowing + pendimethalin 1kg/ha recorded higher leaf area index, crop growth rate, effective tillers (124/m²), maximum grains/panicle (77) and bolder 1000-grain (24.3 g). The treatment produced higher grain yield (2091 kg/ha) and grain production rate (66.0 kg/ha/day) of direct seeded upland rice in comparison to other integrated weed management treatments.

Key words: Integrated weed management, Leaf area index, Crop growth rate, Productivity, Upland rice.

In the changing scenario, rice in eastern India emerges as important and strategic crop. The region has the largest area suitable for rice cultivation and follows a unique practice of cultivation three times in a year. There is a huge rice-wise agricultural labour force and rich biodiversity. The part of the region has abundant water and dependable rainfall. Therefore, changing scenario and technology has thrown open the opportunity to utilize the ample potential for rice production in the region to enhance the food security. In India, total area under upland rainfed rice is about 6 million hectares, which accounts for 13.5% of the total area under rice crop in the country. Upland rice productivity is very low owing to heavy weed infestation. Yield loss due to weeds in direct seeded upland rice varied from 40-100% (Choubey *et al.* 2001) depending on the weed flora, their density and duration of competition. Manual weeding is not only labour intensive but their timely availability is a big problem. Keeping above facts in view, the study on integrated weed management in direct seeded upland rice was conducted with objective to achieve higher crop growth and productivity.

MATERIALS AND METHODS

Field experiments were conducted at the University farm Ranchi, Jharkhand (23°17' N latitude, 85°10'E longitude and 625 m above mean sea level) during *kharif* seasons of 2007 and 2008. The soil of the experimental site was sandy loam in texture, with slightly acidic in reaction (pH 5.2), organic carbon 0.43%, low in available N (243.6 kg/ha) and medium in available P (12.5 kg/ha) and exchangeable K (152.0 kg/ha). The experiment was laid out in randomized block design with eight weed treatments *viz.*, T₁- Pendimethalin 1 kg/ha pre-emergence;

T₂- Pendimethalin 1 kg/ha pre-emergence + 1 hand weeding (HW) at 4 weeks after sowing (WAS); T₃- Pendimethalin 1 kg/ha pre-emergence + 2, 4-D 0.5 kg/ha post-emergence at 4 WAS; T₄-Pendimethalin 1 kg/ha pre-emergence + mechanical weeding (MW) at 4 WAS; T₅ *Sesbania* (broadcast) + T₃; T₆- *Sesbania* (intercropped and incorporated at 4 WAS) + T₁; T₇- 2 hand weeding (at 4 and 6 WAS) and T₈- Weedy check and replicated thrice. Variety of rice "*Vandana*" was sown in line 20 cm apart using 80 kg seed/ha in the last week of June during both years. Crop received recommended fertilizer 60 kg N, 40 kg P and 20 K/ha. Half of N and full phosphorus and potash applied as basal at sowing and the remaining N was top dressed at 30 days after sowing. Crop growth rate and leaf area index was calculated periodically using standard procedure. Yield and yield attributes along with grain and biomass production rate was also calculated.

RESULTS AND DISCUSSION

Effect on crop growth

Leaf area index of upland rice increased with crop age and recorded maximum at 60 days after sowing (Table 1). Upland rice intercropped with *Sesbania* and incorporated at 4 weeks after sowing (WAS) + pendimethalin 1 kg/ha (T₆) being on par with 2 hand weeding (T₇) and *Sesbania* (broadcast) + pendimethalin 1 kg/ha + 2, 4 D 0.5 kg/ha at 4 weeks after sowing (T₃) had higher leaf area index than other integrated weed managements at 20, 40 and 60 days after sowing. At 60 days after sowing, treatment T₆ had maximum leaf area index (3.25) followed by T₇(3.15) and T₃(2.92).

Crop growth rate also increased with crop age reaching its peak during 40-60 days after sowing and

Table 1 Leaf area index and crop growth rate (g/m²/day) in direct seeded rice influenced by integrated weed management

Treatment	Leaf area index			Crop growth rate (g/m ² /day)			
	Days after sowing			Days after sowing			
	20	40	60	20-40	40-60	60-80	80 - Maturity
T ₁ Pendimethalin 1kg/ha	1.0	1.7	2.2	6.1	18.8	15.1	3.4
T ₂ Pendimethalin 1kg/ha + 1 HW	1.4	2.1	2.6	10.4	17.0	15.9	3.2
T ₃ Pendimethalin 1kg/ha + 2, 4 -D 0.5 kg/ha	1.2	1.9	2.4	9.7	17.6	16.6	4.6
T ₄ Pendimethalin 1kg/ha + 1MW	1.1	1.8	2.3	9.4	17.0	14.8	4.1
T ₅ Sesbania (broadcasted) + T ₃	1.4	2.1	2.9	9.8	22.7	16.9	4.4
T ₆ Sesbania (inter-cropped and incorporated) + T ₁	2.0	2.8	3.3	12.8	22.7	20.7	4.5
T ₇ Two hand weeding	1.9	2.7	3.2	12.7	19.4	18.2	3.7
T ₈ Weedy check	0.9	1.6	2.0	3.4	17.3	12.6	7.0
LSD (P= 0.05)	0.6	0.6	0.6	2.7	2.8	NS	NS

