Madras Agric. J., 102 (1-3): 52-56, March 2015
https://doi.org/10.29321/MAJ.10.001066

Evaluation of New Herbicide (Bispyribac sodium 10 SC) on Weed Control and Yield in Direct Seeded Lowland Rice (*Oryza sativa*)

S.T. Kumaran[1], G. Kathiresan[2], P. Murali Arthanari[3], C. Chinnusamy[4] and V. Sanjiv kumar[5]

[1,2,3,4]Department of Agronomy, [5]Department of Soil Science
Tamil Nadu Agricultural University, Coimbatore -641003, Tamil Nadu, India

Field investigation was carried out to evaluate the new formulation of bispyribac sodium 10 SC in direct seeded rice during *rabi* (August to *February*) of 2011-12 at Tamil Nadu Agricultural University, Coimbatore. The experiment was laid out in a randomized block design and replicated thrice with the objective to find out the effect of bispyribac sodium 10% SC on weed control efficiency and yield of direct seeded rice. The treatments consist of EPOE application of bispyribac sodium 10% SC at 10, 20, 40 g ha^{-1}, nominee gold 20 g ha^{-1} (bispyribac sodium 10 SC) on 15 DAS and PE butachlor 1.5 kg ha^{-1}, anilophos 0.45 kg ha^{-1}, pretilachlor S 0.45 kg ha^{-1} on 3 DAS + HW on 40 DAS and power weeder, conoweeder weeding at 20 and 40 DAS, HW twice on 20 and 40 DAS and unweeded control. Application of pretilachlor S 0.45 kg ha^{-1} on 3 DAS + HW on 40 DAS registered lower weed density and dry weight at 20 DAS but during the later stages of crop growth EPOE application of bispyribac sodium 10% SC 40 g ha^{-1} recorded lower weed density and dry weight. The grain and straw yield in both the treatments were comparatively higher than other treatments.

Key words: Soluble concentration, Early post emergence, Rice, Weed management

Rice commands recognition, as a supreme commodity to mankind, because rice is truly life, culture, a tradition and a means of livelihood to millions. Rice is the staple food for about 50 per cent of the world's population that resides in Asia, where 90 per cent of the world's rice is grown and consumed. In Asia, India has the largest area under rice (41.66 million hectare) accounting for 29.4 per cent of the global rice area. Rice is grown in an area of 45 million ha annually with a production of 80.14 million tonnes, with an average productivity of 2177 kg ha^{-1} during 2009 to 2010 (FAO, 2010). India has to produce 135-145 million tonnes of rice by 2020 to feed the additional 350 million people (Prakash *et al.,* 2008).To sustain present food self-sufficiency and to meet future food requirements, India has to increase its rice productivity by 3 per cent per annum.

Direct seeding is practiced in areas of uncertain distribution of rainfall or inadequate availability of irrigation facilities. Direct seeded rice is gaining momentum in India due to high demand of labour during peak season of transplanting and short period of availability of water. The weed competition is more severe in direct seeded rice as crop and weeds emerge simultaneously. The yield loss due to weeds varies from 40 to 100 per cent in direct seeded rice (Choubey *et al* ., 2001). Timely weed control is crucial to increase the productivity of rice. Chemical weed control offers economic and efficient weed control if applied at proper time with correct dose and stage (Kumar and Sharma, 2005). The herbicides presently used in rice are mainly pre-emergence and weeds coming at later stages of crop growth are not controlled as effectively as at emergence stage.

This situation warranted for initiating research efforts to evaluate and identify suitable post emergence herbicide(s). Use of alternative herbicides that provide wide-spectrum of weed control would be desirable for effective weed control. One of the most important classes of herbicides that have been used popularly all over the world is sulfonylurea group of herbicides. Among several sulfonylurea herbicides, bispyribac sodium is a new post emergence rice herbicide. It has eminent activity against a broad spectrum of annual and perennial rice weeds. Therefore, the present study was undertaken to evaluate the performance of new post-emergence herbicides, against complex weed flora in low land direct seeded rice system.

