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Weed management effect in system of rice intensification

S. Rathika* and T. Ramesh

Anbil Dharmalingam Agricultural College and Research Institute, Tamil Nadu Agricultural University, Thiruchirappalli, Tamil Nadu 620 027

**Email: rathikaselvaraj@gmail.com*

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ABSTRACT

A field experiment was conducted at Anbil Dharmalingam Agricultural College and Research Institute, Thiruchirappalli during *Rabi* season 2014-15 to evaluate the weed management practices in system of rice intensification contisted 8 treatments with three replication. Pre-emergence (PE) application of bensulfuron-methyl 60 g/ha + pretilachlor at 600 g/ha on 3 days after transplanting (DAT) *fb* early post-emergence application of bispyribac-sodium at 25 g/ha on 20 DAT registered the minimum total weed density (6.6, 8.8 and 14.3/m^2 at 30, 45 and 60 DAT, respectively) along with higher weed control efficiency (WCE). The highest grain and straw yields of 5.72 and 8.36 t/ha, respectively and net returns and BCR of ` 55436/ha and 2.44, respectively were obtained in application of the same treatment

Rice (*Oryza sativa* L.) is the stable food for more than 60% of the world population. It plays a major role in Indian economy by contributing 45% to the total food grain production in the country. In India, rice is grown in an area of 43.99 million hectares annually with a production of 109.7 million tonnes and an average productivity of 2.5 t/ha (FAO, 2016-17). Productivity of rice in India is declining due to an array of biotic and abiotic factors. Weeds are the prime yield-limiting biotic constraint that competes with rice for moisture, nutrients and light. The problem of weed interference is more in direct-seeded than transplanted rice. Reduction in yield to the tune of 34% in transplanted rice, 45% in direct-seeded low land rice and 67% in upland rice due to weeds have been reported (Muthukrishnan *et al.* 2010).

Most of the farmers in the intensive cropping areas are shifting from conventional transplanting to system of rice intensification (SRI) due to shortage of labour, scarcity of water, energy, *etc*. Cono-weeding is one of the important components in SRI cultivation. Though cono-weeding is considered to be the best, non-availability of labour for cono-weeder and escalating labour cost in many cases have made it imperative to use chemicals for weed control in the SRI. Thus, there is a need to study the chemical weed control in SRI, because of the intensity of weed problems *vis a vis* the scarcity and higher wages of labour for weeding.

A field experiment was conducted at Anbil Dharmalingam Agricultural College and Research Institute, Thiruchirappalli, Tamil Nadu during *Rabi* season 2014-15. The experimental site was located at 10˚45’ N latitude, 78˚36’E longitude and at an altitude of 85 m above mean sea level. A total of 66.1 mm of rainfall in 5 rainy days was received during *Rabi* season in the year 2014-15. The mean minimum and maximum temperatures ranged from 23.1 to 30.3 ^{0}C and the relative humidity ranged from 95.9 to 71.9 per cent during the crop growth period. The experimental soil was sandy clay loam in texture belonging *Vetric Ustropept* with pH of 8.8 and EC of 1.1 dS/m. The experimental soil was low in available nitrogen (229 kg/ha), medium in available phosphorus (14.5 kg/ha) and high in available potassium (288 kg/ha). The experiment was laid out in a randomized block design with eight treatments **(Table 1)** in three replications. The variety used for the experiment was ‘*TNAU Rice TRY 3*’.

Weed density and total weed dry weight was recorded at 30,45 and 60 days after transplanting (DAT) by adopting standard procedure. The weed control efficiency (WCE) was computed by using the formula as suggested by Mani *et al.* (1973). The yield parameters *viz.* productive tillers/m^2, grains/panicle, panicle length and 1000- grain weight and yield of rice were recorded at harvest stage. Economics of weed management was worked out by using the current market price of inputs and rice grain.

Effect on weeds

The weed flora observed in the experimental field during the course of study consisted of grasses, sedges and broad-leaved weeds. The major grass weeds were *Echinochloa crus-galli* (L.) and *Echinochloa colona* (L.) and the common sedges included *Cyperus difformis* (L.), *Cyperus iria* (L.) and *Fimbristylis miliacea* (L.). Among the broad-leaved weeds, *Eclipta alba* (L.), *Ammania baccifera* (L.) *Marsilea quadrifoliata* (L.), *Monochoria vaginalis* (Burm.f.), *Bergia capensis* (L.) and *Ludwigia parviflora (*Roxb.) were the dominant species.

