Indian Journal of Weed Science **53**(4): 426–429, 2021

Print ISSN 0253-8040 Online ISSN 0974-8164

Organic weed management in wet-seeded and transplanted aromatic rice

Yerradoddi Sindhu Sree*, Anjan K. Sarmah and I.C. Barua

Department of Agronomy, Assam Agricultural University Jorhat, Assam 785013, India

**Email: srisindhu4784@gmail.com*

Article information

DOI: 10.5958/0974-8164.2021.00078.2

Type of article: Research note

Received : 27 July 2021
Revised : 20 November 2021
Accepted : 23 November 2021

KEYWORDS

Aromatic rice, Inter cropping, *Dhaincha*, Organic weed management, *Sesbania aculeata L.*, Transplanted rice, Wet-seeded rice

ABSTRACT

A field experiment was conducted during rainy (*Sali*) season of 2019 in organic block of Instructional-cum-Research farm of the Assam Agricultural University, Jorhat to study the effect of organic weed management practices on weeds, rice growth, yield attributes and yield of aromatic rice (*Oryza sativa* L. *cv Kola Joha)* established by wet-seeding and transplanting. The experiment was laid out in split-plot design with main plots of two rice establishment methods, *i.e*., direct wet-seeding (WSR), puddled transplanting (PTR) and sub plots of five organic weed management practices, *viz*. weedy check, hand weeding at 20 and 40 days after transplanting (DAT) / seeding (DAS), weeding with rotary weeder at 20 and 40 DAT/DAS, weeding with cono-weeder at 20 and 40 DAT/DAS and intercropping of *Sesbania* (*Sesbania aculeata L.*) and its incorporation at 40 DAT/DAS. The puddled transplanting method of rice establishment resulted significantly higher rice grain yield (1.82 t/ha), decreased weed density and biomass compared to the direct wet-seeding method. The hand weeding twice at 20 and 40 DAT/DAS produced the highest grain yield (2.19 t/ha), maximum weed control efficiency and weed control index. The next best was the intercropping of *Sesbania* and its incorporation at 40 DAT/ DAS (1.69 t/ha), which recorded the highest B:C ratio (2.61) under the puddled transplanting system of rice establishment.

Rice (*Oryza sativa L.*) is the major cereal crop feeding nearly half of the world's population. In India, rice is the most important and widely grown food crop occupying an area of 43.78 million hectares with a production of 118.43 million tons and productivity of 2705 kg/ha during 2019-2020 (Anonymous 2021). The labour intensive and time- consumption procedures involving nursery raising of seedlings and transplanting rice seedlings in the main field in conventional transplanted rice, the direct-seeding method of rice establishment is gaining popularity as a potential alternative to transplanting in many Asian countries since last two decades (Rao *et al.* 2017). The concept of DSR is relatively new to Assam, where rice is accounted for 96% of the state's total food grain production (Das 2021). In DSR weeds are one of the main biological constraints of successful rice production, particularly in the organic production system where the weeds cause yield reduction to the extent of 64-66% in wet- seeded rice and 57-61% in transplanted rice (Mukherjee *et al*. 2008). The organic rice systems are devoid of the herbicide usage. Thus, experiment was conducted to determine the influence of organic weed control methods on weeds, growth, yield attributes and yield of transplanted and wet- seeded aromatic rice.

A field experiment was conducted in Assam Agricultural University, Jorhat, at Instructional cum Research farm (26°45´N latitude, 94°12´E longitude with an elevation of 87 meters above mean sea level) during *sali* (*Kharif*) (rainy) season of 2019. The climatic condition of Jorhat is sub–tropical humid having hot summer and cold winter. Average annual rainfall is 204.20 cm and the mean maximum and minimum temperature during the crop growing period ranged from 25.8°C to 34.8°C and 14.6°C to 26°C, respectively. Weekly average relative humidity during the crop growing season ranged from 86 to 99 per cent during morning hours and 63 to 90% during afternoon hours. Experimental site was sandy loam in texture with pH 5.9, medium in organic carbon (0.58%), low in available N (242.5 kg/ha), low in available P (18.60 kg/ha) and medium in available K (140.6 kg/ha). The experiment was laid out in split-plot design with three replications. The size of each plot was 15 m^2 (5 x 3 m). The treatments consisted of rice established by two methods of establishment, *viz*. puddled transplanted rice (PTR) and direct wet-

seeded rice (WSR) in the main plot and five organic weed management practices, *viz*. weedy check; hand weeding twice at 20 and 40 days after transplanting (DAT)/ seeding (DAS), weeding with rotary weeder at 20 and 40 DAT/DAS; weeding twice with cono-weeder at 20 and 40 DAT/DAS and intercropping of dhaincha (*Sesbania aculeata L.*) and its incorporation at 40 DAT/DAS in the sub-plots. Rice cultivar *'Kola joha'* (150-160 days duration) with seed rate of 40 kg/ha was line sown managing a spacing of 20 x 15 cm in wet-seeded rice. In case of transplanted rice, 25 days old seedlings were transplanted using 2-3 seedlings per hill with the recommended spacing of 20 cm x 15 cm. In intercropping treatment, dhaincha seeds were sown on the day of sowing and transplanting in between the rows of rice. There was one row of dhaincha between two rows of rice was maintained.

