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EFFECT OF PRE AND POST EMERGENT HERBICIDES ON GROWTH AND YIELD PARAMETER IN TRANSPLANTED RICE

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ABSTRACT
A field experiment was conducted during *Kharif* season 2016 to evaluate the bio-efficacy of new post emergent herbicides along with pre-emergent herbicides in transplanted rice under the hill zone of Karnataka at ZAHRS Mudigere, experiments having ten treatments replicated thrice in RCBD. Among the herbicidal applications, sequential application of Butachlor 50 EC @1.25kg a.i ha^{-1} at 3 DAT followed by (fb) Bispyribac sodium 10 SC@ 20 g a.i ha^{-1} at 21 DAT recorded significantly higher growth and yield attributes at harvest *viz*. plant height (83.10 cm), number of tillers (17.60 $hill^{-1}$), number of green leaves (11.60 $hill^{-1}$), leaf area (169.65 cm^2 $hill^{-1}$), panicle length (18.33 cm), panicle weight (2.89g $panicle^{-1}$), filled grains (95.60 $panicle^{-1}$), higher grain (5165 kg ha^{-1}) and straw yields (6258 kg ha^{-1}). Hence, these combinations of herbicides are suitable for the application in transplanted rice. The above treatment was on par with weed free up to 45 DAT (hand weeding) and application of Butachlor 50 EC @ 1.25 kg a.i ha^{-1} at 3 DAT fb hand weeding at 15 and 30 DAT. Weedy check plots were recorded significantly lower growth and yield attributes which resulted in maximum major nutrients removal by different weeds. However, application of Butachlor 50 EC @ 1.25 kg a.i ha^{-1} at 3 DAT fb Bispyribac sodium 10SC @20 g a.i ha^{-1} at 21 DAT was found on par with application of Bensulfuron methyl +Pretilachlor 6.6 GR @ 12.5 kg a.i ha^{-1} fb Fenoxyprop p ethyl 9.3 EC @ 1250 ml ha^{-1} at 21 DAT and Butachlor 50 EC@ 1.25 kg a.iha^{-1} at 3 DAT fb Chlorimuron ethyl + Metsulfuron methyl 20 WP @ 8 g a.i ha^{-1} at 21 DAT.

KEYWORDS: pre and post emergent herbicides, growth parameter, yield parameter, transplanted rice, hill zone.

INTRODUCTION

Rice is the staple food crop for more than half of the world's population. It is grown in six continents and in more than hundred countries. In Asia, more than two billion people are getting 60-70 per cent of their energy requirement from rice and its derived products (Geethalakshmi *et al.,* 2011). Human consumption accounts 85% of total production and hence rice deserves a special status among cereals as the world's most important wetland crop. The area under rice in the world is 160.9 m ha with a production of 719.7 mt and average productivity of 4472 kg ha^{-1} (Anon, 2015a). In India, rice is grown in an area of 43.97m ha with an annual production of 106.57 mt and productivity of 2424 kg ha^{-1} (Anon., 2015b). In Karnataka, it is grown in 1.33 m ha with a total production of 3.52 mt and the average productivity of 2649 kg ha^{-1} (Anon., 2015b). Rice production is facing various constraints that limit the growth and promoting yield in transplanted rice. Among the various constraints, the weed infestation and shortage of labours are the main problems. The labour requirement during crop establishment is very high at a short span of time, especially during transplanting of seedling and as well as for hand weeding. Hand weeding is a tedious task, time consuming and expensive due to various reasons labour availability is decreasing day by day. Weed infestation is one of the most important factors responsible for yield reduction, which also impairs the quality of the produce due to competition for nutrients, moisture, light and to some extent for space. They harbor many insects, pest and pathogen resulting in poor crop and growth. Losses caused by weeds vary from one location to another, depending on the predominant weed flora and also on the control methods practiced by farmers. In areas where labour is costly and in cases where timely weeding would not be possible due to labour scarcity, herbicide offers an excellent alternative to control weeds in rice fields. In some instances, herbicides offer the most practical, effective and economical means of reducing weed competition and to obtain higher rice yield. Pre-emergent herbicides control the weeds at early stages of crop growth, leaving apart the second flush of the emerged weeds. In order to manage the second flush of weeds, sequential application of pre and post-emergent herbicides may prove promising effective control of weed flora of transplanted rice in absence of manual weed control.