Pre-emergence (PE) application of bensulfuron-methyl 60 g/ha + pretilachlor at 600 g/ha on 3 DAT *fb* early post-emergence application of bispyribac-sodium at 25 g/ha on 20 DAT registered the minimum total weed density (6.6, 8.8 and 14.3/m^2 at 30, 45 and 60 DAT, respectively) and total weed dry weight (1.72, 2.35 and 4.58 g/m^2 at 30, 45 and 60 DAT, respectively) along with higher weed control efficiency (WCE) followed by weeding with cono-weeder at 10, 20, 30 and 40 DAT and pre-emergence application of bensulfuron-methyl 60 g/ha + pretilachlor at 600 g/ha on 3 DAT *fb* weeding with conoweeder at 20 and 30 DAT **(Table 1)**. The highest total weed density and total weed dry weight were recorded in un-weeded control. These results were in accordance with the findings of Veeraputhiran and Balasubramanian (2012), Murali *et al.* (2012) and Nalini *et al.* (2012).

The weed control efficiency at all stages of observation was higher with pre-emergence bensulfuron-methyl 60 g/ha + pretilachlor at 600 g/ha on 3 DAT *fb* bispyribac-sodium at 25 g/ha on 20 DAT followed by weeding with cono-weeder at 10, 20, 30 and 40 DAT **(Table 1)**. This was due to reduced weed population and weed dry weight which resulted in increased weed control efficiency.

Effect on rice

The yield contributing characters, *viz.* productive tillers and grains/panicle were significantly influenced by weed management practices **(Table 2)**. Higher productive tillers (446/m^2) and grains/panicle (168) were obtained with bensulfuron-methyl 60 g/ha + pretilachlor at 600 g/ha on 3 DAT *fb* bispyribac-sodium at 25 g/ha on 20 DAT, which were comparable with weeding with cono-weeder at 10, 20, 30 and 40 DAT. Increased yield attributes under these treatments might be due to effective and prolonged control of weeds, that led to increased nutrient uptake of rice with more sink capacity. Similar results of higher yield attributes by post-emergence application of bispyribac-sodium at 40 g/ha was reported by Nalini *et al.* (2012). Un-weeded control resulted in reduced yield parameters due to severe crop weed competition coupled with reduced uptake of nutrients by crop and increased uptake of nutrients by weeds. Panicle length and 1000-grain weight was not significantly influenced by different weed management practices.

Table 1. Effect of weed management practices on total weed density, total weed dry weight and weed control efficiency in SRI

Treatment	Total weed density (no./m^2)			Total weed dry weight (g/m^2)			Weed control efficiency (%)		
	30 DAT	45 DAT	60 DAT	30 DAT	45 DAT	60 DAT	30 DAT	45 DAT	60 DAT
Weeding with CW at 10, 20 and 30 DAT	3.44 (11.3)	5.22 (26.8)	5.59 (30.8)	1.85 (2.94)	2.22 (4.43)	3.19 (9.66)	75.6	73.6	69.8
Weeding with CW at 10, 20, 30 and 40 DAT	3.00 (8.5)	3.27 (10.2)	4.07 (16.1)	1.65 (2.21)	1.82 (2.80)	2.38 (5.15)	81.6	83.3	84.0
Bensulfuron-methyl 60 g/ha + pretilachlor at 600 g/ha on 3 DAT *fb* weeding with CW on 20 and 30 DAT	3.35 (10.7)	3.35 (10.7)	4.22 (17.3)	1.81 (2.78)	2.03 (3.63)	2.46 (5.54)	76.9	78.4	82.8
Weeding with PORW at 10, 20 and 30 DAT	4.22 (17.3)	6.88 (46.8)	7.86 (61.3)	2.21 (4.37)	3.17 (9.56)	4.49 (19.62)	63.6	43.1	38.9
Weeding with PORW at 10, 20, 30 and 40 DAT	4.16 (16.8)	5.71 (32.1)	6.86 (46.6)	2.24 (4.50)	2.87 (7.72)	3.86 (14.41)	62.6	54.0	53.5
Bensulfuron-methyl 60 g/ha + pretilachlor at 600 g/ha on 3 DAT*fb* weeding with PORW on 20 and 30 DAT	3.62 (12.6)	4.79 (22.4)	4.62 (20.8)	1.94 (3.28)	2.10 (3.91)	2.68 (6.66)	72.7	76.7	79.3
Bensulfuron-methyl 60 g/ha + pretilachlor at 600 g/ha on 3 DAT *fb* EPOE bispyribac-sodium at 25 g/ha on 20 DAT	2.66 (6.6)	3.05 (8.8)	3.85 (14.3)	1.49 (1.72)	1.69 (2.35)	2.25 (4.58)	85.7	86.0	85.7
Un-weeded control	6.83 (46.2)	9.04 (81.3)	10.43 (108.3)	3.54 (12.01)	4.16 (16.82)	6.29 (39.10)	-	-	-
LSD (p=0.05)	0.31	0.42	0.48	0.18	0.22	0.29	-	-	-

