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Research Article

Effect of Low Dose Early Post Emergence Herbicide on Growth and Yield of Transplanted Rice Crop

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Abstract

Field experiment was conducted from *Khairf* 2010 and 2011 to study the effect of low dose early post-emergence herbicide bispyribac sodium at different doses on control of weeds and growth and yield of transplanted rice. The treatments consisted of five doses of new formulation of early post emergence herbicide bispyribac sodium 10% SC at 20, 35, 50, 100 and 200 g a.i. ha^{-1} on 15 DAT; early post emergence formulation nominee gold 100 g/ L SC at 20 g a.i. ha^{-1} on 15 DAT and pre emergence formulation of pretilachlor at 1.0 kg a.i. ha^{-1}, butachlor at1.0 kg a.i. ha^{-1} on 3 DAT followed by hand weeding at 40 DAT and followed by two row rotary weeder weeding at 40 DAT along with hand weeding twice (HW) and unweeded control. In transplanted rice, the weeds could be effectively and economically managed through early post emergence application of bispyribac sodium at 50 g a.i. $ha^{-1}$and pretilachor at 1.0 kg a.i. ha^{-1} + two row rotary weeder weeding at 40 DAT resulted in higher and comparable growth and grain yield of transplanted rice.

Keywords: Transplanted rice, bispyribac sodium, early post emergence herbicide

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Introduction

Rice crop suffers from various biotic and abiotic production constraints. Weed competition is one of the prime yield-limiting biotic constraints in transplanted rice. Weeds compete with crops for water, light, nutrients and space. Weeds are the most competitors in their early growth stages than at later stages and hence the growth of crops slows down and finally grain yield decreases (Jacob and Syriac, 2005) [1]. Transplanted rice is infested with wide range of weeds species *viz.*, grasses, sedges and broad leaved weeds. *Echinochloa crusgalli* and *Cyperus difformis* are the most predominant and highly competitive weeds in transplanted rice ecosystem. *Echinochloa crus-galli* competes with rice crop right from the planting till harvest stage of the rice crop whereas the sedge weed *Cyperus difformis* competes with the crop during the early phase of rice crop because of its shorter life cycle. Weed competition is one of the main factors that affects rice yield. Greater yield losses can occur at times when weed competition coincides with the critical period of growth of rice. Barua *et al.* (2008) [2] reported 30 to 60 days after transplanting as critical period of crop weed competition. Reduction in grain yield due to unchecked weed infestation in transplanted rice varies between 29 and 63 per cent (Bhuvaneswari *et al.*, 2009) [3]

Weed control in transplanted rice by mechanical and cultural is an expensive method. Especially at the time of peak period of labour crisis, sometimes weeding becomes delayed causing drastic reduction in grain yield. Normally two manual weedings are done in lowland rice crop. For the two weedings 50 woman labours are engaged per ha. The amount incurred for manual weeding in low land rice works out around Rs. 1200 million for single crop per year in Tamil Nadu alone (Tajuddin and Fellow, 2009) [4]. In contrast to this, chemical weed control is effective to control weeds. Now-a-days use of herbicides is gaining popularity in rice culture due to their rapid effects and less cost involvement compared to traditional methods. Chemical weed control offers economic and efficient weed control if applied at proper dose and stage (Kumar and Sharma, 2005) [5]. The use of herbicides offers selective control of weeds right from the early stage of the crop for initiation and competitive superiority over weeds (Saha, 2005) [6].

The herbicides that are commonly used in transplanted rice are butachlor, anilofos, thiobencarb, pretilachlor, ethoxysulfuron *etc.* Continuous use of rice herbicides with similar mode of action has to be restricted to avoid undesirable weed shift. Weed shift from grasses to non grasses and annual sedges is being observed in transplanted

rice field due to continuous use of butachlor, pretilachlor and anilofos *etc*., and also continuous use of thiobencarb and 2,4-D has resulted in the predominance of perennial weeds like *Cyperus* spp. Moreover, the rice herbicides presently used are mainly pre-emergence and weeds emerging at early vegetative stage of rice crop are not controlled as effectively as at early emergence stage. This situation warrants for initiating research efforts to evaluate and identify suitable early post emergence herbicide(s).

Application of effective new herbicides that provide wide-spectrum of weed control would be desirable for effective weed control. The low dose herbicide viz., sulfonylurea group has been used all over the world for effective control of weeds in later stages. Among several sulfonylurea herbicides, Bispyribac sodium is a new early post emergence rice herbicide. Hence, the present investigation was taken up to study the effect of early post emergence herbicide on growth and yield of transplanted rice.

