Research Article

Early Post Emergence Herbicide and Their Influence on Weed Population Dynamics in Transplanted Rice (*Oryza Sativa* L.)

Murali Arthanari, P*., S. Gowthami, C. Chinnusamy, R. Sathya Priya, and V. Hariharasudhan

Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore – 641 003, Tamil Nadu, India

Abstract

Field experiments were conducted from *Khairf* 2010 and 2011 to study the effect of early post emergence herbicide and their effect on weed population dynamics in 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. The major grassy weeds were *Echinochloa crus-galli* (L.), *Echinochloa colonum* (L.) and the major sedge weed was *Cyperus difformis* (L.). Among the broad leaved weeds, *Ammania baccifera* (L.) and *Marsilea quadrifoliata* were the dominant species. Among the weed management practices, Bispyribac sodium at 200 g a.i. ha^{-1} markedly suppressed the weeds growth. Bispyribac sodium at 100 g a.i. ha^{-1}, Bispyribac sodium at 50 g a.i. ha^{-1}, pretilachor 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 were the next best in terms of weed control.

Keywords: Transplanted rice, bispyribac sodium, early post emergence herbicide, Weed population dyamics

***Correspondence**
Author: P. Murali Arthanari
Email: agronmurali@gmail.com, muraliarthanari.p@tnau.ac.in

Introduction

In India weed problem is one of the most important biotic constraints that limits rice productivity [1]. Transplanted rice, in particular, is infested by heterogeneous type of weed flora under lowland ecosystems which reduces yield upto 48 per cent and an yearly loss of 15 million tonnes due to weed competition [2]. Prevention of weed competition and provision of weed free environment at critical period of rice growth is necessary for successful rice production.

Transplanted rice is infested with wide range of weeds species *viz.*, grasses, sedges and broad leaved weeds. Among different weed species some group of weeds posing acute yield reduction in the transplanted rice and particularly, 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. Hence, these weeds can be effectively managed using herbicides instead of other weed management options. Since, 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. In this context, an attempt was made to evaluate application of early post emergence herbicide and their influence on weed population dynamics in transplanted rice.

Materials and Methods

Field experiment were conducted during *Khairf* 2010 and 2011 Tamil Nadu Agricultural University, Coimbatore, India to evaluate the effect of early post emergence herbicide Bispyribac sodium on weed population dynamics 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 not drained or 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 [3]. The population of weeds m^{-2} and dry matter production of weeds were recorded at twenty five days interval from the date of transplanting. In order to evaluate the effect of different treatments on vegetative growth and yield characters, the data were statistically analyzed by ANOVA test. Five percent critical difference level of significance was calculated to find out the significance of different treatments over each other [4].

Results and Discussion

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

Weed flora of the experimental field consisted of Echinochloa crus-gallii, Echinochloa colonum, Cyperus difformis, Cyperus iria, Ammania baccifera, Marsilea quadrifoliata, Eclipta prostrate, Monochoria vaginalis and Luduwigia parviflora. Such wide spectrum of weeds in transplanted rice condition was also reported by many workers [5, 6] Among the weeds, sedges were predominant and constituted 55.5 per cent of the weed flora. This was followed by grasses which accounted for 32.1 per cent. Cyperus difformis was the dominant species of sedges (51.1%), followed by Cyperus iria (4.39%). Singh et al., (2009) [7] envisaged that sedges weed population dominated in rice ecosystems. The second position was occupied by grasses, in which Echinochloa crusgalli (19.79%) was the dominant weed. The broad leaved weeds occupied third position in terms of intensity.

Significant variation in total weed density was observed among the weed control treatments. At 25 DAT, lesser weed density was observed with the application of Bispyribac sodium at 200 g a.i. ha^{-1} (1.41 m^{-2}) and it was closely followed by Bispyribac sodium at 100 g a.i. ha^{-1} (1.63 m^{-2}). The total weed density was found to be lesser with the application of Bispyribac sodium at 200 g a.i. ha^{-1} (1.82, 2.77 m^{-2} respectively) at 50 and 75 DAT. Application of Bispyribac sodium at 50 g a.i. ha^{-1}, pretilachlor at 1.0 kg a.i. ha^{-1} + HW at 40 DAT and butachlor at 1.0 kg a.i. ha^{-1} + HW at 40 DAT recorded significantly lesser density of total weeds as compared to unweeded check (10.23, 10.85, 11.45 m^{-2}). The highest weed population was recorded in unweeded check followed by the lower dose of Bispyribac sodium at 20 g a.i. ha^{-1} (6.0, 6.66, 7.33 m^{-2}).