Material and Methods

Field experiment was conducted at Tamil Nadu Agricultural University, Coimbatore during *rabi* (August to February) of 2011-12. The experiment was laid out in a randomized block design with three replications. The soil fertility status was medium in available nitrogen (234 kg ha^{-1}), low in available phosphorus (16.2 kg ha^{-1}) and high in available

*Corresponding author email : kumaran.agri@gmail.com

potassium (467 kg ha^{-1}). Medium duration rice variety CO (R) 48 was used as a test variety in the study. The treatments consisted of early post emergence application of bispyribac sodium 10% SC at 10, 20, 40 g ha^{-1}, nominee gold (bispyribac sodium 10% SC) 20 g ha^{-1} on 15 days after sowing and PE application of butachlor 1.5 kg ha^{-1}, anilophos 0.45 kg ha^{-1}, pretilachlor S 0.45 kg ha^{-1} on 3 days after sowing + HW on 40 days after sowing and power weeder, conoweeder weeding at 20 and 40 days after sowing, HW twice on 20 and 40 days after sowing and unweeded control. A seed rate of 30 kg ha^{-1} was adopted. The sprouted seeds were uniformly sown by manually operated rice drum seeder developed by TNAU, Coimbatore, which drops the seeds at 20 cm apart in continuous row. Careful water management practices were adopted in the first one week.

Recommended doses of fertilizer of 150:50:50 kg N, P_2O_5, K_2O ha^{-1} was adopted. The entire quantity of P was applied as basal. Nitrogen in the form of urea and potassium as muriate of potash were applied in four equal splits at basal, active tillering, panicle initiation and at flowering stages. The farm yard manure was applied @ 12.5 t ha^{-1} at last ploughing, incorporated and then leveled. The quantity of early post emergence (EPOE) and pre emergence (PE) herbicides were calculated as per the treatmental schedule. The pre emergence (PE) herbicide was applied using fan type nozzle (WFN 40) 3 days after sowing while the new molecular bispyribac sodium 10% SC, nominee gold were applied as early post emergence herbicides on 12 days after sowing. The herbicides were applied by keeping a thin film of water in the field. The field was neither drained nor irrigated for 2 days after application of herbicides. Hand weeding was given for PE herbicides treated plots 40 days after sowing. The unweeded control plots were kept undisturbed for the entire cropping period.

Results and Discussion

Total weed density

Significant variation in total weed density was observed among the weed control treatments (Fig 1). At early stage of crop growth, lesser weed density was observed in the weed free plot. Statistically it was on par with the application of pre-emergence herbicide pretilachlor S at 0.45 kg a.i ha^{-1} + HW on 40 DAS, butachlor 50% EW at 1.5 kg a.i. ha^{-1} + HW on 40 DAS and anilophos 30% EC at 0.45 kg a.i. ha^{-1} + HW

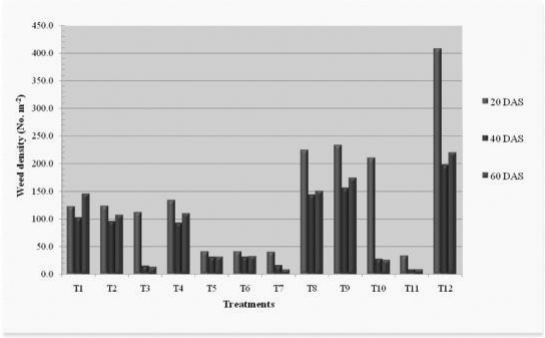

Fig.1. Effect of weed management practices on total density of weeds

on 40 DAS. On 40 and 60 DAS, the total weed density was found to be lesser in weed free treatment and it was on par with application of bispyribac sodium 10% SC at 40 g and pretilachlor S at 0.45 kg a.i ha^{-1} followed by one hand weeding on 40 DAS (T_7).

Total weeds Dry Matter Production

Significant variations were observed on total weed DMP on 20, 40 and 60 DAS due to the adoption of weed management practices (Table 1). No one weed management practice alone lowered the weed dry matter production as compared with weed free check.