MATERIALS & METHODS

A field experiment was conducted during *Kharif* 2016 at Zonal Agricultural and Horticultural Research Station, Mudigere. The experiment involves ten treatments includes two pre-emergent herbicides Butachlor 50 EC and Bensulfuron methyl 0.6% G @ 60 g a.i. ha^{-1} + Pretilachlor 6% G applied alone as pre-emergent at 3 DAT and six post emergent herbicides 2. 4 D Sodium salt 80, Fenoxyprop p ethyl 9.3 EC, Bispyribac sodium 10 SC@, Metsulfuron methyl 20 WP, Chlorimuron ethyl +Metsulfuron methyl 20 WP and Ethoxysulfuron 15 WG. Post emergent herbicide applied as alone and each was preceded by pre emergent herbicides which were compared with weed free up to 45 DAT (hand weeding)

and weedy check which was laid out under randomized block design with three replication.

The sowing of cultivar IET-7191 done with a spacing of 20cm X 10cm and fertilized with recommended doses of nitrogen, phosphorous and potassium (75:75:90 kg ha^{-1}). Five plants were selected randomly in the net plot and labeled for recording the observations in each treatment. Data on growth parameter *viz.*, Plant height, Tillers, No of green leaves, leaf area and total dry matter were recorded at 30, 60, 90 and at harvest. Weed population and weed dry weight are subjected to √x+0.5 transformations by using the Fischer method of ANOVA and the data were analyzed statistically for the test of significance. The level of significance of F test was 5% (Gomez and Gomez, 1984). The yield attributes and grain yield were recorded at harvesting stage of rice and statistically analyzed.

Details of treatments and the corresponding symbols used during the study are as follows.

T_1: Butachlor 50 EC @ 1.25 kg a.i ha^{-1} at 3 DAT followed by (fb) hand weeding at 15 and 30 DAT

T_2: Butachlor 50 EC @ 1.25 kg a.i ha^{-1} at 3 DAT fb 2. 4 D Sodium salt 80 @ 2.5 kg ha^{-1} at 21 DAT

T_3: Butachlor 50 EC @ 1.25 kg a.i ha^{-1} at 3 DAT fb Fenoxyprop p ethyl 9.3 EC 1250 ml ha^{-1} at 21 DAT

T_4: Butachlor 50 EC @ 1.25 kg a.i ha^{-1} at 3 DAT fb Bispyribac sodium 10 SC @ 20 g a.i ha^{-1} at 21 DAT

T_5: Butachlor 50 EC @ 1.25 kg a.i ha^{-1} at 3 DAT fb Metsulfuron methyl 20 WP @ 5 g ha^{-1} at 21 DAT

T_6: Butachlor 50 EC @ 1.25 kg a.i ha^{-1} at 3 DAT fb Ethoxysulfuron 15 WDG @ 15 g ha^{-1} at 21 DAT

T_7:Butachlor 50 EC @ 1.25 kg a.i ha^{-1} at 3 DAT fb Chlorimuron ethyl+Metsulfuron methyl 20 WP @ 8 g ha^{-1} at 21 DAT

T_8: Bensulfuron methyl 0.6 + Pretilachlor 6 GR @ 12.5 kg a.i ha^{-1} fb Fenoxyprop p ethyl 9.3 EC @ 1250 ml ha^{-1} at 21 DAT

T_9: Weedy check

T_{10}: Weed free check up to 45 DAT (hand weeding)

Note: DAT- Days after transplanting**,** a.i- active ingredient.

Treatment details:

RESULTS AND DISCUSSION

TABLE 1: Growth parameters of rice as influenced by different weed control treatments in transplanted rice

Treatment	Plant height (cm)	Number of tillers ($hill^{-1}$)	Number of green leaves ($hill^{-1}$)	Leaf area (cm^2 $hill^{-1}$)	Total dry matter production (g $hill^{-1}$)	Straw yield (kg ha^{-1})
T_1	83.50	18.20	12.60	186.73	28.87	6,486
T_2	75.60	14.60	7.80	107.99	23.32	4.995
T_3	73.30	13.20	6.40	96.09	21.09	4,947
T_4	83.10	17.60	11.60	169.65	27.81	6,258
T_5	76.60	15.43	8.23	119.57	23.61	5,314
T_6	78.00	15.80	9.20	127.37	24.12	5,437
T_7	79.00	16.20	10.00	140.20	24.86	5,594
T_8	80.40	16.80	10.80	153.73	25.97	5,769
T_9	71.45	10.60	4.80	65.50	17.86	3,759
T_{10}	85.00	19.00	13.50	205.36	29.61	6,661
S.Em±	1.10	0.60	0.65	13.50	0.83	164.77
C.D. at 5%	3.30	1.80	1.95	40.50	2.49	494.31

