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Crop growth, weed control, yield, economics and nutrient uptake in wetland transplanted rice as influenced by different weed management practice

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Abstract
A field trial was conducted during wet seasons of 2014 and 2015 at two locations of the district Angul, Odisha to study the crop growth, weed control, yield, economics and nutrient uptake in wetland transplanted rice as influenced by different weed management practice. Four weed management practices, *viz*. two hand weedings at 20 and 40 DAT, bensulfuron methyl at 60 g ha^{-1} + pretilachlor at 600 g ha^{-1}, bispyribac-Na at 25g ha^{-1} and weedy check were laid out in randomized block design with ten replications. *Panicum repense, Digitaria sanguinalis* under grasses, *Xanthium strumarium*, *Ageratum conyzoides* among broad leaf and *Cyperus difformis* among sedges were predominant weeds in wetland transplanted rice. The results revealed that two hand weedings at 20 and 40 DAT recorded significantly higher plant height, filled grains $panicle^{-1}$, grain yield, straw yield, weed control efficiency, nutrient uptake by plant which remained at par with bensulfuron methyl 60g ha^{-1} + pretilachlor 600 g ha^{-1}. In terms of economics, net return and B:C ratio were higher with application of bensulfuron methyl 60 g ha^{-1} + pretilachlor 600 g ha^{-1}. Pre-emergence application of bensulfuron methyl 60g ha^{-1} + pretilachlor 600 g ha^{-1} at 3 DAT considerably reduced the weed infestation registering higher weed control efficiency, higher grain yield in t wetland transplanted rice. Thus, it appeared to be effective, economically viable for weed control, crop growth, nutrient uptake, higher grain yield and profitability.

Keywords: Economics, nutrient uptake, profitability, transplanted rice, weed, weed control efficiency

Introduction

Rice (*Oryza sativa* L.) is the predominant crop of Odisha with a total coverage of 4.0 million hectare which is about 53% of the total cultivable area of the state. Area under rice crop in Angul district of the state is 0.084 million hectare with a production of 0.17 million tones which is 48% less than that of state (Anonymus, 2013) [1]. In India rice is grown over 42.4 million ha area with the production of 104.4 million tons and a productivity of 2.46 tons ha^{-1}. The average yield of rice in India is low due to several constraints. Among them weeds pose a major threat for increasing productivity. Uncontrolled weed growth caused 33-45% reduction in grain yield of rice. The weed flora of rice under transplanted condition is very much diverse and consists of sedges, grasses and broad leaf weeds causing yield reduction up to 76 percent. Herbicides like pretilachlor applied alone are more effective against grasses, but less effective against sedges. While bensulfuron methyl is found more effective against sedges than other weeds (Masthana *et al*., 2012) [8]. Weed control in India is primarily achieved through use of herbicide and hand weeding, but the later is becoming less common because of migration of farm workers to cities. It has been estimated that 300 to 400 man hours per hectare are required to remove weeds from transplanted rice field. Thus due to increasing labour shortage problem, herbicide-based weed management system is becoming the most popular method of weed control in rice (Mahajan and Chouhan, 2008) [7]. Hand weeding twice at 20 and 40 DAT resulted significantly resulted in lower removal of nutrients by weeds and higher uptake of nutrients by rice and it was at par with bensulfuron methyl 60g ha^{-1} + pretilachlor 600 g/ha due to better control of weeds (Parameswari and Srinivas, 2014) [10]. Hence, the present investigation was under taken to study the crop growth, weed control, yield, and economics and nutrient uptake in wetland transplanted rice as influenced by different weed management practice.

