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EVALUATION OF EARLY POST-EMERGENCE HERBICIDE APPLICATION ON WEED CONTROL, CROP GROWTH AND NUTRIENT UPTAKE IN TRANSPLANTED RICE (*ORYZA SATIVA*)

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ABSTRACT

A field experiment was conducted during *Kuruvai* season at the Experimental Farm, Department of Agronomy, Annamalai University to evaluate the performance of early post emergence application of herbicides on weed control in transplanted rice. The experiment was carried out in a Randomized Block Design with eight treatments and three replications. All the imposed treatments significantly influenced the weed parameters and crop parameters in rice. The experimental results revealed that, hand weeding twice at 20 and 40 DAT recorded the lowest total weed count (13.74), highest weed control efficiency (WCE) (92.79 per cent), highest plant height (85.76 cm), higher leaf area index (4.28), higher crop dry matter production (7689 kg ha^{-1})and highest nutrient uptake by rice crop (134.79, 33.17, 99.41 kg of N, P_2O_5, K_2O ha^{-1}, respectively) which was statistically on par with application of penoxsulam + cyhalofop butyl@135 g ha^{-1} (premix)(15 DAT) that recorded the total weed count (16.74), weed control efficiency (91.21 per cent), plant height (85.03cm), leaf area index (4.19), dry matter production (7567 kg ha^{-1}), crop nutrient uptake (132.37 , 32.48, 97.25 kg of N, P_2O_5, K_2O ha^{-1}, respectively). Highest total weed count, with lowest plant height, leaf area index, crop dry matter production and crop nutrient uptake were recorded with unweeded control.

Keywords – Transplanted rice, Early post emergence herbicides, penoxsulam + cyhalofop butyl (premix).

Introduction

Rice is the principal food for more than 50 per cent of the global population and main food in the countries with lower and middle income. Annually, more than 100 countries in the world produce 756.7 million tonnes (502.2 million tonnes of milled rice) from 158 million hectares (Banik *et al.,* 2020) and 90 per cent of global rice production is from Asian continent. India ranks second in rice production next to china, with an area, production and productivity of 44.5 million ha, 116 million tonnes and 3.91 tonnes ha^{-1}, respectively. In Tamil Nadu, rice is grown in an area of 17.80 lakhs hectare with a production of 60 lakhs tonnes and productivity of 3.37 tonnes ha^{-1}. National food security system is highly relying on rice production and productivity (Singh *et al.,* 2020). Rice productivity is highly plummeted by weeds which competes with crop for nutrients, resources, space and harbors various pests. Weed competition could be included as a huge factor that limits the crop yield (Leghari *et al.,* 2016). Weed infestation causes 45-51 per cent of yield reduction in transplanted paddy (Veeraputhiran and Balasubramanian, 2013). Hand weeding was proved to be an effective weed control measure when compared to cultural and chemical measures in reducing the weed infestation in transplanted rice (Kathiresan, 2002). In the current scenario, high labor wages and non-availability of labour makes timely hand weeding uncertain. However, chemical method of weed control is found to be economic and efficient method if applied at proper dose and stages (Kumar and Sharma, 2005). Nevertheless, the use of low dose high efficient herbicides will lessen the volume of herbicide per unit area, facilitates easier application and highly economical to farming community (Kiran *et al*., 2010). Besides, early post-emergence application of herbicides controls the weeds for a longer period of time in the field condition without frequent weed control measures. With this prospective, a field trail was conducted to assess the early post emergence application of new and alternative herbicides having wider applicability and broad spectrum of activity against weeds.

Materials and Methods

A field trial was conducted during *Kuruvai* (June – September, 2018) season in Experimental Farm, Department of Agronomy, Annamalai University, Annamalai Nagar to test the performance of early post emergence application of herbicides against weeds in short duration transplanted rice. The soil of experiment site is clayey loam in texture with low available N, high available P and K. The experiment was laid out in a randomized block design with 8 treatments and 3 replications. The imposed treatments are T_1- Unweeded control, T_2- Hand weeding twice on 20 and 40 DAT, T_3-bispyribac sodium @ 25 g ha^{-1}, T_4-cyhalofop butyl @ 80 g ha^{-1}, T_5-penoxsulam @ 25 g ha^{-1},T_6-penoxsulam + cyhalofop butyl @ 105 g ha^{-1}(premix), T_7-penoxsulam + cyhalofop butyl @ 120 g ha^{-1} (premix), T_8-penoxsulam + cyhalofop butyl @ 135 g ha^{-1} (premix). Twenty one days old Co- 47 rice