Table 1. Effect of weed management practices on total density of weeds and total dry matter production

Treatment	Total weed density (No. m^{-2})			Total weed dry matter (g. m^{-2})		
	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS
T_1 EPOE bispyribac sodium 10 % sc at 10g a.i./ha^{-1}	11.15(122.3)	9.43(87.0)	12.12(145.0)	7.42(53.00)	6.49(41.7)	14.44(206.7)
T_2 EPOE bispyribac sodium 10 % sc at 20g a.i./ha^{-1}	11.18(123.0)	9.87(95.3)	10.44(107.0)	7.42(53.00)	5.70(31.7)	12.66 (160.0)
T_3 EPOE bispyribac sodium 10 % sc at 40g a.i./ha^{-1}	10.68(112.0)	4.12(15.0)	3.87(13.0)	7.48(54.00)	2.91(6.7)	9.02(79.5)
T_4 EPOE bispyribac sodium (nominee gold) 10 % sc at 20g a.i./ha^{-1}	11.66(134.0)	9.67(91.6)	10.58(110.0)	7.41(52.92)	5.71(31.8)	12.69(160.7)
T_5 PE butachlor at 1.5kg a.i./ha^{-1} + hw on 40 Das	6.52(40.5)	5.67(30.2)	5.74(31.0)	7.16(49.33)	4.87(22.7)	11.56(131.7)
T_6 PE anilophos at 0.45kg a.i./ha^{-1} + hw on 40 Das	6.56(41.0)	5.78(31.4)	5.83(32.0)	7.16(49.33)	4.87(22.7)	11.63(133.3)
T_7 PE pretilachlor s at 0.45kg a.i./ha^{-1} + hw on 40 Das	6.48(40.0)	4.58(19.0)	3.12(7.8)	7.16(49.33)	2.86(6.3)	9.14(81.7)
T_8 Power weeder on 20 and 40 DAS	15.03(224.0)	12.10(144.3)	12.33(150.0)	7.42(53.00)	6.49(41.7)	14.33(203.6)
T_9 Cono weeder on 20 and 40 DAS	15.32(232.8)	12.21(147.0)	13.27(174.0)	7.42(53.10)	6.49(41.7)	14.19(199.6)
T_{10} Hand weeding on 20 and 40 DAS	14.56(21.0)	5.57(29.0)	5.20(25.0)	7.42(53.00)	4.67(20.7)	11.48(130.9)
T_{11} Weed free check	5.92(33.0)	3.17(8.0)	3.16(8.0)	1.97(1.90)	1.59(1.8)	5.66(30.0)
T_{12} Weedy Check	20.25(408.0)	13.85(190.0)	14.87(219.0)	7.47(53.85)	7.40(55.0)	16.49(270.0)
SEd	0.14	0.10	0.07	0.05	0.32	0.37
CD (P=0.05)	0.30	0.21	0.16	0.14	0.93	1.08

The weed free check significantly registered lower dry weight of the total weeds on all the days of observation. The differences in the dry weight of weeds between weed management practices on 20 DAS was not significant. But, on 40 and 60 DAS, pretilachlor S at 0.45 kg a.i ha^{-1} + HW on 40 DAS (T_7), bispyribac sodium 10% SC 40 g ha^{-1} (T_3) registered lower dry weight and were on par with each other.

Table 2. Effect of weed management practices on yield and harvest index of rice

Treatment		Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest Index
T_1	EPOE bispyribac sodium 10 % sc at 10g a.i./ha^{-1}	4196	7500	0.56
T_2	EPOE bispyribac sodium 10 % sc at 20g a.i./ha^{-1}	4419	7640	0.58
T_3	EPOE bispyribac sodium 10 % sc at 40g a.i./ha^{-1}	5058	8520	0.59
T_4	EPOE bispyribac sodium (nominee gold) 10 % sc at 20g a.i./ha^{-1}	4393	7540	0.58
T_5	PE butachlor at 1.5kg a.i./ha^{-1} + hw on 40 das	4654	7900	0.59
T_6	PE anilophos at 0.45kg a.i./ha^{-1} + hw on 40 das	4632	7850	0.59
T_7	PE pretilachlor s at 0.45kg a.i./ha^{-1} + hw on 40 das	5005	8600	0.58
T_8	Power weeder on 20 and 40 DAS	4218	7450	0.57
T_9	Cono weeder on 20 and 40 DAS	4221	7600	0.56
T_{10}	Hand weeding on 20 and 40 DAS	4655	7945	0.59
T_{11}	Weed free check	5268	8900	0.59
T_{12}	Weedy Check	2239	4389	0.51
SEd		71	141	0.01
CD (P=0.05)		148	284	NS

