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Evaluation of New Herbicide Molecules on Sustainable Weed Management in Transplanted Rice

M. Deiveegan[1*], S. Muralikrishnasamy[2] and S. Ravichandran[1]
[1]Department of Agronomy, AC & RI, TNAU, Coimbatore - 641 003, Tamil Nadu, India.
[2]Directorate of Planning and Monitoring, TNAU, Coimbatore - 641 003, Tamil Nadu, India.

Field experiments were conducted during Rabi 2014, at Paddy Breeding Station, Tamil Nadu Agricultural University, Coimbatore to study the effect of pre-emergence / early post emergence herbicides along with hand weeding options on weed control in transplanted rice. The soil of the experimental field was clay loam in texture with pH 8.23. The performance of different pre-emergence application of butachlor 50% EC 1.5 kg a.i. ha^{-1}, flucetosulfuron 10% WG in two doses at 20 g a.i ha^{-1} and 25 g a.i ha^{-1}, pyrazosulfuron-ethyl 10% WB 75 g a.i ha^{-1}, early post emergence application of penoxsulam + cyhalofop-butyl in two doses at 120 g a.i ha^{-1} and 135 g a.i. ha^{-1}, bispyribac sodium 10% SC 35 g a.i ha^{-1} were evaluated along with pre-emergence application of pretilachlor 50% EC 1.0 kg a.i ha^{-1} + HW at 45 DAT, butachlor 50% EC 1.0 kg a.i ha^{-1} + HW at 45 DAT in comparison with hand weeding twice at 20 and 40 DAT, unweeded control and weed free check. The test variety used in this experiment was Co (R) 50. The experimental results revealed that weed free check had 100% weed control efficiency (WCE) in all the stages of crop growth. Among the various treatments tested, At 90 DAT, weed control efficiency (WCE) was maximum with early post emergence application of penoxsulam + cyhalofop-butyl135 g a.i. ha^{-1} (T_5) recorded the maximum weed control efficiency of 85.78%. The number of productive tillers m^{-2} recorded ranged between 441 in T5 and 295 in unweeded control (T_{11}). Grain yield ranged between 7717 kg ha^{-1} in weed free check (T_{12}) and 5194 kg ha^{-1} in unweeded control (T_{11}). The maximum straw yield of 9277 kg ha^{-1} was recorded in weed free check (T_{12}). This was on par with early post emergence application of penoxsulam+ cyhalofop-butyl 135 g a.i. ha^{-1} (T_5) and hand weeding twice at 20 and 40 DAT (T_{10}) with 9206 kg ha^{-1} and 9019 kg ha^{-1}.

Key words: Rice, New herbicides, Weed Control Efficiency (WCE).

Rice (*Oryza sativa* L.) is the leading cereal of the world (Juraimi *et al*., 2013) and two third of the Asian peoples receive their daily calories from rice. Rice is a principal and extensively grown crop of India. But, the average yield of rice in the country is very low as compared to the world average. There is more scope to increase the average yield of rice provided improved package of practices are adopted. Control of weed is one of the important and necessary practice in the management of rice crop. Weeds that grow with the crop deplete considerable amount of plant nutrients, which results in lower crop yields. Nutrient depletion by weeds, besides other factors, depends on soil type and composition of weeds.

In India, weed menace is one of the most important biotic constraints that limit rice productivity (Saha and Rao, 2007). Weeds that emerged in the cropped field have considerable quantum of costly fertilizer and native plant nutrients, which resulted in lowering the economic yield. Effective control of weeds, is therefore, vitally important.

Transplanted rice was infested by heterogeneous weed flora under lowland ecosystems, which reduced the rice grain yield upto 48 per cent accounting for a yearly loss of 15 million tonnes due to weed competition (Saha, 2009). Prevention of weed competition and provision of weed free environment at critical period of rice growth was necessary for successful rice production. The new herbicide molecules like Penoxsulam and Flucetosulfuron has potential to accumulate in the food chain (bioconcentrate) in low concentration. They are adsorbed by soil and have low to moderate leaching potential in most of the soil types. In soil, they are easily broken down by microbial degradation. They are highly toxic to aquatic organisms on an acute (single, high dose) basis and practically nontoxic to birds.