seedlings were transplanted in 5 × 4 m size plots, with 2 seedlings hill^{-1} at 15 x 10 cm spacing. Herbicides were sprayed along with 500 l ha^{-1} of water by knapsack sprayer equipped with flood jet nozzle in the morning time on 15 DAT as early post emergence application. The crop and weed data from the field trial were statistically analyzed according to the recommendations of Gomez and Gomez (1984). The total weed species count on 60 DAT was recorded separately from four quadrates of 0.25 m^2 area placed random in each plot. Later the average weed count in a quadrat at 0.25 m^2 area was arrived at and the data were computed to give the weed count in m^2 and the Weed control efficiency was worked out from the data. The data on plant height, Leaf area index (LAI) and Crop dry matter production (DMP) was recorded on 60 DAT. The crop samples collected for estimating biomass at harvesting were pooled treatment wise and analyzed for N, P and K. The data on weed counts were transformed by square root transformation. The data involving percentage values were transformed by angular transformations for analysis.

Results and Discussion

Effect of herbicides on weed parameters

The experimental plot consists of weeds like *Echinochloa colonum, Leptochloa chinensis, Echinochloa crusgalli* among grasses;*Cyperus rotundus, Cyperus iria* among sedges and *Bergia capensis, Marselia quadrifolia* among broad leaved weeds. Among these, the dominant weed species *viz*., *Cyperus rotundus, Cyperus iria*, *Echinochloa colonum* and *Leptochloa chinensis* largely contributed for the total weed count and weed dry matter production that were significantly influenced by the treatments. Among the treatments compared, hand weeding twice during the cropping period gives exorbitant results by recording the least total weed count of 13.74 m^{-2} and highest weed control efficiency(WCE) of 92.79 per cent at 60 DAT. This treatment was on par with application of penoxsulam + cyhalofop butyl @ 135 g ha^{-1} (15 DAT) that recorded the total weed count of 16.74 m^{-2} and weed control efficiency of 91.21 per cent at 60 DAT, respectively. The above mentioned two treatments were significantly superior to the rest of the treatments compared (Table 1). The remarkable performance of hand weeding twice was due to, complete removal of weedy plants without leaving any traces and this leads to highest weed control efficiency in transplanted rice. This finding is appropriate with the results of Chandraprakash *et al.* (2013). Early post emergence application of premix formulation of penoxsulam+ cyhalofop butyl @ 135 g ha^{-1} (15 DAT) also contribute for higher weed control efficiency and, it might be due to the fact that, penoxsulam is an strong inhibitor of the enzyme acetolactate synthase (ALS) which obstructs the production of valine, leucine and iso-leucine like amino acids and leads to death of weeds by hindering protein synthesis (WSSA, 2007). The another herbicide combination Cyhalofop butyl, is selective post emergence herbicide for grassy weeds in rice crop by restraining Acetyl-Coenzyme A Carboxylase (ACCase) enzyme which catalyze the fatty acid biosynthesis process (Ruiz-santaella *et al.,* 2006). Moreover, the combined effect caused by premix formulation of herbicide with penoxsulam + cyhalofop butyl, brings broad spectrum herbicidal activity against different weeds in rice ecosystem and increases the effectiveness of weed control, which was reflected by lesser weed parameters and higher weed control efficiency in this treatment. This finding is in agreement with the result of Abraham and Menon (2015).The highest total weed count of 190.5 was recorded with unweeded control.