Grain yield

Since, different weed management practices did exert significant influence on growth and yield attributes of rice crop, it reflected on grain yield also(Table 2). As in the weed control efficiency, significantly higher grain yield was recorded by weed free check (5268 kg ha^{-1}). It was 135.26 per cent higher than weedy check and 13.15 per cent higher than hand weeding twice on 20 and 40 DAS (farmer's method), which recorded 4655 kg ha^{-1}.

Table 3a. Cost of cultivation and economics of different weed control treatments

Particulars	Cost of cultivation for rice		
	Inputs	Rate (Rs.)	Total cost (Rs.ha^{-1})
Preparatory cultivation			
Ploughing with power tiller	1 power tiller for 10 hr	150 /hr	1500.0
Leveling	4 bullock pair	300 / pair	1200.0
Bund forming	4 man days	150 /day	600.0
Lay out forming	20 women days	150 /day	3000.0
Rectification	14 women days	150 /day	2100.0
Seeds and sowing			
Cost of seed	8 kg	120 / kg	960.0
Seed sowing by seed drill	4 man & 2 woman days	150 / day	900.0
Fertilizer			
Cost of fertilizer	150 kg N ha^{-1}	5.52/ kg	828.0
	50 kg P ha^{-1}	10.34/ kg	517.0
	50 kg K ha^{-1}	4.63 / kg	231.5
Application charges	4 woman days	150 / day	600.0
Plant Protection			
Monocrotophos	250 ml	315 / lit	78.75
After cultivation			
Cost of irrigation	15 irrigations	50 / irrigation	750.0
Labour charges	10 women days	150 / day	1500.0
weeding	30 women days	150 / day	4500.0
Operating mechanical weeding	10 man days	150 / day	1500.0
Total cost for rice			20,765.25
Cost of cultivation for residual crop (Green gram)			
Preparatory cultivation			
Stubbles removing	20 women days	150 /day	3000.0
Seeds and sowing			
Cost of seed	4 kg	120 / kg	480.0
Seed dibbling	10 women days	150 /day	1500.0
After cultivation			
Cost of irrigation	8 irrigations	50 / irrigation	400.0
Picking and transportation	20 woman days	150 /day	3000.0
Land rent and Tax		325 /ha	325.0
Total cost for green gram	-	-	8,705
Total cost for rice + green gram	-	-	29,470.25

Among the weed management treatments, EPOE bispyribac sodium 10% SC at 40 g ha^{-1} (T_3) recorded 5058 kg ha^{-1} grain yield and was on par with pretilachlor S at 0.45 kg a.i ha^{-1} as pre-emergence + one hand weeding on 40 DAS (T_7) which recorded 5005 kg ha^{-1}. Earlier treatment has registered 8.65 per cent and later registered 7.51 per cent higher grain yield over hand weeding twice on 20 and 40 DAS (T_{10}).

Butachlor 50% EW + one hand weeding on 40 DAS (T5) and anilophos 30% EC +one hand weeding on 40 DAS (T_6) recorded the grain yield with 0.01 and 0.49 per cent lesser than hand weeding twice on 20 and 40 DAS (T_{10}), where as the mechanical weed control method with power weeder (4218 kg ha^{-1}) and manually operated cono weeder (4221 kg ha^{-1}) recorded 9.37 and 9.31 per cent lesser grain yields than hand weeding twice on 20 and 40 DAS. But, they have recorded significantly higher yield than weedy check.

Application of bispyribac sodium 10% SC at 20 g ha^{-1} (T_2) and bispyribac sodium 10% SC at 10 g ha^{-1} (T_1) recorded grain yield of 4419 kg ha^{-1} and 4196 kg ha^{-1} respectively, which were 12.6 and 17.0 per cent lesser than bispyribac sodium 10% SC at 20 g ha^{-1} (T_2). The available early post-emergence in the market Nominee gold 10 % SC at 20g ai/ha (T_4) application registered 4393 kg ha^{-1}, which was 13.1 per cent lesser in grain yield than bispyribac sodium 10 SC at 40 g ha^{-1} (T_3).

