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Effect of crop establishment and weed control methods on productivity of rice (*Oryza sativa* L.)

D. HASSAN AND R. R. UPASANI

Department of Agronomy
Birsa Agricultural University
Kanke- 834006, Ranchi, Jharkhand

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ABSTRACT

A field experiment was conducted at agronomical research farm of Birsa Agricultural University, Ranchi during rainy season of 2009 with the objective to find out the effect of establishment and weed control method on weed dynamics, growth and productivity of rice under wet land situation. The treatment comprised of 4 methods of crop establishment i.e. transplant, SRI, drum seeded and broadcast in main plot and 4 methods of weed control – pyrazosulfuron 0.02 kg ha^{-1} PE + mechanical weeding at 25 DAS or DAT, weeding by cono weeder at 25 DAS or DAT, hand weeding at 25 and 40 DAS or DAT, and weedy check in sub plot. The result revealed that among establishment and weed control methods, transplant and application of pyrazosulfuron 0.20 kg ha^{-1} + one mechanical weeding at 25 DAS or DAT were most productive. Application of pyrazosulfuron 0.20 kg ha^{-1} + one mechanical weeding at 25 DAS or DAT in transplanted or drum seeded or broadcasted rice was most effective in suppressing weed population and weed dry matter accumulation thereby producing higher rice grain yield compared to other weed control methods.

***Keywords*:** Cono weeder, rice, weed, yield

Rice is a main crop of Jharkhand. Mainly *kharif* rice is grown in the state whereas *boro* or summer rice is being cultivated in some areas. Average productivity of rice in the state is 1411 kg ha^{-1} and it belongs to low productivity group. The scope for expanding rice production lies in enhancing productivity. Several studies have indicated that the adoption of recommended rice technology gives high yields and income to the farmers. Rice is cultivated as conventional transplanting, SRI (system of rice intensification), drum seeded and broadcast under wet land condition. The method of crop establishment in rice largely affects the initial plant stand and uniformity. Since last decades increasing labour costs and their unavailability at peak time have resulted in a general shift in rice production system from transplanted rice to direct seeded rice, of which wet seeding has been the main method of crop establishment. Weeds are the main problem of direct seeded wet land rice as pre germinated seeds and already existed weed seed in soil weed seed bank grow simultaneously thereby inviting competition for resources like moisture, nutrient and light. Most of the introduced herbicides are selective and are specified to control only one or two types of weeds. Weeds have variable growth habits and life cycles and they even vary under different cultural practices. Therefore, the use of chemicals only cannot effectively control weeds in all situations (De Datta and Herdt, 1983). Hence, realizing the importance of various above mentioned methods of rice establishment and weed control in rice under medium land condition an experiment was proposed.

The experiment was conducted during rainy season of 2009 on the sandy loam soils of agronomical research farm of Birsa Agricultural University, Jharkhand. The experimental soil was acidic with pH 5.68, sandy loam in texture, low in organic carbon (0.37%) and nitrogen (242.23 kg ha^{-1}) and medium in phosphorus (14.43 kg ha^{-1}) and low in potassium (123 kg ha^{-1}). The treatment comprised of 4 methods of rice establishment *i.e.* transplant, SRI, drum seeded and broadcast in main plot and 4 methods of weed control – pyrazosulfuron 0.02kg ha^{-1} PE + mechanical weeding at 25 DAS/T, weeding by cono weeder at 25 DAS or DAT, hand weeding at 25 and 40 DAS or DAT, and weedy check in sub plot. The experiment was laid out in split plot design with 3 replications. Rice variety "Lalat" was sowed on 10-07-10 under drum seeded, broad cast as well as seedling raising for SRI, and transplant methods of establishment. The recommended dose of fertilizers @ 100 kg N, 60 kg P_2O_5 and 40 kg K_2O ha^{-1} were applied from urea, single super phosphate and muriate of potash respectively. Half dose of N and full amount of P_2O_5 and K_2O were applied in experimental field as basal at the time of sowing or transplanting as the case may be. Rest half of N was applied in two splits as top dressing *i.e.* one fourth of N was top dressed at 25 days after sowing or transplanting and the rest one fourth of N at 45 days after sowing or transplanting. Hand weeding was done as per

Short Communication
Email:upasani.ravikant@gmail.com

Table 1: Weed dynamics, weed control efficiency and nutrient uptake by weed in rice influenced by establishment and weed control method

Treatments	Weed dry matter (g m^{-2})		Weed density m^{-2}		Weed control efficiency (%)		Nutrient uptake (kg ha^{-1})		
	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	N	P	K
Transplant	0.71 (0.00)	3.09 (18.01)	0.71 (0.00)	12.90 (333)	0.00	71.18	10.37	1.69	14.38
SRI	0.71 (0.00)	6.42 (52.24)	0.71 (0.00)	17.08 (427)	0.00	58.65	9.081	1.48	12.60
Drum Seeded	11.57 (141.31)	5.01 (30.84)	35.93 (1469)	18.99 (594)	35.69	62.30	11.72	1.91	16.27
Direct Seeded	11.57 (147.15)	4.59 (26.25)	41.35 (2085)	24.07 (1069)	44.33	60.76	13.94	2.27	19.34
LSD (0.05)	**1.29**	**1.71**	**8.22**	**2.24**	**9.28**	**9.67**	**NS**	**NS**	**NS**
Pyrazosulfuron + mechanical weeding	3.77 (25.27)	3.03 (11.77)	9.32 (187)	5.14 (35)	39.35	87.72	3.74	0.61	5.19
Cono weeder	6.08 (76.63)	2.89 (10.40)	18.80 (714)	10.57 (128)	17.99	87.04	6.83	1.11	9.48
2 Hand weeding	10.78 (65.51)	4.10 (19.56)	20.27 (795)	13.57 (197)	22.67	78.14	4.65	0.76	6.46
Weedy check	8.13 (121.05)	9.10 (85.60)	30.36 (1858)	43.76 (2063)	0.00	0.00	29.88	4.87	41.47
LSD (0.05)	**0.80**	**1.01**	**4.29**	**2.96**	**5.16**	**8.23**	**4.38**	**0.71**	**6.08**