Materials and Methods

A field trial was conducted during wet season of 2014 and 2015 at farmer's field at two locations, one at *Bauligarh* and another at *Banuasahi* village of the district Angul, Odisha, India to study the crop growth, weed control, yield, economics and nutrient uptake in wetland transplanted rice as influenced by different weed management practice. The experimental site lies in 84^0 56′ 05′′ to 84^0 57′ 13′′ E longitude and 20^0 51′ 5′′ to 20^0 53′ 37′′ N latitude and average elevation of 195 m above sea level. Climate of the region was fairly hot and humid monsoon and mild winter. The total rainfall received during the crop season was 1271.5 mm as against normal of 1257.8 mm. The mean maximum and mean minimum temperature registered during the study period was 33.0^0 C in June and 14.0 ^{0}C in November respectively. The soil of the experimental site was slightly acidic in reaction (pH-5.7 to 5.9), sandy loam in texture with medium in organic carbon (0.55 to 0.61%), nitrogen (281.0 to 290.5 kg ha^{-1}), potassium (180.0 to 190.2 kg ha^{-1}) and low in phosphorus (8.5 to 10.1 kg ha^{-1}) contents. The treatments comprised of different weed management practices *viz.* T_1-Two hand weedings at 20 DAT & 40 DAT, T_2- bensulfuron methyl 60g ha^{-1} + pretilachlor 600 g ha^{-1} at 3 DAT, T_3-bispyribac-Na at 25g ha^{-1} at 20 DAT and T_4-Weedy check. The experimental trial was laid out in randomized block design with ten replications in each farmer's field. Rice variety (*Pooja*) was transplanted during 2^{nd} week of July and harvested during 3^{rd} week of November in both the year with recommended package of practices. Bispyribac-Na was sprayed with manually operated knapsack sprayer fitted with a flat-fan nozzle using a spray volume of 500 litres water per hectare and bensulfuron methyl 60g ha^{-1} + pretilachlor 600 g ha^{-1} was broadcasted. Observation on crop growth, yield attributes and yield were recorded following standard procedures. Weed population was selected randomly by throwing a metallic quadrate of size 0.5 m× 0.5 m at 2 places at 60 day after transplanting and expressed on square meter basis(no m^{-2}). Then oven dried and weight recorded. The weed control efficiency (WCE) was calculated by using the formula (Kondap *et al.*, 1985) [6].

$$WCE = \frac{(DWC-DWT)}{DWC} \times 100$$

Where: DWC = Dry weight of weeds under control plot

DWT = Dry weight of weeds under treated plot

Economic analysis was done by calculating cost of cultivation, gross return, net return and B:C ratio. Available soil nutrients as well as nutrient content and their uptake by soil and weeds were determined following the standard procedures (Jackson 1973) [4]. All the data obtained were statistically analyzed applying the techniques of analysis of variance and the significance of different sources of variations were tested by error mean square of Fisher Snedecor's 'F' test at probability level 0.05(Cochran and Cox, 1977**)** [3].

Results and Discussion

Growth and yield parameters

The study over the two years clearly indicated that growth and yield parameters *viz.* plant height, effective tillers $plant^{-1}$ and filled grains $panicle^{-1}$ was higher in 1^{st} year than 2^{nd} year in all the treatments (Table 1). Maximum plant height (96.23 to 101.35 cm) was observed in T_1 (Two hand weedings at 20 DAT and 40 DAT) over rest of the treatments might be due to better control of weeds resulting less crop-weed competition (Khare *et al.*, 2014) [5]. Among the herbicidal treatments, T_2 (Bensulfuron methyl 60g ha^{-1} + pretilachlor 600 g ha^{-1} at 3 DAT) recorded higher plant height(91.69 to 98.45 cm) than T_3 (Bispyribac-Na at 25g ha^{-1} at 20 DAT) during two years. Lowest plant height was observed in T_4(Weedy check).The highest numbers of effective tillers $plant^{-1}$ was recorded in case T_1 (10.79 to 15.71) during the years while the lowest was in T_4 with an average value of 9.28. Two year's data showed that number of filled grains $panicle^{-1}$ was quite identical in the treatments and maximum number of filled grains $panicle^{-1}$ (96.23 to 101.35) was found in T_1 during two years. Prasad *et al.* (2001) [12] reported that hand weeding gave the highest number of filled grains $panicle^{-1}$ as compared to herbicides.

