

Original Research Article

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## Growth and Yield of Aerobic Rice as Influenced by Different Weed Management Practices in Tripura, India

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### ABSTRACT

A field experiment was conducted at Krishi Vigyan Kendra (KVK), South Tripura during the kharif season of 2013 and 2014 to study the influence of weed management practices on growth and yield of aerobic rice. The experiment consisting of twelve treatments was laid out in a randomized complete block design with three replications. The common weed flora found in the experimental field were *Amaranthus viridis*, *hedyotis corymbosa*, *Spilanthes acmella*, *Ludwigia parviflora*, *Cleome ruidosperma*, *Malvastrum coromandalinum* among the broad leaf weeds, *Digitaria sanguinalis* among grasses and *Cyperus iria* among sedges. Although hand weeding thrice at 15, 30 and 45 DAS recorded the lowest weed dry weight for all types of weed, higher values of growth parameters, yield and yield attributing parameters of upland rice but it was not economically viable. Among the various management practices, the treatment pendimethalin at 1.0 kg ha<sup>-1</sup> at 2 DAS + bispyribac sodium at 25 g ha<sup>-1</sup> at 20 DAS recorded the highest net return and return per rupee invested and appeared to be the most promising and remunerative weed management practice and followed by pendimethalin at 1.0 kg ha<sup>-1</sup> at 2 DAS + one hand weeding at 30 DAS for direct seeded rice under Tripura condition.

### Keywords

Aerobic rice, weed management, pendimethalin, weed dry weight, bispyribac sodium

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### Introduction

Rice is the staple food of India. It plays a crucial role in the economic and social stability of the world. The resources for rice production like-land, water, nutrients, and labour are becoming scarce. Meeting rice demand of ever increasing population is of great challenge in near future. Transplanting of rice is an age old practice but in the recent years shortage of labour made the task

difficult (Budhar and Tamilselven, 2002). Therefore direct seeded rice is gaining popularity over the transplanted rice. Direct-seeded rice (DSR) has several advantages over puddled transplanted rice like easier planting, timely sowing, less drudgery, early crop maturity by 7-10 days, less water requirement, better soil physical condition for next crop and low production cost and more profit (Kumar and Ladha, 2011). However, weeds are the main biological constraints to the production

of DSR (Rao *et al.*, 2007; Chauhan and Johnson, 2010) which may cause 60-80% reduction in grain yield of rice. Hence the present investigation was carried out to study the efficacy of some weed management practices in direct seeded upland rice under Tripura condition.

## Materials and Methods

A field experiment was conducted at Krishi Vigyan Kendra, South Tripura during the *kharif* (wet) season of 2013 and 2014 to study the influence of different weed management practices in direct seeded rice under aerobic condition in Tripura, India. Twelve treatments *viz.* Pendimethalin at 1.0 kg ha<sup>-1</sup> at 2 DAS (T<sub>1</sub>), Bispyribac sodium at 25 g ha<sup>-1</sup> at 25 DAS (T<sub>2</sub>), Pendimethalin at 1.0 kg ha<sup>-1</sup> at 2 DAS+ one hand weeding at 30 DAS (T<sub>3</sub>), Pendimethalin at 1.0 kg ha<sup>-1</sup> at 2 DAS + bispyribac sodium at 25 g ha<sup>-1</sup> at 20 DAS (T<sub>4</sub>), Metsulfuron methyl+ chlorimuron ethyl (Almix) at 4 g at 10 DAS followed by Bispyribac sodium at 25 g at 20 DAS (T<sub>5</sub>), Pyrazosulfuron ethyl at 25 g ha<sup>-1</sup> at 3 DAS followed by bispyribac sodium at 25 g at 20 DAS (T<sub>6</sub>), Fenoxaprop-p-ethyl at 60 g ha<sup>-1</sup> + metsulfuron methyl+ chlorimuron ethyl (Almix) at 4 g ha<sup>-1</sup> at 15 DAS (T<sub>7</sub>), Stale seed bed + smother crop (cowpea)(T<sub>8</sub>) in between two rows of rice, Stale seed bed + one hand weeding at 30 DAS(T<sub>9</sub>), Sesbania (broadcast) @ 25 kg ha<sup>-1</sup> during sowing of rice + 2,4-D at 500 g ha<sup>-1</sup> at 25 DAS(T<sub>10</sub>), Hand weeding at 15, 30 and 45 DAS (T<sub>11</sub>), Weedy check (T<sub>12</sub>) were assigned in a randomized block design replicated thrice. Rice variety NDR-97 was used for the experimental purpose with recommended package of practices.