TABLE 2: Yield parameters of rice as influenced by different weed control treatments in transplanted rice

Treatment	No. of panicles $hill^{-1}$	Length of Panicle (cm)	Panicle weight (g)	Total no. of grains panicle	Filled grains $panicle^{-1}$	Unfilled grains $panicle^{-1}$	Sterility (%)	Grain yield (kg ha^{-1})
T_1	17.68	19.31	2.97	107.00	98.80	8.20	7.66	5,441
T_2	13.66	15.16	2.63	95.03	84.23	10.80	11.34	4,056
T_3	12.33	13.83	2.49	91.42	79.20	12.22	13.34	3,863
T_4	17.58	18.33	2.89	104.40	95.60	8.80	8.67	5,165
T_5	13.80	15.66	2.65	96.66	86.40	10.26	10.77	4,297
T_6	14.43	17.16	2.67	98.80	88.80	10.00	10.12	4,370
T_7	15.20	17.32	2.76	100.80	91.20	9.60	9.52	4,511
T_8	15.55	17.60	2.83	102.60	93.40	9.20	8.95	4,720
T_9	10.60	10.90	2.18	82.80	68.60	14.20	17.15	2,674
T_{10}	19.00	19.66	3.06	110.60	103.00	7.60	6.85	5,647
S.Em±	0.79	0.51	0.07	2.07	2.99	0.41	0.61	172.47
C.D. at 5%	2.36	1.53	0.21	6.21	8.97	1.23	1.86	517.41

TABLE 2: Yield parameters of rice as influenced by different weed control treatments in transplanted rice

The predominant weed flora observed in the experimental field in association with the transplanted rice includes grassy weeds like *Panicum tripheron, Panicum repens, Echinochloa colonum*, sedges like *Cyperus difformis, Cyperus procerus, Euriocolon sp.* And *Scirpus rayali* and broad leaved weeds like *Monocoria vaginalis, Ammania baccifera, Rotala verticilaries, Eclipta alba, Ludwizia parviflora and Marselia quadrifolia* Similar weed species under transplanted rice were also reported by Duary *et al.* (2015)

The herbicidal application of Butachlor 50 EC @ 1.25 kg a.i ha^{-1} at 3 DAT fb Bispyribac sodium 10 SC @ 20 g a.i ha^{-1} at 21DAT recorded higher growth and yield parameters like plant height (83.10 cm), number of tillers (17.60 $hill^{-1}$), number of green leaves (11.60 $hill^{-1}$), leaf area (169.65cm^2 $hill^{-1}$**)**, total dry matter production (27.81

g hill^{-1}), number of tillers (17.60 hill^{-1}), number of green leaves (11.60 hill^{-1}), leaf area (169.65 cm^2 hill^{-1}), number of panicle (17.58 hill^{-1}), panicle length (18.33 cm), panicle weight (2.89g panicle^{-1}), filled grains (95.60 panicle^{-1}), grain yield (5165 kg ha^{-1}) and straw yield (6258 kg ha^{-1}) at harvest time. This treatment closely followed by application of Butachlor or at 3 DAT fb Chlorimuron ethyl +Metsulfuron methyl 20WP@ 8g ha^{-1} at 21 DAT and Bensulfuron methyl 0.6 +Pretilachlor 6 GR @ 12.5kg a.i ha^{-1} fb Fenoxyprop p ethyl 9.3 EC @ 1250 ml ha^{-1} at 21 DAT which are on par with the each other. However, weed free up to 45DAT recorded highest growth parameters like plant height (85 cm), number of tillers (19.00 hill^{-1}), number of green leaves (13.50 hill^{-1}), leaf area (205.36 cm^2 hill^{-1}) and yield parameters like), number of panicle (19.00 hill^{-1}), panicle length (19. 00 cm), panicle weight (3.06 g panicle^{-1}), filled grains (110.60 panicle^{-1}), grain yield (5647 kg ha^{-1}) and also straw yield (6661kg ha^{-1}) at harvest time. This was significantly on par with T_4.