HW - Hand weeding; MW - Mechanical weeding

declined thereafter. Upland rice intercropped with Sesbania and incorporated at 4 WAS + pre-emergence application of pendimethalin and 1 kg/ha recorded maximum value throughout crop period was at par with Sesbania (broad-cast) + pendimethalin 1 kg/ha +2,4-D 0.5 kg/ha at 4 WAS during 40-60 days after sowing and with 2 hand weeding during 20-40 days after sowing. The treatment had higher crop growth rate than other integrated weed management during 20-40 and 40-60 days after sowing. However, the effect of integrated weed management on crop growth rate was not significant during later stages. Growing of Sesbania along with direct seeded rice and its subsequent incorporation or browning by 2,4-D might have reduced weed infestation, enhanced soil fertility resulting in higher leaf area index and crop

growth rate of direct seeded rice. This confirms the findings of Mishra and Singh (2007).

Effect on productivity

Sesbania (intercropped and incorporated at 4 weeks after sowing) + pendimethalin 1 kg/ha produced significantly higher grain yield (2091 kg/ha) and grain production rate (66.0 kg/ha/day) of direct seeded upland rice than other integrated weed managements except Sesbania (broadcast) + pendimethalin 1 kg/ha + 2,4-D 0.5kg/ha at 4 weeks after sowing (1845 kg/ha grain and 63.5 kg/ha/day grain production rate) and 2 hand weeding at 4 and 6 weeks after sowing (2074 kg/ha grain and 70 kg/ha/day grain production rate) owing to higher effective tiller/m² (124) coupled with maximum grains/ panicle (77) and heavier 1000-grain 24.3 g (Table 2). Straw yield

Table 2 Yield and yield attributes, harvest index, grain production rate and biomass production rate of direct seeded rice influenced by integrated weed management (mean of 2 years)

Treatment	Effective tillers (m ²)	Grains/panicle	1000 grain weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest index (%)	Grain production rate (kg/ha/day)	Biomass production rate (kg/ha/ day)
T ₁ Pendimethalin 1k g/ha	87	67.5	22.4	1219	1950	38.2	38.4	36.0
T ₂ Pendimethalin 1kg/ha + 1 HW at 4 WAS	97	72.5	23.5	1662	2078	44.4	56.5	42.5
T ₃ Pendimethalin 1kg/ha + 2, 4-D 0.5 kg/ha	92	71.3	23.3	1505	1715	46.7	50.2	36.6
T ₄ Pendimethalin 1kg/ha + 1MW at 4 WAS	88	71.2	23.3	1295	1489	46.3	43.7	31.6
T ₅ Sesbania (broadcasted) + T ₃	98	75.5	23.5	1845	2066	47.0	63.5	44.4
T ₆ Sesbania (inter-cropped and incorporated) + T ₁	124	77.0	24.3	2091	2405	46.5	66.0	51.1
T ₇ Two hand weeding	121	75.5	23.9	2074	2488	45.4	70.0	51.8
T ₈ Weedy check	72	60.9	21.3	1004	1506	39.9	31.8	28.5
LSD (P= 0.05)	25	NS	NS	320	83	5	12.0	4.0

HW - Hand weeding; MW - Mechanical weeding, WAS - Weeks after sowing

followed the trend of grain yield. Integrated weed management consisting Sesbania had significantly higher harvest index of direct seeded rice (47.0 and 46.5) than pendimethalin 1kg/ha alone and weedy check. As regards to biomass production rate, Sesbania (intercropped and incorporated at 4 WAS) + pendimethalin 1 kg/ha had significantly higher biomass production rate (51.1 kg/ha/day) than all other integrated weed managements except 2 hand weeding 4 and 6 WAS (51.8 kg/ha/ha). Sesbania might have supplied sufficient nutrients in soil after decomposition coupled with smothering effect on weeds during the crop period which resulted in increased crop growth and yield. This confirmed the findings of Dwivedi and Thakur (2000) and Sardana *et al.* (2004). It may be concluded that integrated weed management of Sesbania intercropped and incorporated 4 weeks after sowing + pendimethalin 1kg/ha having better leaf area

index and crop growth rate may be adopted for achieving higher productivity of direct seeded upland rice.

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