Weed control treatments had dramatically altered the population of weed species (**Figure 1**). Among the weed control treatments, early post emergence application of Bispyribac sodium at 200 and 100 g a.i. ha^{-1} are very effective in controlling the weeds resulting in lowest weed density. This treatment caused reduction in total weed density to the tune of 98 and 95 per cent respectively over unweeded check. Bispyribac sodium at 50 g a.i. ha^{-1} and pretilachlor at 1.0 kg a.i. ha^{-1} + hand weeding at 40 DAT are also comparable at higher doses. Similar observation also made by Yadev *et al*. (2009) [8] who found that, application of bispyribac sodium 30-60 g ha^{-1} on 15 DAT were on par with pretilachlor at 1.0 kg a.i. ha^{-1} and butachlor at 1.5 a.i. kg ha^{-1}

Bispyribac effectively controls broad spectrum of weeds. At harvest stage also, the data clearly indicated that higher doses (200 and 100 g a.i. ha^{-1}) of bisbyribac sodium effectively controlled the weeds. Application of butachlor at 1.0 kg a.i. ha^{-1} + hand weeding at 40 DAT and hand weeding twice significantly reduced the weed population at all stages of crop growth.

Herbicides (Butachlor or pretilachlor) followed by two row rotary weeder weeding at 40 DAT was less effective in controlling the weeds. Two row rotary weeder are difficult to use because they must be moved back and forth and also difficult to uproot the weeds, because weeds are older and larger during 40 DAT. Only advantage of using two row rotary weeder was soil stirring. Balasubramanian and Ramanathan (2002) [9] reported that the mechanical weeding plus soil stirring must be done when most weeds are at the 2 to 3 leaf stage and mechanical weeding is difficult when weeds are older and larger.

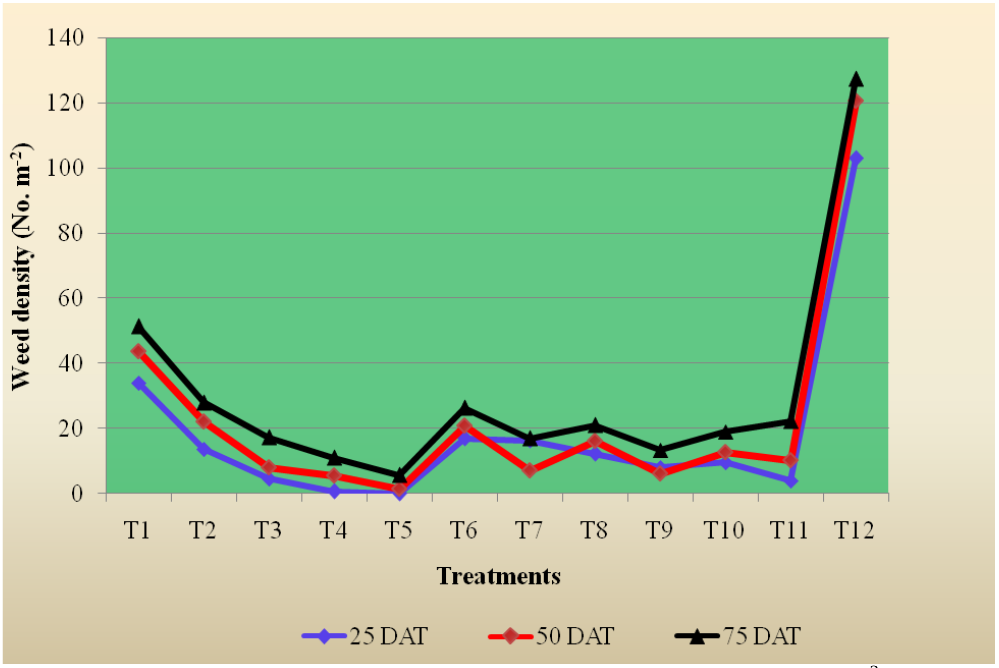

Figure 1 Effect of weed management practices on the density of total weeds (No. m^{-2}) in transplanted rice