The upland rice was fertilized as per recommended package of practices in Tripura. Five tonnes of Farm Yard Manure were applied at the time of field preparation for both the crop. Chemical fertilizers were applied to meet 60 kg nitrogen in the form of

urea, 40 kg phosphorus in the form of single superphosphate and 40 kg potassium in the form of muriate of potash in the rice.

Weed counts at different stages (15, 30, 60 and at harvest stage) was taken by placing quadrat at random from three sites in each plot and calculating the average. Weed sample from each of the quadrat was taken, grouped into grasses, broad leaved weed and sedges, dried and weighed. Weed dry matter was expressed category wise in g m<sup>-2</sup>. Data on growth parameters, yield attributes and yield of rice were taken. Economics of different weed management practices was also calculated. The data generated from the experiment were subject to analysis of variance (ANOVA) as applied to randomized block design describe by Cochran and Cox, 1965.

## Results and Discussion

### Effect on weeds

The common weed flora found in the experimental field were *Amaranthus viridis*, *Hedyotis corymbosa*, *Spilanthes acmella*, *Ludwigia parviflora*, *Cleome rutidosperma*, *Malvestrum coromondalianeum* among the broad leaf weeds, *Digitaria sanguinalis* among grasses and *Cyperus iria* among sedges. Similar weed flora in direct seeded rice was also reported by Duary *et al.*, 2005; Duary and Mukherjee, 2013; Duary *et al.*, 2016. The effect of various weed management practices on dry weight of grasses, broadleaved weeds, sedges and all weeds showed highly significant differences at 60 DAS (Table 1). There was no remarkable changes in dry weight of grasses, broad leaved, sedges and total weeds between the two years. It is evident from the data that, in both the year weed dry weight of grasses, broadleaved, sedges and total weed was the highest in weedy check (T<sub>12</sub>) in comparison to other treatment tested (Table 1 and 2). The

uncontrollable weed growth exploited the available nutrients and water, resulting in better growth and dry matter production of it. Similar result has been observed by Duary *et al.*, 2005; Sunil *et al.*, 2010 who reported significantly higher weed population and weed dry weight under unweeded check in aerobic rice. The lowest dry weight was recorded with hand weeding thrice at 15, 30 and 45 DAS (T<sub>11</sub>) and this treatment was closely followed by pendimethalin + one hand weeding (T<sub>3</sub>) and pendimethalin + bispyribac sodium (T<sub>4</sub>). The result was in conformity with the findings of Duary *et al.*, 2005; Bhurer *et al.*, 2013.

### **Effect on growth parameters of rice**

It was clear from the data presented in Table 2 that different weed management practices have positive effect on plant height, numbers of tiller, leaf area index and dry matter accumulation.

Among the various treatments, hand weeding thrice at 15, 30 and 45 DAS (T<sub>11</sub>) recorded the highest plant height and number of tillers m<sup>-2</sup> and this treatment was at par with pendimethalin + one hand weeding (T<sub>3</sub>) and pendimethalin + bispyribac sodium (T<sub>4</sub>). Similar trend was followed in case of leaf area index and drymatter accumulation.

### **Effect on yield parameters, yield and economics**

It was clear from the data presented in Table 3 that different weed management practices did have a positive role in determining the yield and other yield attributing characters of upland rice. Among the different treatments, hand weeding thrice at 15, 30 and 45 DAS (T<sub>11</sub>) recorded the highest number of panicles m<sup>-2</sup>, number of grains panicle<sup>-1</sup>, grain and straw yield<sup>-1</sup>, harvest index during both the years.

This treatment was at par with pendimethalin + one hand weeding (T<sub>3</sub>) and pendimethalin + bispyribac sodium (T<sub>4</sub>). Pendimethalin is an excellent herbicide showing its better efficacy since last three decades (Das and Duary, 1998). The efficacy of pendimethalin in combination with hand weeding was reported effective in controlling weed in dry direct seeded rice by Ramamoorthy *et al.*, 1998; Singh *et al.*, 2005; Duary *et al.*, 2016. Effective and timely weed management under these treatments reduced the dry weight of weeds which facilitated the crop to have sufficient space, light, nutrient and moisture and thus the number of panicles m<sup>-2</sup>, number of grains panicle<sup>-1</sup> and finally the grain and straw yield was increased. Test weight of rice was not influenced by the weed management practices.