Straw yield

Similar to grain yield, straw yield was also influenced significantly by different weed management practices (Table 2). Weed free check recorded the highest straw yield of 8900 kg ha^{-1}, which was on par with integraded weed management method of pre-emergence application of pretilachlor at 0.45 kg a.i. ha^{-1} + HW at 40 DAS (8600 kg ha^{-1}) and early post-emergence herbicide application of bispyribac sodium 10% SC at 40 g ha^{-1} (8520 kg ha^{-1}). Unweeded check recorded significantly low straw yield of 4389 kg ha^{-1}.

Harvest index

Different weed management practices failed to reach the level of significance in influencing the harvest index (Table 2). However, the maximum harvest index of 0.59 was recorded by early post-emergence herbicide application of bispyribac sodium 10% SC at 40 g ha^{-1}(T_3), pre- emergence application of butachlor at 1.5 kg a.i. ha^{-1} + HW at 40 DAS (T_5), anilophos at 0.45kg a.i./ha^{-1} + HW on 40 DAS (T_6), hand weeding on 20 and 40 DAS and weed free check (T_{11}).

Table 3b. Cost of cultivation and economics of different weed control treatments

Treatment	Fixed cost of cultivation (Rs. ha^{-1})	Cost of herbicide (Rs. ha^{-1})	Herbicide application charge (Rs. ha^{-1})	Cost of weeding (Rs. ha^{-1})	Total cost of cultivation (Rs. ha^{-1})	Grain yield (kg ha^{-1})	Gross income (Rs. ha^{-1})	Net income (Rs. ha^{-1})	B:C ratio
T - Bispyribac sodium 10 % SC at10g a.i./ha^{-1}	20,765	90.85	600	-	21,456	4,196	50,362	28,906	2.35
T_1 - Bispyribac sodium 10 % SC at 20g a.i./ha^{-1}	20,765	180.5	600	-	21,546	4,419	53,037	31,491	2.46
T_2 - Bispyribac sodium 10 % SC at 40g a.i./ha^{-1}	20,765	363.4	600	-	21,728	5,058	60,698	38,970	2.79
T_3 - Bispyribac sodium (Nominee gold) 10 % SC at 20g a.i./ha^{-1}	20,765	158.0	600	-	21,523	4,393	52,725	31,202	2.45
T_4 - Butachlor at 1.5kg a.i./ha^{-1} + One HW	20,765	507.0	600	2,100	23,972	4,654	55,857	31,885	2.33
T_5 - Anilophos at 0.45kg a.i./ha^{-1} + One HW	20,765	345.0	600	2,100	23,810	4,632	55,589	31,779	2.33
T_6 - Pretilachlor S 0.45kg a.i./ha^{-1} + One HW	20,765	427.5	600	2,100	23,893	5,005	60,064	36,171	2.51
T_7 - Power weeder on 20 and 40 DAS	20,765		-	1,587	22,352	4,218	50,627	28,275	2.26
T_8 - Cono weeder on 20 and 40 DAS	20,765	-	-	1,200	21,965	4,221	50,663	28,698	2.31
T_9 - HW on 20 and 40 DAS	20,765	-	-	5,250	26,015	4,655	55,866	29,851	2.15
T_{10} - Weed free check	20,765	-	-	6,000	26,765	5,268	63,217	36,452	2.36
T_{11} – weedy check	20,765	-	-	-	20,765	2,239	26,870	6,105	1.29

Price of rice: Rs 12 /kg **Cost of hand weeding** Women – Man day – ' 150/-

Cost of herbicides

Bispyribac sodium 10 % SC	:	Rs 632 / 80 ml
Butachlor at 1.5kg a.i./ha	:	Rs 169 / litre
Anilophos at 0.45kg a.i./ha	:	Rs 230 / litre
Pretilachlor S 0.45kg a.i./ha	:	Rs 285/ litre

Economics of weed management practices

Adoption of different weed management practices significantly influenced the gross returns, net returns and B:C ratio (Table 3a, 3b). The treatment consisting of application of bispyribac sodium 10% SC at 40 g ha^{-1} registered Rs. 60,698 ha^{-1} as gross income next to weed free check Rs. 63,217 ha^{-1} with a net return of Rs. 38,970 ha^{-1} and a B:C ratio 2.79. This was followed by pretilachlor at 0.45 kg a.i. ha^{-1} + HW on 40 DAS with a gross return of Rs. 60,064 ha^{-1}, net return Rs. 36,171 ha^{-1} and B:C ratio 2.51.