Table 1: Effect of different treatment on growth and yield parameters in wet land transplanted rice

Treatment	Plant height(cm) at harvest			Effective tillers $plant^{-1}$ at harvest			Filled grains $panicle^{-1}$		
	2014	2015	Mean	2014	2015	Mean	2014	2015	Mean
T_1	101.35	96.23	98.79	15.71	10.79	13.25	101.35	96.23	98.79
T_2	98.45	91.69	95.07	14.60	10.52	12.56	98.45	91.69	95.07
T_3	94.23	87.73	90.98	13.72	9.98	11.85	95.23	87.73	90.98
T_4	75.51	70.55	73.03	10.72	7.84	9.28	75.51	70.55	73.03
S. Em. +	0.38	0.36	0.37	0.07	0.04	0.06	0.38	0.37	0.37
CD (P=0.05)	1.10	1.06	1.08	0.20	0.13	0.16	1.1	1.06	1.08

Weed density, weed dry weight and weed control efficiency

Weed density, weed dry weight and weed control efficiency varied significantly in both the year (Table 2). Weed density was significantly higher in T_4 (47.76 to 52.12 m^{-2}) than the weed-control treatments. In contrast, T_1 recorded lower weed density (9.59 to 11.81 m^{-2}) than rest of the weed management practices during two years with mean value of 10.70 m^{-2}. Similarly, between two herbicidal treatments, T_2 was more effective to check all types of weed population (10.82 to 12.84 m^{-2}) due to effective weed control. Weed dry weight was highest in T_4 (152.45 to 165.43 g m^{-2}) and the lowest under T_1 (32.87 to 38.87 g m^{-2}) at 60 DAT. Among the herbicidal treatments, T_2 registered the lower weed dry weight (35.52 to 43.34 g m^{-2}) and was significantly superior to T_3 due to lower weed density and its higher mean weed control efficiency (75.27%). Maximum weed control efficiency was recorded T_1 (77.30%) and minimum was in T_3(Pal *et al.*, 2009) [9].

Table 2: Effect of treatment on weed density, weed dry weight and weed control efficiency in wet land transplanted rice

Treatment	Weed density m^{-2} at 60 DAT			Weed dry weight(g m^{-2}) at 60 DAT			Weed control efficiency at 60 DAT(%)		
	2014	2015	Mean	2014	2015	Mean	2014	2015	Mean
T_1	11.81	9.59	10.70	32.87	38.87	35.87	78.45	75.45	77.30
T_2	12.84	10.82	11.83	35.52	43.34	39.43	76.71	72.86	75.27

T_3	14.63	12.93	13.78	41.47	48.63	45.05	72.81	68.74	71.0
T_4	47.76	52.12	49.94	152.45	165.43	158.94	-	-	-
S. Em. +	0.08	0.09	0.09	0.11	0.13	0.12			
CD (P=0.05)	0.23	0.27	0.25	0.33	0.36	0.35			

Weed composition

The floristic composition of the study area (Table 3) was dominated with grasses *i.e Panicum repense, Digitaria sanguinalis* and broad leaf weeds *i.e Xanthium strumarium, Ageratum conyzoides* and sedges *i.e Cyperus difformis* throughout the cropping period. At 60 DAT grasses, broad leaf weed and sedges on an average constituted 37.1, 53.9 and 9.0% of total weed population respectively (Samant, 2016) [14]. In T_4 broad leaf weeds were predominant (55.1%) followed by grasses (36.9%) and sedges (8%) of total weed population.