Materials and Methods

Field experiment was conducted from *Khairf* 2010 and 2011 Tamil Nadu Agricultural University, Coimbatore, India to study the effect of low dose new formulation of early post-emergence herbicide bispyribac sodium 10% SC at different doses on control of weeds and on the selectivity, growth and yield of transplanted rice. The experiment was laid out in a randomized complete block design with three replications. The treatments consisted of five doses of new formulation of early post emergence herbicide bispyribac sodium 10% SC at 20, 35, 50, 100 and 200 g a.i. ha^{-1} on 15 DAT); early post emergence formulation nominee gold 100 g/ L SC at 20 g a.i. ha^{-1} on 15 DAT and pre emergence formulation of pretilachlor at 1.0 kg a.i. ha^{-1}, butachlor at1.0 kg a.i. ha^{-1} on 3 DAT followed by hand weeding at 40 DAT and followed by two row rotary weeder weeding at 40 DAT along with hand weeding twice (HW) and unweeded control. The test variety used for the experiment was CO(R) 49.

The quantity of post emergence herbicides and pre emergence herbicides were calculated as per the treatmental schedule and pre-emergence herbicides were applied using fan type WFN 40 nozzle at 3 DAT while in the new molecule of bispyribac sodium and Nominee gold were applied as early post emergence herbicides on 15-20 DAT. The herbicides were applied 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 pre emergence herbicides treated plots at 40 DAT and two row weeder weeding was given for pre emergence herbicides treated plots at 40 DAT. The hand weeding treatment plot, two hand weeding was done at 20 and 40 DAT. The unweeded control plots were kept undisturbed for the entire cropping period.

The observations on weeds were made as per the methods described by Burnside and Wicks (1965) [7]. The population of weeds m^{-2} and dry matter production of weeds were recorded at twenty five days interval from the date of transplanting. The growth parameters of the transplanted rice were recorded at 25, 50, 75 DAT and at harvest stages of the crop. In order to evaluate the effect of different treatments on vegetative growth and yield characters, the data were statistically analyzed using "Analysis of variance test". The critical difference at 5% level of significance was calculated to find out the significance of different treatments over each other (Panse and Sukhatme, 1989) [8]

Results and Discussion

The pooled results of *Kharif* 2010 and 2011 of the experiment were presented and discussed hereunder.

Growth characters of transplanted rice

The grassy weed seedlings are morphologically similar to that of rice plants. Weed seedlings get transplanted along with rice seedlings and are highly competitive and difficult to control. Hence, the rice seedlings have to face severe weed competition in early stage itself. The problem becomes more critical when the farmers do not get their fields weeded at appropriate time due to non availability of labour. As a result, the growth and yield attributes of the crop are affected. Under such situations, herbicides are found to be better alternative for the management of weeds. Many herbicides are highly selective and available for use in rice. Pretilachlor and butachlor are such chemicals used to inhibit germination of weed species and kill germinated weed seedling at early stage.

Adoption of different weed management practices produced distinct variations on the height of plants at all the stages. Tallest rice plants were noted with application of pretilachlor at 1.0 kg a.i. ha^{-1} + TRRW at 40 DAT (83.39cm). It was comparable with application of bispyribac sodium at 50 g a.i. ha^{-1}. This might be due to the better weed control

throughout growth stages of rice and better availability of all resources *viz.*, light, moisture, space and nutrients to rice. As a result of severe competition for resources in uncontrolled weedy crop, the plant height was lower throughout the growth period. Srinivasan and Palaniappan (1994) [9] observed higher plant height under minimum weed competition plots.

Application of Bispyribac sodium at 50 g a.i. ha^{-1} and pretilachlor at 1.0 kg a.i. ha^{-1} + HW at 40 DAT recorded the highest leaf area index. This could be attributed to the effective suppression of weeds, which favoured congenial environment to the crop to utilise all available resources efficiently. The higher numbers of tillers were attributed the efficient control of weeds which might have caused more availability of growth factors to the crop. Bispyribac sodium at 50 g a.i. ha^{-1} recorded 60 per cent increased in the number of tillers over unweeded check. It might be due to severe weed competition from the early stage onwards. These findings were in conformity with the findings of Kalita and Gogoi (1994) [10] and Sangeetha *et al.* (2009) [11].