General view of experimental field

Post emergence application of Bispyribac sodium @100g/ha

Weed dry weight

Early post emergence herbicide bispyribac sodium at 200 g a.i. ha^{-1} registered lesser weed biomass compared to other doses and treatments as a result of reduction of weed density by herbicidal action. Bispyribac sodium at 100 and 50 g a.i. ha^{-1}, pretilachor 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 were also offered effective and comparable weed control by recording lesser weed biomass similar to higher dose of bispyribac sodium (200 g a.i. ha^{-1}), but better than nominee gold 100 g/L SC at 20 g a.i. ha^{-1}, pretilachor at 1.0 kg a.i. ha^{-1} + two row rotary weeder weeding at 40 DAT, butachlor at 1.0 kg a.i. ha^{-1} + two row rotary weeder weeding at 40 DAT. Yadev *et al.* (2009) [10] reported that dry weight of weeds decreased with increase in dose of bispyribac sodium.

Invariably, the lowest dose (20 and 35 g a.i. ha^{-1}) of bispyribac sodium didn't inhibit either weed germination or weed growth, might be a sub lethal dose for the weed species exist in the present study. However, as the crop growth stage advanced, the weed dry weight gradually increased. Rajkhowa *et al*. (2001) [11] also reported an increased weed dry weight as the crop growth stage advanced. Dry weight of grasses and sedges was four fold higher the dry weight of broad leaved weeds.

Weed control efficiency

Weed control efficiency indicates the comparative magnitude of reduction in weed dry weight by weed control treatments. Due to reduced weed population, the weed dry weight was very much reduced in the treatments. Weed control efficiency was highly influenced by different treatment throughout the crop period. Weed control efficiency was higher at 200 and 100 g a.i. ha^{-1} of bispyribac sodium.

Bispyribac sodium at 50 g a.i. ha^{-1} and pretilachlor at1.0 kg a.i. ha^{-1} + hand weeding at 40 DAT was comparable with higher dose of bispyribac sodium. Bispyribac sodium at 50 g a.i. ha^{-1} recorded the highest weed control efficiency (98.1%) observed by Veeraputhiran and Balasubramanian (2010) [12]. Weed control efficiency was lesser with lower doses (20 and 35 g a.i. ha^{-1}) of bispyribac sodium and nominee gold 100 g/L SC at 20 g a.i. ha^{-1} due their ineffective weed control.

Table 1 Effect of weed management practices on total weed density (No. m^{-2}) of transplanted rice (Pooled data of two years)