Table 3: Weed composition of grasses, broadleaved weed and sedges m^{-2} at 60 DAT in different treatment

Sl. no	Weed species	T_1	T_2	T_3	T_4
	Grasses				
1	*Cynodon dactdylon*	0.92	0.96	1.51	3.22
2	*Digitaria sanguinalis*	0.75	0.77	2.04	5.08
3	*Panicum repense*	1.10	2.10	1.18	5.73
4	*Echinochloa glabrescens*	1.10	0.38	0.78	4.39
	Total grasses	3.87	4.21	5.51	18.42
	Broad leaved weed				
1	*Cleome viscose*	1.38	1.81	3.9	5.48
2	*Ageratum conyzoides*	2.02	2.19	2.45	9.96
3	*Xanthium strumarium*	2.33	2.29	0.58	12.08
	Total broad leaf	5.73	6.29	6.93	27.52
	Sedges				
1	*Cyperus difformis*	1.10	1.33	1.34	4.0
	Grand total	10.70	11.83	13.78	49.94

Grain yield, straw yield and harvest index

Data pertaining to yield of grain and straw of rice for both years are presented in (Table 4). The grain yield was significantly increased by weed management practice the extent of 3.44 to 5.11 t ha^{-1}. The lowest value was recorded in T_4. The maximum grain yield was obtained in the treatment T_1 *viz* 5.27 and 4.98 t ha^{-1} during 1st and 2nd year, respectively followed by T_2 which gave the mean yield 5.01 t ha^{-1}. due to increased grains $panicle^{-1}$, better crop growth and reduced crop weed competition. T_4 recorded the 48.5 per cent grain loss as compared to T_1 due to high weed density. These results are in agreement with findings of Parthipan and Ravi, 2014 [11].

The straw yield varied from 4.04 to 5.68 t ha^{-1}. Increase straw yield in different treatments was due to effective weed control. T_1 was found to be superior and recorded significantly higher straw yield (5.68 t ha^{-1}) than other treatments due to effective weed control and better crop growth. T_4 produced minimum straw yield (4.04 t ha^{-1}).

The harvest index was comparatively higher in 1st year than 2nd year in all the treatment except T_1 and with a maximum average value of 49.30% in T_2 and minimum 45.92% in T_4. (Chongtham *et al.*, 2016) [2].

Table 4: Effect of treatment on grain yield, straw yield and harvest index in wetland transplanted rice

Treatment	Grain yield (t ha^{-1})			Straw yield (t ha^{-1})			Harvest index (%)		
	2014	2015	Mean	2014	2015	Mean	2014	2015	Mean
T_1	5.27	4.98	5.11	5.87	5.48	5.68	47.39	47.51	47.43
T_2	5.19	4.87	5.01	5.34	4.99	5.16	49.32	49.27	49.30
T_3	4.73	4.42	4.56	5.43	5.17	5.30	46.70	46.05	46.38
T_4	3.55	3.35	3.44	3.68	4.41	4.04	48.84	43.49	45.92
S. Em. +	0.09	0.08	0.09	0.17	0.23	0.18	1.17	1.43	1.25
CD (P=0.05)	0.26	0.25	0.25	0.49	0.65	0.53	3.39	4.15	3.62

Nutrient uptake by crop

Perusal of data further indicated that all the weed management treatments recorded significantly higher N, P and K uptake than weedy check in rice (Table 5). Higher uptake of nitrogen, phosphorus and potassium was recorded during 1st year than 2nd year and it was maximum for the treatment T_1 *viz.* (80.45 to 90.11), (22.31 to 24.86) and (101.84 to 113.10) kg ha^{-1} N, P and K respectively during two years. Among the two herbicidal treatments, higher average uptake of nutrients was recorded with T_2 which was 4.3, 25.4 and 6.8 per cent higher in N, P and K respectively than T_3 owing to more availability of nutrients due to effective control of weeds by herbicide application (Rana *et al.*, 2000) [13]. Minimum average nutrient uptake was T_4 *viz.* 49.77, 11.78 and 64.36 NPK kg ha^{-1} respectively.