Crop growth rate was higher in Bispyribac sodium at 50 g a.i. ha^{-1} and was comparable with pretilachlor at 1.0 kg a.i. ha^{-1} + hand weeding at 40 DAT. Better weed control and subsequent enhanced nutrient availability had resulted in higher plant height, LAI and tiller production which had positive influence on CGR. From 75-100 DAT, the lowest growth rate was on account of limited biomass increased in the reproductive phase and energy has been spent for conversion of source to sink. (**Table 1**). Bhargavi and Yellamanda Reddy (1994) [12]. Control of weeds up to the critical periods of crop weed competition by Bispyribac sodium at 50 g a.i./ha^{-1} and pretilachlor at 1.0 kg a.i. ha^{-1} + hand weeding at 40 DAT led to better plant growth, crop canopy and effective utilization of available nutrients resulted in increased drymatter production (**Figure 1**).

Table 1. Effect of weed management treatments on growth characters of transplanted rice (Pooled data of two years)

Treatments	**75 DAT**			**At harvest**	**75-100 DAT**
	Plant height (cm)	**Leaf area index on**	**No. of tillers m^{-2}**	**Dry matter production (kg ha^{-1})**	**Crop growth rate g m^{-2} day^{-1}**
T_1 – Bispyribac sodium (10% SC) @ 20g a.i/ha	72.70	6.34	503	9850	6.06
T_2 – Bispyribac sodium (10% SC) @ 35g a.i/ha	79.07	6.65	524	10738	7.40
T_3 – Bispyribac sodium (10% SC) @ 50g a.i/ha	82.13	7.33	571	11073	7.76
T_4 – Bispyribac sodium (10% SC) @ 100g a.i/ha	76.41	6.31	535	10016	6.28
T_5 – Bispyribac sodium (10% SC) @ 200g a.i/ha	70.16	6.10	514	9749	7.00
T_6 – Nominee Gold 100g/L SC@20g a.i/ha	79.18	6.90	535	10314	6.80
T_7 – Butachlor @1.0 kg a.i/ha + HW at 40 DAT	81.20	7.13	542	10320	5.70
T_8 – Butachlor @1.0 kg a.i /ha + TRRW at 40 DAT	81.77	7.31	558	10751	6.56
T_9 – Pretilachlor @1.0 kg a.i/ha + HW at 40 DAT	81.80	7.24	562	10349	6.60
T_{10} – Pretilachlor @1.0 kg a.i /ha + TRRW at 40 DAT	83.39	7.34	574	11033	7.69
T_{11} – HW twice at 20 and 40 DAT	81.15	7.19	565	10789	6.71
T_{12}– Unweeded Check	64.00	5.93	341	7450	5.36
SEd	1.46	0.18	18	343	1.00
CD (P= 0.05)	3.04	0.38	38	711	2.07

HW – Hand Weeding, TRRW – Two Row Rotary Weeder

Yield attributes of transplanted rice

Productive tillers m^{-2} and number of filled grains $panicle^{-1}$ were the most important factors deciding the grain yield. Panicle length, panicle weight, grain $panicle^{-1}$ and thousand grain weight were higher under post emergence application of Bispyribac sodium at 50 g a.i. $ha^{-1.}$ Similar findings reported by Veeraputhiran and Balasubramanian (2010) [13]. This was comparable with pretilachlor 1.0 kg a.i. ha^{-1} + TRRW weeding at 40 DAT, butachlor at 1.0 kg a.i. ha^{-1} + TRRW weeding at 40 DAT, pretilachlor at 1.0 kg a.i. ha^{-1} + hand weeding at 40 DAT, butachlor at 1.0 kg a.i. ha^{-1} + hand weeding at 40 DAT and hand weeding twice. Higher weed control efficiency of these treatments and lower depletion of nutrients by weeds, promoted the sink capacity of the crop and ultimately the yield (**Table 2**). Choudhary and Thakuria (1998) [14].