Among the different treatments, pendimethalin + bispyribac sodium (T<sub>4</sub>) recorded the highest net return and return per rupee invested and it was at par with pendimethalin + one hand weeding (T<sub>3</sub>). The result of the present study revealed that the remuneration from the rice crop was highly dependent on weed management practices adopted. Pendimethalin at 1.0 kg ha<sup>-1</sup> at 2 DAS + bispyribac sodium at 25 g ha<sup>-1</sup> at 20 DAS (T<sub>4</sub>) recorded the highest net return (Rs. 23847/- in the first year and Rs. 26010/- in the second year) and return per rupee invested (2.02 and 2.11) in both the years and was found to be the most remunerative weed management practices. The herbicide pendimethalin at 1.0 kg ha<sup>-1</sup> + one hand weeding at 30 DAS (T<sub>3</sub>) registered net return of Rs. 21427/- and 25573/- in the first year and second year respectively and was the next best treatment. This is simply due to higher grain and straw yield of the crop obtained from these treatments. Similar result was reported by Yakadri *et al.*, 2016.

**Table.1** Dry weight of grasses, broad leaved, sedges and total weed at 60 DAS

Treatment	Weed dry weight (gm <sup>-2</sup> )							
	Grasses		Broad leaved		Sedges		Total weed	
	2013	2014	2013	2014	2013	2014	2013	2014
T1	76.91	72.02	39.49	36.45	29.17	26.15	145.57	134.61
T2	95.69	91.08	43.90	40.72	9.09	8.49	148.67	140.28
T3	28.39	23.21	23.55	20.40	9.39	6.49	61.33	50.10
T4	29.85	23.84	26.01	20.50	9.58	7.48	65.44	51.82
T5	88.81	84.29	43.33	40.55	8.89	7.71	141.03	132.55
T6	78.70	73.94	37.39	34.65	16.77	14.08	132.87	122.67
T7	82.44	77.88	40.74	37.34	15.90	12.85	139.08	128.07
T8	117.16	111.51	40.44	36.94	30.40	27.72	188.00	176.17
T9	92.95	88.03	41.89	38.38	23.76	21.19	158.60	147.60
T10	113.14	108.87	37.18	33.88	29.76	27.30	180.08	170.05
T11	24.89	20.12	18.99	15.63	5.14	2.84	49.02	38.59
T12	141.09	136.27	67.67	64.66	42.81	40.51	251.57	241.44
S. Em (±)	2.64	2.61	1.42	1.38	1.15	1.14	2.82	3.05
CD(P=0.05)	7.76	7.66	4.16	4.05	3.37	3.35	8.26	8.96
CV (%)	5.66	5.96	6.41	6.83	10.37	11.70	3.53	4.14

**Table.2** Effect of weed control treatments on growth parameters of aerobic rice

Treatment	Plant height(cm) at harvest		No. of tillers m <sup>-2</sup> harvest at 60 DAS		Leaf area index at 90 DAS		Dry matter accumulation (g m <sup>-2</sup> ) at 90 DAS	
	2013	2014	2013	2014	2013	2014	2013	2014
T1	73.97	71.42	299.60	258.80	2.20	2.21	729.33	835.67
T2	77.48	73.61	289.47	294.00	2.38	2.38	750.00	839.00
T3	87.45	85.60	370.27	377.73	3.00	2.84	915.67	989.67
T4	88.17	82.89	358.13	380.00	3.02	2.62	921.83	1001.67
T5	79.55	74.43	276.80	313.07	2.77	2.37	761.33	876.67
T6	75.96	80.22	304.67	303.07	2.43	2.43	853.00	934.10
T7	73.15	67.78	246.67	247.60	2.65	2.39	701.00	765.00
T8	71.58	68.84	259.20	244.40	2.37	2.39	709.00	799.33
T9	74.39	73.22	281.87	312.93	2.47	2.37	759.67	880.67
T10	70.18	69.21	245.60	271.33	2.42	2.37	687.67	840.00
T11	88.53	86.54	363.33	381.73	3.03	2.90	959.83	1014.67
T12	52.19	56.29	165.73	162.67	1.72	1.32	489.17	470.00
S. Em (±)	3.23	2.31	16.42	14.67	0.12	0.11	14.01	16.03
CD (P=0.05)	9.43	6.78	48.17	43.02	0.34	0.33	41.08	47.03
CV (%)	7.32	5.39	9.86	8.59	8.45	8.13	3.15	3.25