Table 5: Effect of treatment on nutrient uptake by rice

Treatment	Nutrient uptake by crop								
	N (kg ha^{-1})			P (kg ha^{-1})			K (kg ha^{-1})		
	2014	2015	Mean	2014	2015	Mean	2014	2015	Mean
T_1	90.11	80.45	85.70	24.86	22.31	23.55	113.10	101.84	107.65
T_2	78.92	71.61	75.75	22.44	19.45	20.66	102.21	89.93	96.22
T_3	75.51	68.82	72.60	18.05	15.47	16.47	94.01	85.33	90.11
T_4	50.15	49.05	49.77	12.52	11.41	11.78	60.07	67.72	64.36
S. Em. +	1.05	1.03	1.01	0.26	0.23	0.24	2.72	3.26	2.78
CD (P=0.05)	3.05	3.0	2.93	0.77	0.68	0.71	7.89	9.47	8.07

Nutrient uptake by weed

Minimum depletion of nutrients by weeds (Table 6) was observed in T_1 over rest of the treatments due to lower density and dry weight of weeds. Among the two herbicidal treatments, removal of nutrients by weeds was lower in T_2 *viz.*27.96, 4.91 and 45.13 kg NPK ha^{-1} respectively due to more dry matter production and subsequently better availability of these nutrients to crop, while maximum uptake of these nutrients was observed in T_4 which on an average removed 128.68, 20.26 and 182.46 kg NPK ha^{-1} respectively due to minimum shoot dry matter production by the crop (Uma *et al*., 2014) [16].

Table 6: Effect of treatment on nutrient uptake by weed

Treatment	Nutrient uptake by weed								
	N (kg ha^{-1})			P (kg ha^{-1})			K (kg ha^{-1})		
	2014	2015	Mean	2014	2015	Mean	2014	2015	Mean
T_1	21.37	24.49	22.93	4.08	4.78	4.43	38.13	44.70	41.41
T_2	25.57	30.34	27.96	4.44	5.37	4.91	40.85	49.41	45.13
T_3	31.52	35.99	33.75	5.23	6.08	5.65	48.93	56.90	52.92
T_4	125.01	132.34	128.68	19.51	21.01	20.26	182.94	181.97	182.46
S. Em. +	0.10	0.33	0.092	0.01	0.02	0.02	0.13	0.14	0.13

Economics

The economics (Figure 1) of weed management practices revealed that T_1 recorded maximum average gross return (Rs.76429.61 ha^{-1}) where as higher net return (Rs.34611.08 ha^{-1}) was obtained in T_2 due to comparatively lower cost of cultivation (Rs.39862.28 ha^{-1}). Similarly, significantly higher B:C ratio (1.87) and profitability(Rs. 94.82 ha^{-1} day^{-1}) was achieved in T_2 followed by T_1(Figure 2). The lowest B:C ratio (1.37) and profitability(Rs. 38.03 ha^{-1} day^{-1}) was observed in T_4. These results were in agreements with results of Teja *et al* (2015) [15].