Effect of herbicides on Crop growth and nutrient uptake of rice

Among the treatments compared hand weeding twice showed stupendous performance in weed management in transplanted rice by recording highest plant height, leaf area index and crop dry matter production of 85.76 cm, 4.28 and 7689 kg ha^{-1}, respectively with the crop nutrient uptake of 134.79, 33.17, 99.41kg of N, P_2O_5, K_2O ha^{-1}, respectively. This was on par with application of penoxsulam+ cyhalofop butyl @ 135 g ha^{-1} (15 DAT) that recorded plant height, leaf area index and crop dry matter production of 85.03 cm, 4.19 and 7567 kg ha^{-1},respectively with the crop nutrient uptake of 132.37, 32.48, 97.25 kg of N, P_2O_5, K_2O ha^{-1}, respectively. These treatments shows significantly superior performance among all the treatments compared (Table 2). Hand weeding twice nullifies the crop weed competition and favors crop by providing a competition free environment to attain higher plant height, leaf area index, dry matter production and crop nutrient uptake. This finding is in agreement with the reports of Prasanthi *et al.* (2017). Similarly, the increased plant height, leaf area index, crop dry matter production and crop nutrient uptake of rice in the treatment with application of premix combination of penoxsulam+ cyhalofop butyl @ 135 g ha^{-1} (15 DAT) was recorded. Penoxsulam+ cyhalofop butyl (premix) offered weed free environment during critical crop growth stages by suppressing the weeds by its highly selective broad spectrum of activity and this positively influenced the crop growth parameters like plant height, leaf area index, dry matter production and crop nutrient uptake. This finding is in line with the findings of Sheeja and Elizabeth (2018). Unweeded control treatment recorded the lowest plant height of 58.45cm, leaf area index of 2.47, crop dry matter production of 5386 kg ha^{-1}and crop nutrient uptake of 89.4 ,16.52, 68.01 kg of N, P_2O_5, K_2 Oha^{-1}, respectively.

Conclusion

From this field trial, it can be inferred that, hand weeding twice at 20 and 40 DAT during the cropping season controls the weeds of rice plants efficiently and enhances the crop nutrient uptake. Nonetheless, during times of labour shortage and higher labour charges, early post emergence application of premix formulation of penoxsulam + cyhalofop butyl @ 135 g ha^{-1} (15 DAT) could be used as alternative weed control measure in transplanted paddy.

Table 1: Effect of Early post-emergence application of herbicides on Total weed count (m^{-2}) and Weed Control efficiency (WCE)

Treatments	Total weed count at 60 DAT (m^{-2})	WCE at 60 DAT (Per cent)
T_1 – Unweeded Control	13.82 (190.5)	-
T_2 - Hand weeding twice on 20 & 40 DAT	3.77 (13.74)	74.42 (92.79)
T_3 - Bispyribac-sodium @ 25 g ha^{-1}	5.67 (31.60)	65.97 (83.41)
T_4 - Cyhalofop butyl @ 80 g ha^{-1}	9.91 (97.69)	44.27 (48.72)
T_5 - Penoxsulam @ 25 g ha^{-1}	11.71 (136.63)	32.13 (28.28)
T_6 - Penoxsulam + Cyhalofop butyl @ 105 g ha^{-1}	8.34 (69.14)	52.95 (63.71)
T_7 - Penoxsulam + Cyhalofop butyl @ 120 g ha^{-1}	5.32 (27.77)	67.55 (85.42)
T_8 - Penoxsulam + Cyhalofop butyl @ 135 g ha^{-1}	4.15 (16.74)	72.76 (91.21)
S.Ed	0.44	0.79
CD(p=0.05)	0.95	1.70

(Figures in parenthesis indicate the original value)

Table 2: Effect of Early post-emergence application of herbicides on Plant height, Leaf Area Index (LAI), Dry matter Production (DMP) and Crop nutrient uptake of rice crop

Treatments	Plant height at 60 DAT (cm)	LAI at 60 DAT	DMP at 60 DAT (kg ha^{-1})	Crop nutrient uptake at harvest (Kgha^{-1})		
				N	P	K
T_1 - Unweeded Control	58.45	2.47	5386	89.4	16.52	68.01
T_2 - Hand weeding twice on 20 & 40 DAT	85.76	4.28	7689	134.79	33.17	99.41
T_3 - Bispyribac-sodium @ 25 g ha^{-1}	79.14	3.89	7137	121.69	28.34	87.18
T_4 - Cyhalofop butyl @ 80 g ha^{-1}	71.34	3.35	6436	106.12	21.25	77.04
T_5 - Penoxsulam @ 25 g ha^{-1}	64.47	3.07	5946	97.93	19.09	72.83
T_6 - Penoxsulam + Cyhalofop butyl @ 105 g ha^{-1}	74.93	3.66	6871	111.44	23.1	81.32
T_7 - Penoxsulam + Cyhalofop butyl @ 120 g ha^{-1}	81.44	3.99	7307	124.81	29.46	90.05
T_8 - Penoxsulam + Cyhalofop butyl @ 135 g ha^{-1}	85.03	4.19	7567	132.37	32.48	97.25
S.Ed	1.45	0.06	119	1.99	0.59	1.59
CD(p=0.05)	3.11	0.13	254.68	4.25	1.28	3.4

(DAT – Days after transplanting)

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