Figures in parentheses are original values; CW Cono-weeder; PORW - Power operated rotary weeder; DAT – Days after transplanting

Table 2. Effect of weed management practices on yield attributes, yield and economics of rice under SRI

Treatment	Yield attributes				Yield		Economics	
	Productive tillers (no./m^2)	Grains (no./ panicle)	Panicle length (cm)	1000-grain weight (g)	Grain yield (t/ha)	Straw yield (t/ha)	Net returns (x10^3 `/ha)	BCR
Weeding with CW at 10,20 and 30 DAT	380	147	25.2	25.0	4.66	6.70	39.40	2.07
Weeding with CW at 10,20,30 and 40 DAT	445	163	25.7	26.1	5.50	7.91	52.71	2.41
Bensulfuron-methyl 60 g/ha + pretilachlor at 600 g/ha on 3 DAT *fb* weeding with CW on 20 and 30 DAT	438	162	25.5	25.9	5.43	7.79	51.01	2.35
Weeding with PORW at 10, 20 and 30 DAT	338	130	25.0	24.7	4.05	5.76	29.92	1.82
Weeding with PORW at 10, 20, 30 and40 DAT	314	135	25.0	24.8	4.26	6.18	32.42	1.84
Bensulfuron-methyl 60 g/ha + pretilachlor at 600 g/ha on 3 DAT *fb* weeding with PORW on 20 and 30 DAT	402	140	25.3	25.6	4.74	6.96	39.42	2.03
Bensulfuron-methyl 60 g/ha + pretilachlor at 600 g/ha on 3 DAT *fb* EPOE bispyribac-sodium at 25 g/ha on 20 DAT	466	168	25.9	26.1	5.73	8.36	55.44	2.44
Un-weeded control	228	116	24.3	24.6	2.83	4.26	11.82	1.34
LSD (p=0.05)	36	16	NS	NS	0.48	0.57	-	-

CW – Cono- weeder; PORW - Power operated rotary weeder; DAT - Days after transplanting; BCR: benefit-cost ratio

The highest grain and straw yields of 5.72 and 8.36 t/ha, respectively were recorded by pre-emergence applicationof bensulfuron-methyl at 60 g/ ha + pretilachlor at 600 g/ha on 3 DAT *fb* early post-emergence application of bispyribac-sodium at 25 g/ ha on 20 DAT (**Table 2**). This was comparable with cono-weeding at 10, 20, 30 and 40 DAT and pre-emergence application of bensulfuron-methyl at 60 g/ ha + pretilachlor at 600 g/ha on 3 DAT *fb* weeding with cono-weeder at 20 and 30 DAT. This might be due to the cumulative effect of lesser weed density as well as dry weight, higher WCE and lesser nutrient removal by weeds as a result of reduced crop weed competition. This is in line with the findings of Yadav *et al.* (2009) and Veeraputhiran and Balasubramanian (2012).

Economic analysis

Application of bensulfuron-methyl 60 g/ha + pretilachlor at 600 g/ha on 3 DAT *fb* bispyribac-sodium at 25 g/ha on 20 DAT gave maximum net returns and BCR (`55436/ha and 2.44) due to increased grain and straw yields, which clearly showed the influence of weed free environment for crop growth and development (**Table 2**). These results were in line with the findings of Veeraputhiran and Balasubramanian (2012). Un-weeded control gave the lowest net returns and BCR as ` 11824/ha and 1.34, respectively) due to drastic reduction in grain yield by virtue of uncontrolled weed growth throughout the crop period. This was in conformity with the findings of Mirza *et al.* (2009).

It was concluded that pre-emergence application of bensulfuron-methyl at 60 g/ha + pretilachlor at 600 g/ha on 3 DAT *fb* early post-emergence application of bispyribac-sodium at 25 g/ ha on 20 DAT is an ideal weed management option for increased productivity and profitability of rice in SRI.

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