Treatments	**Total weed density (No. m^{-2})**			**Total Dry Weight 50 DAT**		
	25 DAT	**50 DAT**	**75 DAT**	**Grass ($g\ m^{-2}$)**	**Sedges ($g\ m^{-2}$)**	**BLW ($g\ m^{-2}$)**
T_1 – Bispyribac sodium (10% SC) @ 20g a.i/ha	6.00 (33.97)	6.66(42.34)	7.30(51.33)	6.39(38.79)	3.57(10.75)	2.40(3.77)
T_2 – Bispyribac sodium (10% SC) @ 35g a.i/ha	4.08 (14.63)	4.93 (22.33)	5.48 (28.00)	5.04 (23.38)	2.76 (5.63)	2.24 (3.02)
T_3 – Bispyribac sodium (10% SC) @ 50g a.i/ha	2.58 (4.67)	3.56 (10.67)	4.40 (17.33)	3.39(9.40)	1.88(1.54)	2.07 (2.30)
T_4 – Bispyribac sodium (10% SC) @ 100g a.i/ha	1.63 (0.67)	2.71 (5.33)	3.61 (11.00)	2.14(2.57)	1.76(1.06)	1.83 (1.33)
T_5 – Bispyribac sodium (10% SC) @ 200g a.i/ha	1.41 (0.00)	1.82 (1.33)	2.77 (5.67)	1.84(1.37)	1.41(0.00)	1.41 (0.00)
T_6 – Nominee Gold 100g/L SC@20g a.i/ha	4.36 (16.97)	4.80 (21.00)	5.32 (26.33)	4.79(20.95)	3.06(7.38)	2.50 (4.25)
T_7 – Butachlor @1.0 kg a.i/ha + HW at 40 DAT	4.23 (15.93)	3.06 (7.33)	4.20 (15.67)	1.68(0.82)	1.49(0.22)	1.82 (1.29)
T_8 – Butachlor @1.0 kg a.i /ha + TRRW at 40 DAT	3.78 (12.27)	4.28 (16.33)	4.80 (21.00)	4.21(15.72)	2.51(4.29)	2.08 (2.34)
T_9 – Pretilachlor @1.0 kg a.i/ha + HW at 40 DAT	3.16 (8.00)	2.89 (6.33)	3.79 (12.33)	1.78(1.17)	1.61(0.58)	1.79 (1.19)
T_{10} – Pretilachlor @1.0 kg a.i /ha + TRRW at 40 DAT	3.56 (10.67)	3.83 (12.67)	4.51 (18.33)	3.75 (12.09)	1.86(1.46)	1.84 (1.38)
T_{11} – HW twice at 20 and 40 DAT	2.45 (4.00)	3.46 (9.97)	4.93 (22.33)	2.11(2.45)	1.85(1.42)	1.78 (1.16)
T_{12}– Unweeded Check	10.23(102.63)	10.85(115.67)	11.45 (129.00)	7.03(47.37)	7.14(49.03)	3.07 (7.44)
SEd	0.4	0.32	0.49	0.25	0.23	0.21
CD (P= 0.05)	0.84	0.67	1.02	0.55	0.47	0.43

HW – Hand Weeding, TRRW – Two Row Rotary Weeder, BLW – Broad Leaved Weeds. (Figures in parenthesis are original values)

Nutrient removal by weeds

In general, uptake of nutrients by weeds invariably resulted in reduced nutrient uptake by the crop resulting in decreased yield. Weeds usually grow faster than crop plants and thus absorb the available nutrient earlier resulting in lack of nutrients for the crop plants. The pattern of nutrient removal by weeds showed that wherever effective weed control possible, the nutrient loss due to weeds was minimum. The loss of nutrients by weeds varied with intensity of weeds and weed drymatter accumulation. Bispyribac sodium at 200 and 100 g a.i. ha^{-1} prevented the subsequent accumulation drymatter of weeds led to decreased depletion of soil nutrient. It was comparable with bispyribac sodium at 50 g a.i. ha^{-1}.

Rana and Angiras (1999) [13] confirmed that N, P and K removal by weeds was limited in herbicide applied plots compared to unweeded control. Due to uncontrolled weed growth, the removal of N, P and K by the weeds was the highest in the unweeded check which resulted in increased dry matter production of weeds.

Table 2 Effects of weed management practices on weed control efficiency and nutrients removal by weeds in transplanted rice (Pooled data of two years)