Butachlor found very effective in control weeds at early stages and further different post-emergent weedicides depends on its mode of action and favorable soil condition effectively controlled the weed flush at later stages. The better weed control and lesser dry weight of the weeds by the sequential application of pre-emergent herbicide (Butachlor) and broad spectrum new post-emergent herbicide such as Bispyribac sodium which controlled total or the most of the weeds very effectively. The rapid absorption of herbicides molecules by the shoots and roots of weeds are responsible for prevention of cell division and inhibition of protein and fat synthesis activity. Similarly the other post-emergent broad spectrum herbicides *viz*. Ethoxysulfuron, Chlorimuron ethyl+ methyl and Fenoxyprop p ethyl controlled the weeds effectively by inhibiting Aceto Lactate Synthase, Aceto Hydroxyl Acid Synthase, acetyl CoA carboxylase enzyme and fatty acid synthesis by activity of both foliage and soil. Sequential application of these herbicides ensured that the reliable control of most of the grasses, sedges and broadleaved weeds throughout the crop growth period as evidenced by lowest weed population and dry weight of the weeds. The results are in conformity with the findings of Parthipan and Ravi (2016), Khaliq *et al.* (2012), and Vaishali Yadava (2015).

During the crop growth period, the number of green leaves and number of tillers per hill increased up to 90 DAT and there after decreases due to senescence. Increase in the growth parameters is mainly attributed to minimum competition of weeds with rice plant for nutrients, moisture and light which showed positive influence on growth components *viz*., plant height, number of green leaves per hill, number of tillers per hill and finally better dry matter production and its distribution in the crop. Sequential application of pre and above mentioned new post-emergent herbicides resulted in increased dry matter production of plant, which was mainly due to better translocation of photosynthates. This increase in dry matter was a consequence of effective weed control, which reduced the competition of weeds with crop plant and also increased availability of resources. Thus more photosynthates were produced which were transformed into more number of productive tillers per hill, leaf area and leaf area index. This is due to better weed control efficiency as evidenced by lower weed population and weed dry weight which helped the crop to grow better and absorb more nutrients from the soil. This indicates the replacement of hand weeding by post-emergent application of Bispyribac sodium along with Butachlor pre-emergent application. Further application of Bensulfuron methyl 0.6 +Pretilachlor 6 GR @ 12.5 kg a.i ha^{-1} fb Fenoxyprop p ethyl 9.3 EC @ 1250 ml ha^{-1} at 21 DAT and these two treatment were statistically on par with each other. Similar reasons have been reported by Sreedevi *et al.* (2016), Singh *et al.* (2016) and Vaishali Yadav (2015).

While, statistically least growth parameters *viz.* (71.44 cm), number of tillers (10.60 hill^{-1}), number of green leaves (4.80 hill^{-1}), leaf area (65.50 cm^2 hill^{-1}),), and yield parameter like number of panicle (10.60 hill^{-1}), panicle length (10.90 cm), panicle weight (2.18 g panicle^{-1}), filled grains (82.80 panicle^{-1}), grain yield (2674 kg ha^{-1}) and straw yield (3759 kg ha^{-1}) was noticed with weedy check. This is due to more competition of the weeds with the crop plants; this is in confirmation with the results of Malaviya *et al.* (2014) and Mallikarjun *et al.* (2014).

CONCLUSION

The results indicated that among the herbicides tested, sequential application of applied Butachlor 50 EC @ 1.25 kg a.i ha^{-1} at 3 DAT fb Bispyribac sodium 10 SC @ 20 g a.i ha^{-1} at 21DAT and Bensulfuron methyl 0.6 + Pretilachlor 6 GR @ 12.5 kg a.i ha^{-1} fb Fenoxyprop p ethyl 9.3 EC @ 1250 ml ha^{-1} at 21 DAT resulted in higher growth and yield parameters like plant height, number of tillers/hill, number of green leaves/hill, leaf area, total dry matter production, number of panicle/hill panicle length, filled grains/panicle, grain and straw yield besides giving broad spectrum of weed control in labour scare area of hill zone of Karnataka.

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