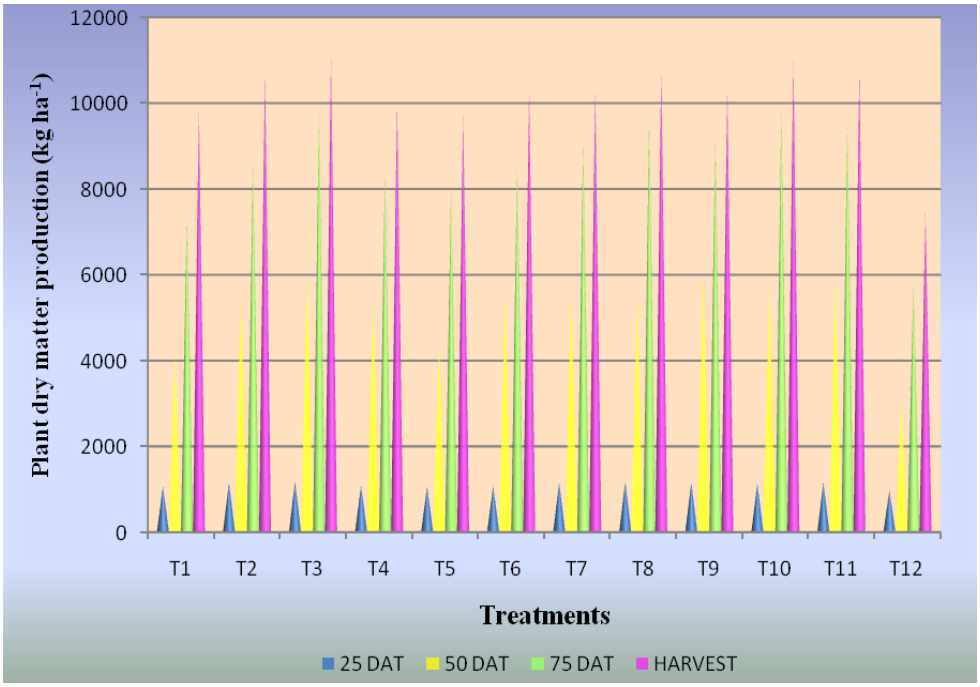

Figure 1 Effect of weed management practices on dry matter production of rice (kg ha^{-1})

Table 2 Effect of weed management practices on Yield parameters and yield of transplanted rice (Pooled data of two years)

Treatments	Productive tillers m^{-2}	Filled grains $panicle^{-1}$	1000 grain weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{1})	Harvest index
T_1 – Bispyribac sodium (10% SC) @ 20g a.i/ha	400	106	16.81	4600	7467	0.38
T_2 – Bispyribac sodium (10% SC) @ 35g a.i/ha	474	119	16.95	5033	7550	0..39
T_3 – Bispyribac sodium (10% SC) @ 50g a.i/ha	511	129	18.43	5674	8667	0.40
T_4 – Bispyribac sodium (10% SC) @ 100g a.i/ha	453	105	17.84	4350	8017	0.35
T_5 – Bispyribac sodium (10% SC) @ 200g a.i/ha	431	103	17.77	3987	7417	0.35
T_6 – Nominee Gold 100g/L SC@20g a.i/ha	482	114	17.48	4834	7976	0.37
T_7 – Butachlor @1.0 kg a.i/ha + HW at 40 DAT	485	118	17.85	5155	8383	0.38
T_8 – Butachlor @1.0 kg a.i /ha + TRRW at 40 DAT	501	122	17.25	5242	8160	0.40
T_9 – Pretilachlor @1.0 kg a.i/ha + HW at 40 DAT	495	123	17.5	5190	8633	0.38
T_{10} – Pretilachlor @1.0 kg a.i /ha + TRRW at 40 DAT	505	127	17.72	5538	8617	0.40
T_{11} – HW twice at 20 and 40 DAT	497	121	16.66	5210	8200	0.39
T_{12}– Unweeded Check	179	95	16.25	2296	4920	0.32
SEd	5.33	3.45	1.12	161	178	0.01
CD (P= 0.05)	10.99	7.16	NS	335	370	NS

HW – Hand Weeding, TRRW – Two Row Rotary Weeder

Highest grain yield was recorded with Bispyribac sodium at 50 g a.i. ha^{-1}, grain yield (5671 kg/ha) under this treatment was 147.1 per cent higher over unweeded check. Narayanan *et al.* (2000) [15] reported that application of bispyribac sodium at 50 g a.i. ha^{-1} recorded the highest grain yield and it was comparable with pretilachlor at 1.0 kg a.i. ha^{-1} + TRRW weeding at 40 DAT. This was attributed to efficient and broad spectrum of weed control. The favourable conditions created through the efficient weed control resulted in lesser weed competition between the crops and weeds. This favoured the crop to produce more LAI and plant drymatter production, increased productive tillers was (35%) over unweeded check. Application of butachlor at1.0 kg a.i. ha^{-1} + TRRW weeding at 40 DAT, pretilachlor 1.0 kg a.i. ha^{-1} + HW weeding at 40 DAT, butachlor at 1.0 kg a.i. ha^{-1} + TRRW weeding at 40 DAT and hand weeding twice next in the order in terms of resulting higher grain yield. The impact of weed control treatments on straw yield was similar to their effect on grain yield. Except higher and lower doses of Bispyribac sodium, all other treatments enhanced the straw yield and were comparable to hand weeding twice (Table 2). Weed control treatments did not cause a conspicuous difference in harvest index.

Conclusion

Based on the result of the study conducted in transplanted rice, it is concluded that, early post emergence application of Bispyribac sodium at 50 g a.i. ha^{-1} recorded enhanced crop growth, yield component and yield in transplanted rice.

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