The recommended dose of N-P-K for traditional *sali* rice cultivar of Assam is 20- 10-10 kg/ha. Only the recommended dose of nitrogen 20 kg/ha was applied using combinations of three organic sources using 1/3rd each of farm yard manure, vermicompost, and mustard oil cake. Weed Density (no. of weeds/ m^2) at 30 and 60 DAT/DAS and at harvest was recorded by using two quadrats (50 x 50 cm) placed randomly in each plot. Weeds were uprooted from quadrats at 30, 60 DAT/DAS and at harvest, dried in shade after cleaning the soil particles adhered to the roots and oven dried at 60°C. Weed control efficiency and weed control index were calculated using the standard formulae. The observations on rice effective tillers per m^2, panicle length (cm), number of filled and unfilled grains per panicle, 1000 grain weight (g), grain yield (t/ha), straw yield (t/ha) and harvest index were recorded following standard methodologies. The intercropped dhaicha was incorporated manually with hoe at 40 DAT/DAS as per the treatments. The crop was infested with blast and brown spot diseases at tillering stage. The diseases were reasonably controlled by the application of fresh cow dung slurry prepared by mixing 3.0 kg fresh cow dung in 20.0 liters of water.

Effect on weed flora

The experimental field was infested by 12 weed species, of which, grass species *Echinochloa crusgalli* (L.) Beauv. and sedges: *Cyperus iria* L., *Cyperus difformis* L., *Fimbristylis littoralis* Gaudich. had emerged early and appeared in the field within the first fortnight. The broad-leaved weeds like *Monochoria vaginalis* (Burm.f.) C. Presl ex Kunth., *Sphenoclea zeylanica* Gaertn., *Acmella paniculata* (Wall. ex DC.) R.K.Jansen., *Hydrolea zeylanica* (L.) Vahl, *Sagittaria guyayanensis* Kunth. and grasses like *Isachne himalaica* Hook.f. and *Eragrostis japonica* (Thunb.) Trin. appeared at least 25 days after transplanting/sowing.

The weed density and biomass were the highest in wet-seeded rice than in puddled transplanted rice (**Table 1**). In wet-seeded rice the pre-germinated rice seeds were sown in main field and weeds emerged simultaneously with rice resulting in higher competition for growth factors between the WSR and weed than in transplanted field (Rao *et al*. 2007). In transplanting rice system, 25 days old seedlings raised in nursery established well and competed with emerging weeds. (Bhardwaj *et al*. (2018). During first three weeks after sowing high rainfall (409.8 mm) was received creating temporary inundation of plots which reduced the germination of weed seeds resulting lower weed density and biomass at 30 DAS.

Table 1. Effect of rice establishment methods and organic weed management treatments on weed density and weed biomass in aromatic rice

Treatment	Weed density (no./m^2)			Weed biomass (g/m^2)		
	30 DAT/DAS	60 DAT/DAS	Harvest	30 DAT/DAS	60 DAT/DAS	Harvest
Rice establishment method						
Transplanting	4.72(22.4)	6.00(38.2)	6.65(46.4)	7.51(58.5)	7.89(70.7)	8.10(72.2)
Direct-seeded (wet-seeding)	5.00(24.7)	8.29(69.8)	8.52(73.1)	4.72(22.5)	9.77(97.9)	11.79(146.2)
LSD (p=0.05)	0.26	0.38	0.27	0.55	0.13	0.34
Weed management						
Weedy check	5.54(30.3)	9.34(87.5)	9.29(88.2)	8.13(69.7)	12.55(157.2)	13.32(179.2)
Hand weeding twice at 20 and 40 DAT/DAS	4.32(18.3)	5.27(29.8)	5.77(35.0)	4.58(21.0)	6.07(42.1)	7.24(68.1)
Weeding by rotary weeder twice at 20 and 40 DAT/DAS	4.84(23.2)	6.94(48.7)	7.46(55.1)	6.12(38.7)	8.40(71.8)	9.22(88.2)
Weeding by cono-weeder twice at 20 and 40 DAT/DAS	5.23(27.0)	7.94(64.3)	8.34(69.3)	6.30(41.4)	9.98(99.3)	10.98(122.1)
Intercropping of *dhaincha* and its incorporation at 40 DAT/DAS	4.38(19.0)	6.23(39.8)	7.09(51.3)	5.45(31.8)	7.14(51.1)	8.99(88.4)
LSD (p=0.05)	0.43	0.29	0.51	0.26	0.17	0.27
Interaction effect						
LSD (p=0.05)	NS	0.51	NS	0.60	0.25	0.46