**Table.3** Effect of weed control treatment on yield attributes and yield of rice

Treatment	No. of panicles m <sup>-2</sup>		No. of filled grains panicle <sup>-1</sup>		Test weight (g)		Grain yield (t ha <sup>-1</sup> )		Straw yield (t ha <sup>-1</sup> )		Harvest index (%)		Net return (Rs. ha <sup>-1</sup> )		Return rupee <sup>-1</sup> invested	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
T1	240.54	198.16	52.95	50.66	23.34	23.43	2.15	2.36	3.89	4.21	35.60	35.82	14297	1.55	1.55	1.70
T2	232.90	235.13	44.03	54.68	23.28	23.36	2.21	2.26	3.65	4.22	37.69	34.77	11830	1.49	1.49	1.54
T3	324.17	335.10	65.23	69.66	23.45	23.25	3.30	3.59	5.03	5.28	39.62	39.82	25573	1.81	1.81	1.96
T4	317.24	336.27	66.67	68.01	23.19	23.23	3.26	3.41	4.87	5.17	40.14	39.73	26010	2.02	2.02	2.11
T5	216.54	253.73	45.45	56.19	23.59	23.03	2.49	2.65	3.72	4.65	40.14	36.29	16542	1.60	1.60	1.73
T6	249.42	291.24	60.35	61.14	22.87	23.10	2.71	2.80	4.04	4.81	40.15	36.68	18490	1.73	1.73	1.82
T7	182.93	168.85	49.15	51.81	23.20	23.39	1.89	1.98	3.82	3.98	32.97	33.18	9188	1.39	1.39	1.45
T8	188.75	173.30	52.18	52.82	23.26	23.52	1.86	2.01	3.79	4.01	32.92	33.27	6613	1.19	1.19	1.28
T9	228.11	259.80	57.31	54.80	23.51	23.42	1.86	2.10	3.71	3.89	33.42	35.10	5203	1.07	1.07	1.20
T10	198.00	218.61	53.07	53.81	23.42	23.17	1.81	1.93	3.75	3.74	32.79	34.13	9083	1.38	1.38	1.46
T11	339.36	322.18	67.67	71.28	23.28	23.50	3.45	3.60	5.16	5.43	40.33	40.57	19713	1.54	1.54	1.61
T12	119.55	101.86	32.65	33.18	23.07	23.23	0.58	0.74	2.90	2.80	16.85	20.76	-3450	0.66	0.66	0.78
S. Em (±)	21.06	15.52	3.42	2.72	0.17	0.11	0.11	0.13	0.22	0.17	1.33	0.80	1783	0.07	0.07	0.08
CD (P=0.05)	61.76	45.51	10.03	7.97	NS	NS	0.34	0.37	0.64	0.49	3.88	2.35	5230	0.22	0.22	0.23
CV (%)	15.42	11.14	10.99	8.33	1.24	0.84	8.62	8.93	9.40	6.70	6.52	3.97	23.29	8.39	8.39	8.95

Though the rice yield and gross return were the highest under hand weeding at 15, 30 and 45 DAS (T<sub>11</sub>), the data on net income and return per rupee invested showed that it was less remunerative than pendimethalin at 1.0 kg ha<sup>-1</sup> at 2 DAS + bispyribac sodium at 25 g ha<sup>-1</sup> at 20 DAS (T<sub>4</sub>) and pendimethalin at 1.0 kg ha<sup>-1</sup> + one manual weeding at 30 DAS (T<sub>3</sub>) which implied that it was uneconomic and unnecessary to give three hand weeding during the entire crop growth. The net income was found negative under weedy check due to greater competition between rice and weed which led to poor growth of the crop, lower grain and straw yield. This again emphasized the importance of weed management in profitable rice production.

This is in conformity with the study conducted by Prashanth *et al.*, 2016 who reported that the lowest net returns and B: C ratio was obtained in unweeded check in transplanted rice. Kashid *et al.*, 2015 reported that significantly the highest net return and return per rupee invested was obtained with the pre-emergence application of herbicide integrating with one hand weeding or one post emergence herbicide. Sharma *et al.*, 2004 reported that pendimethalin + one hand weeding and pendimethalin + criss cross sowing + one hand weeding were better than the other treatments in terms of increasing grain, biomass yields and net returns.

Economically viable cropping system is usually accepted by the farming community. In the present study growth and yield of direct seeded upland rice was highly influenced by the different weed management practices. Among the various treatments, pendimethalin + bispyribac sodium (T<sub>4</sub>) fetched highest net return and return per rupee invested and proved itself to be the most remunerative weed management practices for direct seeded aerobic rice under upland condition in Tripura.

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