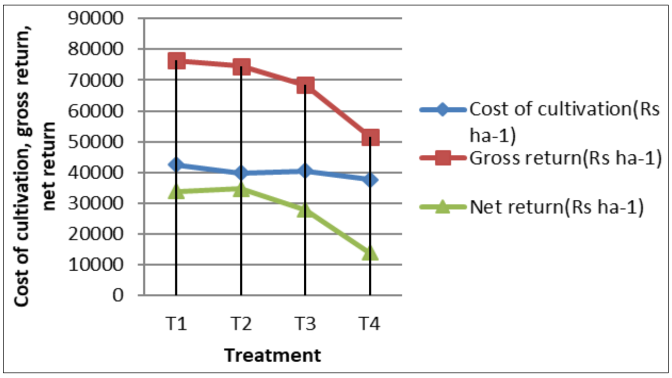

Fig 1: Effect of treatment on cost of cultivation, gross return and net return

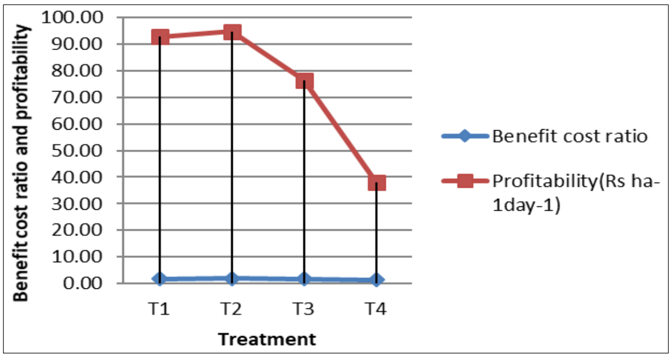

Fig 2: Effect of treatment on B:C ratio and profitability

Conclusion

The study over the two years clearly suggested that pre-emergence application of bensulfuron methyl 60g ha^{-1} + pretilachlor 600 g ha^{-1} at 3 DAT considerably reduced the weed infestation registering higher weed control efficiency, higher grain yield in wetland transplanted rice. Thus, it appeared to be effective, economically viable for weed control, crop growth, nutrient uptake, higher grain yield and profitability.

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References

1. Anonymous. Odisha Agriculture Statistics 2012-13. Directorate of Agriculture and Food production, Bhubaneswar, Odisha, 2013.
2. Chongtham SK, Singh RP, Singh RK. Effect of crop establishment methods and weed management practices on weed flora and yield of direct-seeded rice (*Oryza sativa*). Indian Journal of Agronomy. 2016; 61(1):33-36.
3. Cochran WG, Cox GM. Experimental Designs. Asia Publishing House, Kolkata, 1977, 95-132, 142-181.
4. Jackson ML. Soil chemical analysis. Prentice Hall India Pvt. Ltd., New Delhi, 1973, 498.
5. Khare TR, Sharma R, Sobhana V. Control of complex weed flora in direct seeded and transplanted rice with early post emergence herbicide Oryza. 2014; 51(1):96-99.
6. Kondap SM, Upadhyay UC. A Practical Manual of Weed Control. Oxford and IBH Publ. Co., New Delhi, 1985.
7. Mahajan G, Chauhan B. Performance of Penoxsulam for weed control in transplanted rice. Pest Technology. 2008; 2(2):114-116.
8. Masthana Reddy BG, Ravishankar G, Balganvi S, Joshi VR, Negalur RK. Efficacy of bensulfuron methyl plus pretilachlor for controlling weeds in transplanted rice. Oryza. 2012; 49(1):65-67.
9. Pal S, Banerjee H, Mandal NN. Efficacy of low dose of herbicides against weeds in transplanted kharif rice (*Oryza sativa* L.). The Journal of Plant Protection Sciences. 2009; 1(1):31-33.
10. Parameswari YS, Srinivas A. Influence of weed management practices on nutrient uptake and productivity of rice under different methods of crop establishment. Journal of Rice Research. 2014; 7(1 & 2):77-86.
11. Parthipan T, Ravi V. Productivity of transplanted rice as influence by weed control methods. African Journal of Agricultural Research. 2014; 9(29):2250-2254.
12. Prasad SM, Mishra SS, Singh SJ. Effect of establishment methods, fertility levels and weed management practices on rice (*Oryza sativa*). Indian Journal of Agronomy. 2001; 46(2):216-221.
13. Rana SS, Angiras NN, Sharma GD. Effect of herbicides and inter culture on nutrient uptake by puddle seeded rice and associated weeds. Indian Journal of weed science. 2000; 31(1&2):70-73.
14. Samant TK. Effect of oxadiargyl on weed density, yield and economics in dry seeded through front line demonstration. Journal of Crop and Weed. 2016; 12(1):120-124.
15. Teja KC, Duary B, Bhowmik MK. Efficacy of herbicides on weed management in wet season transplanted rice. Journal Crop and Weed. 2015; 11:224-227.
16. Uma G, Ramana MV, Reddy AP, Ram prakash T. Evaluation of low dose herbicides in transplanted rice (*Oryza sativa* L.). International Journal of Applied Biology and Pharmaceutical Technology. 2014; 5(4):96-101.