Note: Data in parentheses indicate original values

Table 2: Yield and yield attributes of rice influenced by interaction of establishment and weed control methods

Treatment	Plant height(cm)	Effective tillers m^{-2}	Panicle length(cm)	Grains $panicle^{-1}$		1000 grain weight (g)	Yield (kg ha^{-1})		Weed index
				Filled	Unfilled		Grain	Straw	
Transplant	89.09	309	21.15	68	18	28.02	3925	6454	15.08
SRI	92.17	236	20.44	60	15	27.45	3068	4853	24.44
Drum seeded	88.24	235	17.41	42	14	26.04	2726	4318	41.13
Broad cast	87.26	212	19.43	47	15	26.76	2587	4167	33.59
LSD (0.05)	**NS**	**36.11**	**1.98**	**12.14**	**NS**	**1.25**	**582.9**	**994.1**	**15.4**
Pyrazosulfuran + mechanical weeding	92.36	293	20.40	60	16	27.14	4377	7279	0.00
Cono weeder	92.05	270	20.00	57	17	27.28	3176	5052	25.01
2 Hand weeding	89.84	292	19.90	55	16	26.86	3533	5552	16.96
Weedy check	82.51	138	18.16	44	15	26.99	1220	1909	72.26
LSD (0.05)	**NS**	**33.4**	**0.50**	**10.3**	**NS**	**NS**	**476.2**	**816.9**	**11.2**

treatment. The data on weed density and dry weight were recorded with the help of quadrate (0.5m × 0.5 m). Observations on crop growth parameters, *viz.* plant height and yield attributes like panicle m^{-2}, grains per panicle and grain yield were recorded. The weed control efficiency was worked out on the basis of weed dry matter production using the formula suggested by Mani *et al.* (1973) and weed index was calculated by using the formula suggested by Gill and Vijayakumar (1966).

Effect on weeds

The major weeds in experimental field observed were *Ludwigia parviflora*, and *Digitaria sanguinalis* (15.4% each) followed by *Spillanthes acmella* (14.1%), *Echinocloa crusgalli* and *Fimbrystlis milliaceae* (8.97% each), *Cyperus iria* (6.41%). Halder *et al.* (2007) have also reported *L. parvifolia* as dominant broad-leaved weed associated with rice in their experimental field. Broadcasted and drum seeded rice registered higher weed population of 2085 and 1469 m^{-2}, respectively while weed dry matter were 147g m^{-2} and 141g m^{-2}, respectively at 30 DAS due to relatively weed free situation (Table 1). This may be explained as pre germinated and sprouted rice seeds sown in puddled wet land soil was also favorable situation for weed seeds germination and their establishment already present in weed seed bank of the soil compared to frail and week germinating rice seedlings. The impact of establishment is also reflected in terms of weed control efficiency as transplanted rice registered higher (71.18%) weed control efficiency compared to SRI; drum seeded and broadcasted rice at 60 DAS. The SRI method of rice establishment registered lowest weed control efficiency (58.65%) because one seedling per hill of 14 days old was not healthy enough to counter the competition caused by weed for growth resources. This confirmed the findings of Ahmed *et al*. (2010) and Gangwar *et al*. (2009). The mean uptake of nitrogen, phosphorus and potash by weeds were 11.28, 1.80 and 15.65 kg ha^{-1} at 70 DAS. The mean N, P and K content of weeds were 25, 24.5 and 25%. Moody (1981) suggested that weeds have a large requirement for nutrients and may have higher mineral nutrient contents than rice. Application of pyrazosulfuron @ 0.020 kg ha^{-1} + one mechanical weeding at 25 DAS, was most effective in controlling all categories of weeds namely grassy, broad-leaved and sedges population. This confirms the findings of Upasani and Barala, 2014. Weed control efficacy of this treatment in controlling grassy, broad leaved weeds and sedges was maximum at 30 and 60 DAS.

Effect on crop

Transplanting method of rice establishment recorded 27.93, 43.98, 51.72 % higher rice grain yield (3925 kg ha^{-1}) as well as 32.98, 49.46, and 54.88 % higher straw yield (6454 kg ha^{-1}) compared to SRI, drum seeded and broadcast methods of rice establishment practices, respectively (Table 2). It also recorded 30.93, 31.49, 45.75 % higher effective tillers per unit area 3.47, 21.48, and 8.85% higher panicle length and 13.33, 61.90, 44.68 percent higher filled grain per panicle as compared to rice grown under SRI, drum seeded and broadcast methods, respectively. Weight of grain was also higher due to production of healthy and bold grain. Application of pyrazosulfuron@ 0.020 kg ha^{-1} + one mechanical weeding at 25 DAS or DAT being similar to weeding by cono weeder and hand weeding recorded 112.3% significantly higher effective tillers m^{-2} and 36.6% higher filled grains per panicle over weedy check. This confirms the findings of Gogoi *et al*. (2000). It may be concluded that transplanting associated with application of pyrazosulfuran 20g *a.i.* ha^{-1} pre-emergence + mechanical weeding by Dutch hoe at 40 DAS can be adopted for effective weed control and higher rice yield.

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