Application of butachlor 50% EW at 1.5 kg a.i. ha^{-1} + HW on 40 DAS, anilophos 30% EC at 0.45kg a.i. ha^{-1}+ HW on 40 DAS and hand weeding twice registered comparable gross return, net return and B: C ratio.The unweeded check recorded the lowest gross return (Rs 26,870 ha^{-1}), net return (Rs 6,105) ha^{-1} and B: C ratio (1.29).

Conclusion

The results of this experiment revealed that among the weed management practices, application of early post emergence herbicide bispyribac sodium 10 SC 40 g ha^{-1} (T_3) recorded lesser weed density and helped to enhance crop growth, yield components and yield in direct seeded rice. Hence, bispyribac sodium 10 SC at 40 g a.i. ha^{-1} as early post emergence herbicide is found to be an effective and alternative post emergence herbicide for better weed control, higher grain yield and economic returns in direct seeded lowland rice.

References

Biswas, J.C. and S.A. Sattar. 1992. Weed control in wet seeded rice in Bangladesh. IRRN., **17**(5): p. 8.

Christos, A. Damlas, Kico V. Dhima and Ilias G. Eleftherohorins. 2008. Bispyribac-sodium Efficacy on early Water grass (Echinochloa oryzoides) and late watergrass (Echinochloa phyllopogon) as affected by Co-application of selected Rice herbicides and insecticides. *Weed Technol.,* **22**: 622-627.

Fischer, A.J., D.P. Cheetham, F. Vidotti and R. De. Prado. 2004. Enhanced effect of thiobencarb on bispyribac-sodium control of Echinochloa phyllopogam (stapf) Koss. In California rice (Oryza sativa) *Weed Biol. Mang.,* **4**: 206-212.

Jayadeva, H.M. and S.T. Bhairappanavar. 2002. Chemical weed control in Drum Seeded Rice. *Indian J. Weed Sci.,* **34**(3 and 4): 290-292.

Madhavi, M. and M.D. Reddy. 2002. Relative efficacy of herbicides on performance of wet seeded rice. *Trop. Pest Management.* **38:** 9-12.

Moody, K. 1989. The status of weed control in rice in Asia. FAO Plant Prot. Bull, **30** (3 and 4): 119-123.

Nagarajan R. and C. Chinnusamy. 2010. Evaluation of bensulfuron methyl and butachlor on weed control and productivity of transplanted rice (Oryza sativa L.) In: Proc. of Annual Weed Science Conf., 30th November & 1st December, TNAU, Coimbatore. P.145.

Payman, G. and Surjit Singh. 2008. Effect of seed rate, spacing and herbicide use on weed management in direct seeded rice (*Oryza sativa)*. *Indian J. Weed Sci.,* **40** (1 and 2): 11- 15.

Tajuddin, A. and Fellow. 2009. Development of a power weeder for low land rice. *Indian J. Agric. Engineering*. **90**: 15-17.

Tomar, S.S. 1991. Agronomic and economic evaluation of herbicides in transplanted rice. IRRW. **16**(2): 24.

Walia, U. S., M. S. Bhullar, Shelly Nayyar and Amandeep Singh Sidhu. 2008. Control of complex weed flora of dry-seeded rice (Oryza sativa) with pre and post emergence herbicides. *Indian. J. Weed Sci.*, **40**(3&4):161-164.

Yadev, D.B., Ashok Yadev and S.S. Punia. 2009. Evaluation of bispyribac sodium for control in transplanted rice. *Indian J. Weed Sci.,* **41**(1&2): 23-27.

Received after revision: December 12, 2014; Accepted: January 10, 2015