$\sqrt{x+0.5}$ transformed values original values in the parentheses, LSD + least significant difference at the 5% level of significance; DAS: Days after seeding; DAT: Days after transplanting

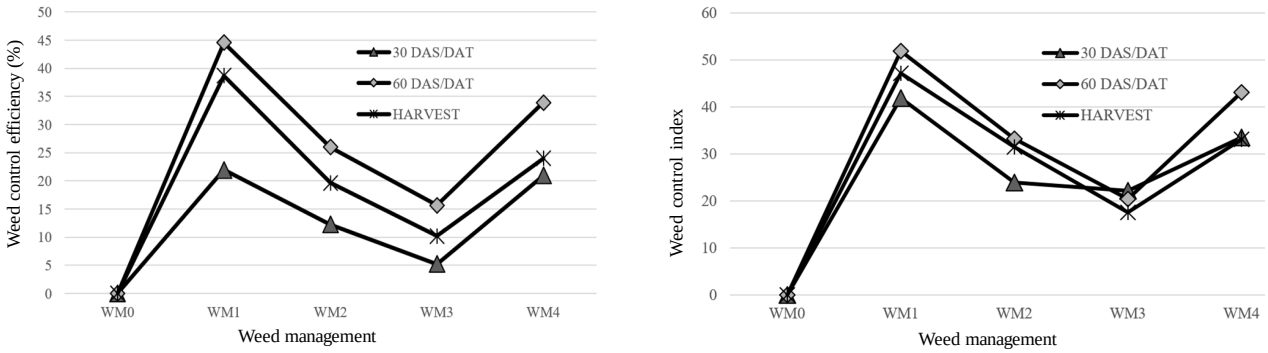

Figure 1. Weed control efficiency and weed control index of different weed management practices under two methods of aromatic rice establishment

Different weed management treatments significantly reduced weed density and biomass as compared to the weedy check. The least weed biomass at 30 and 60 DAT/DAS was recorded with hand weeding twice at 20 and 40 DAT/DAS followed by intercropping of dhaincha and its incorporation at 40 DAT/DAS. Hand weeding provided efficient weed control in comparison to other weed management practices causing reduced weed density and consequently reduced weed biomass as observed by Barla *et al*. (2016).

The rice establishment method had significant effect on WCE and WCI (**Figure 1**). The highest WCE (%) and WCI (%) were found in PTR. Among weed management practices, hand weeding twice at 20 and 40 DAT/DAS (WM1) resulted the highest WCE and WCI followed by intercropping of *dhaincha* and its incorporation at 40 DAT/DAS (WM4) at all observations.

Effect on rice

The effective tillers number/m^2, panicle length, panicle weight, filled grains per panicle and test weight, grain yield and straw yield (**Table 2**) were significantly higher in PTR as compared to WSR. Weeds compete in the crop field for the growth resources and crops get suffered due to this competition. The transplanted crop experienced late emergence of weeds coupled with less weed density which minimized the competition between crop and weed and thereby promoted the growth of different yield attributing characters of the transplanted rice crop.

Different weed management practices significantly influenced rice yield attributing characters and rice grain and straw yield. Hand weeding twice at 20 and 40 DAT/DAS enhanced rice effective tillers no./m^2, panicle length, panicle weight, number of filled grains per panicle, test weight, grain yield and straw yield as compared to the remaining treatments. The next best treatment was

Table 2. Yield attributes, yield and harvest index of aromatic rice as influenced by rice establishment methods and organic weed management treatments

Treatment	No. of effective tillers/m^2	Panicle length (cm)	Panicle weight (g)	Filled grains/ panicle	1000 grain weight (g)	Grain yield t/ha	Straw yield t/ha	Harvest index (%)
Rice establishment method								
Transplanting	207.00	24.16	1.25	103.6	11.85	1.82	3.01	37.23
Direct-seeded (wet-seeding)	159.00	22.68	1.07	98.06	10.86	1.11	2.06	34.00
LSD (p=0.05)	12.64	NS	NS	2.45	0.20	0.11	0.67	1.80
Weed management								
Weedy check	129.00	21.65	1.02	91.5	9.7	0.84	1.60	34.83
Hand weeding twice at 20 and 40 DAT/DAS	231.00	24.68	1.15	109	11.93	2.19	3.50	36.80
Weeding by rotary weeder twice at 20 and 40DAT/DAS	183.86	24.03	1.21	100.5	11.75	1.44	2.49	35.43
Weeding by cono-weeder twice at 20 and 40 DAT/DAS	176.00	23.57	1.09	97.80	11.63	1.16	2.15	35.32
Intercropping of *dhaincha* and incorporation at 40DAT/DAS	193.81	23.76	1.33	105.33	11.76	1.69	2.90	35.66
LSD (p=0.05)	6.92	1.58	NS	3.02	0.45	0.31	0.18	-
Interaction effect								
LSD (p=0.05)	14.46	NS	NS	NS	NS	0.40	0.68	-