Treatments	**Weed control efficiency (percent)**			**Nutrients removal (kg/ha) by weeds on 50 DAT**		
	25 DAT	**50 DAT**	**75 DAT**	**N**	**P**	**K**
T_1 – Bispyribac sodium (10% SC) @ 20g a.i/ha	56.04	48.23	58.85	26.14	2.64	22.28
T_2 – Bispyribac sodium (10% SC) @ 35g a.i/ha	83.34	68.88	73.16	24.4	2.24	20.3
T_3 – Bispyribac sodium (10% SC) @ 50g a.i/ha	91.47	82.26	85.17	18.17	2.05	15.59
T_4 – Bispyribac sodium (10% SC) @ 100g a.i/ha	100	93.81	88.22	17.78	1.71	14.67
T_5 – Bispyribac sodium (10% SC) @ 200g a.i/ha	100	98.67	94.45	16.46	1.46	13.26
T_6 – Nominee Gold 100g/L SC@20g a.i/ha	78.28	68.17	72.91	25.31	2.19	21.47
T_7 – Butachlor @1.0 kg a.i/ha + HW at 40 DAT	80.55	94.32	82.56	14.38	1.98	11.5
T_8 – Butachlor @1.0 kg a.i /ha + TRRW at 40 DAT	82.65	78.15	78.69	18.16	2.13	18.61
T_9 – Pretilachlor @1.0 kg a.i/ha + HW at 40 DAT	88.16	96.63	84.55	13.95	1.94	12
T_{10} – Pretilachlor @1.0 kg a.i /ha + TRRW at 40 DAT	84.06	85.16	83.05	18.17	2.26	19.98
T_{11} – HW twice at 20 and 40 DAT	95.29	92.6	78.37	16.84	2.17	10.43
T_{12}– Unweeded Check	-	-	-	49.96	3.18	28.07
SEd	-	-	-	1.03	0.12	0.93
CD (P= 0.05)	-	-	-	2.13	0.26	1.93

HW – Hand Weeding, TRRW – Two Row Rotary Weeder, BLW – Broad Leaved Weeds. (Figures in parenthesis are original values)

Conclusion

From the results of two years study in transplanted rice, it is revealed that, early post emergence application of Bispyribac sodium at 200 g a.i. ha^{-1} recorded higher weed control efficiency in all stages of crop growth with slight phytotoxicity effect in transplanted rice.

References

[1] Saha, S. and K. S. Rao. 2007. Weed management in rice. Research Buletin No. 2, pp-1-20. Central Rice Research Insitiute, Cuttack, Orissa, India.
[2] Saha, S. 2009. Efficacy of bensulfuron methyl for controlling sedges and non-grass transplanted rice (Oryza sativa). Indian J. Agric. Sci., 79(4): 313-316.
[3] Burnside, O.C. and L.A. Wicks. 1965. Effect of herbicides and cultivation treatments on yield components of dryland sorghum in Nebraska. Agron. J., 57: 21-24.
[4] Panse, V.G. and Sukhatme, P.V. (1989) Statistical Methods for Agricultural Workers. ICAR, New Delhi.
[5] Kabir, M. H., M. N. Bari, M. Moynal Haque, G. J. U. Ahmed and A. J. M. S. Islam. 2008. Effect of water management and weed control treatments on the performance of transplanted Aman rice. Bangladesh J. Agril. Res., 33(3): 399-408.
[6] Mirza, Hasanuzzaman., M. H. Ali, M. M. Alam, M. Akther and K. F. Alam. 2009. Evaluation of Preemergence Herbicide and Hand Weeding on the Weed Control Efficiency and Performance of Transplanted Aus Rice. American-Eurasian J. of Agronomy, 2 (3): 138-143.
[7] Singh, V. P, S. P. Singh, M. Neeta Tripathi, K. Singh and Abinash Kumar. 2009. Bioefficacy of penoxsulam on transplanted rice weeds. Indian J. Weed Sci., 41(1&2): 28-32.
[8] 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.
[9] Balasubramanian, V and S. Ramanathan. 2002. Integrated crop management for enhancing yield, factor productivity and profitability in Asian rice farms. Paper presented at the 39th All India Rice Research Group Meeting, IARI- New Delhi, India.
[10] 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.
[11] Rajkhowa, D. J., A. K. Gogai and R. Kandali. 2001. Effect of weed control and nutrient management practices in rice. Indian J. Weed Sci., 33(1&2): 41-45.
[12] Veeraputhiran. R. and R. Balasubramanian. 2010. Evaluation of new post emergence herbicide in transplanted rice. In: Proc. of Annual Weed Science Conf., 30th November & 1st December, TNAU, Coimbatore. P.175.
[13] Rana, S. S. and N. N. Angiras. 1999. Effect of herbicides in integration with halod-an indigenous method of weed control in direct sown puddled rice. Indian J. Agron., 44(2): 320-325.

Publication History
Received 08th Mar 2017
Revised 18th Mar 2017
Accepted 18th Mar 2017
Online 30th Mar 2017