LSD: Least significant difference at the 5% level of significance; DAS: Days after seeding; DAT: Days after transplanting

Table 3. Comparative economics of different organic weed management treatments under two establishment methods of aromatic rice

Treatment	Cost of cultivation (x10^3 `/ha)	Gross return (x10^3 `/ha)	Net return (x10^3 `/ha)	B:C ratio
Transplanted rice				
Weedy check	29.14	53.39	24.25	0.83
Hand weeding at 20 and 40DAT/DAS	41.64	136.16	94.52	2.27
Weeding by rotary weeder at 20and 40 DAT/DAS	32.89	87.83	54.94	1.67
Weeding by cono-weeder at 20 and 40 DAT/DAS	32.89	66.06	33.17	1.00
Intercropping of *dhaincha* and its incorporation at 40 DAT/DAS	31.11	112.39	81.28	2.61
Direct wet-seeded rice				
Weedy check	22.64	32.57	9.92	0.44
Hand weeding twice at 20 and 40 DAT/DAS	35.14	82.82	47.68	1.36
Weeding by rotary weeder twice at 20 and 40 DAT/DAS	26.39	57.38	30.99	1.17
Weeding by cono-weeder twice at 20 and 40 DAT/DAS	26.39	52.67	26.28	0.99
Intercropping of *dhaincha* and its incorporation at 40 DAT/DAS	24.64	58.83	34.19	1.38

LSD: Least significant difference at the 5% level of significance; DAS: Days after seeding; DAT: Days after transplanting.

intercropping of dhaincha and its incorporation at 40 DAT/DAS. Intercropping dhaincha which is a green manure crop added not only valuable plant nutrient through atmospheric fixation of N, but also reduce the occurrence of weed by occupying the interspaces. Thus, led to increased grain yield and straw yield. Manual weeding has more advantage because of complete removal of weeds and helps in increasing grain yield and straw yield (Barla *et al.* 2016). Rice grain yield and weed biomass at 60 DAT / DAS had noticed a negative linear relationship with coefficient of determination of 0.844 was observed between rice grain yield and weed biomass at 60 DAT/DAS.Even though the highest grain yield was with the treatment hand weeding twice at 20 and 40 DAS/DAT (**Table 2**), the highest B:C ratio was recorded with intercropping of dhaincha and its incorporation at 40 DAS/ DAT, which was 2.61 and 1.38 with transplanted rice and wet seeded rice, respectively (**Table 3**). Hence, it may be concluded that for obtaining optimum grain yield and economic returns, intercropping of dhaincha and its incorporation at 40 DAT/DAS may be considered as one of the best options for organic weed management in aromatic rice.

REFERENCES

Anonymous. 2021. *Agricultural Statistics 2020*. Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare, Gov of India.

Barla S, Upasani RR, Pandey AC and Kumar SS. 2016. Weed management through green manuring in direct seeded rice (*Oryza sativa*) under medium land condition at East Singhbhum District of Jharkhand, India. *Ecology Environment and Conservation* **22** (4): 227–230.

Bhardwaj R and Singh RK. 2018. Effect of crop establishment methods on weed dynamics and productivity of rice under puddle condition. *Journal of Pharmacognosy and Phytochesmistry* **7**(5): 1357–1360.

Das C. 2021. Rice cultivation in Assam – A complete guide. Agripedia. https://krishijagaran.com.

Mukherjee PK, Sarkar A and Maity SK. 2008. Critical period of crop-weed competition in transplanted and wet-seeded kharif rice (*Oryza sativa* L.) under terai conditions. *Indian Journal of Weed Science* **40**(3&4): 147–152.

Rao AN, Wani SP, Ramesha MS and Ladha JK. 2017. Rice production systems. Chapter 8. Pp. 185-205. In: (Eds. Chauhan BS *et al.*), Rice Production Worldwide. Springer International Publishing.

Rao AN, Johnson DE, Sivaprasad B, Ladha JK and Mortimer AM. 2007. Weed management in direct seeded rice. *Advances in Agronomy* **93**: 153–255.