*Corresponding author's email: devedeva07@gmail.com

Material and Methods

Field experiment was conducted during rabi 2014, at Paddy Breeding Station, Tamil Nadu Agricultural University, Coimbatore to study the effect of pre-emergence / early post emergence herbicides along with hand weeding options on weed control in transplanted rice. The experiment was laid out in a Randomized Block Design with three replications and twelve treatments. The performance of pre-emergence application of butachlor 50% EC 1.5 kg a.i. ha^{-1}, flucetosulfuron 10% WG in two doses at 20 g a.i. ha^{-1} and 25 g a.i. ha^{-1}, pyrazosulfuron-ethyl 10% WB 75 g a.i ha^{-1}, early post emergence

application of penoxsulam + cyhalofop-butyl in two doses at 120 g a.i ha^{-1} and 135 g a.i. ha^{-1}, bispyribac sodium 10% SC 35 g a.i. ha^{-1} were evaluated along with pre-emergence application of pretilachlor 50% EC 1.0 kg a.i. ha^{-1} + HW at 45 DAT, butachlor 50% EC 1.0 kg a.i ha^{-1} + HW at 45 DAT in comparison with hand weeding twice at 20 and 40 DAT, unweeded control and weed free check. The test variety used in this experiment was Co (R) 50. Weed control efficiency was calculated as per the procedure suggested by Sankaran and Mani (1974).

$$\text{WCE (\%)} = \frac{\text{Dry weight of weeds in control plot} - \text{Dry weight of weeds in treated plot}}{\text{Dry weight of weeds in control plot}}$$

Number of productive tillers at harvest was counted from five tagged hills and mean number of productive tillers m^{-2} was arrived out. One thousand grains from each net plot produce were taken and their weight was estimated at 14 per cent moisture content and expressed in g. Grains from net plot were cleaned, sun dried and weighed at 14 per cent moisture content and grain yield was calculated and expressed in kg ha^{-1}. After separating the grains the left over straw from the net plot was sun dried and weighed. The straw yield was calculated and expressed in kg ha^{-1}. The data observed were subjected to statistical analysis for testing significance.

Results and Discussion

Weed control efficiency (WCE)

Weed free check had 100% weed control efficiency (WCE) in all the stages of crop growth. Among the various treatments tested, At 90 DAT, weed control efficiency (WCE) was maximum with early post emergence application of penoxsulam + cyhalofop-butyl135 g a.i. ha^{-1} (T_5) recorded the maximum weed control efficiency of 85.78% and effectively controlled grasses, sedges and broad leaved weeds. This might be due efficacy of the herbicide for a longer period.

Table 1. Effect of new herbicide molecules on weed control efficiency and yield components

T.No	Treatment	WCE (%)	Productive tillers (m^{-2})	1000 grain weight (g)
T_1	PE butachlor 50% EC 1.5 kg a.i. ha^{-1}	65.8	375	20.49
T_2	PE flucetosulfuron 10% WG 20 g a.i. ha^{-1}	60.74	350	20.38
T_3	PE flucetosulfuron 10% WG 25 g a.i. ha^{-1}	66.54	368	20.48
T_4	EPOE penoxsulam + Cyhalofop-butyl 120 g a.i. ha^{-1}	79.21	397	20.51
T_5	EPOE penoxsulam + Cyhalofop-butyl 135 g a.i. ha^{-1}	85.78	441	21.06
T_6	EPOE bispyribac sodium 10% SC 35 g a.i. ha^{-1}	78.46	400	20.55
T_7	PE pretilachlor 50% EC 1 kg a.i. ha^{-1} + HW at 45 DAT	60.31	363	20.45
T_8	PE butachlor 50% EC 1 kg a.i. ha^{-1} + HW at 45 DAT	56.61	359	20.43
T_9	PE pyrazosulfuron-ethyl 10% WB 75 g a.i. ha^{-1}	32.81	329	19.92
T_{10}	Hand weeding twice at 20 and 40 DAT	76.36	386	20.60
T_{11}	Unweeded control	-	295	19.56
T_{12}	Weed free check	100	415	20.65
	SEd	-	17.56	0.5389
	CD (p=0.05)	-	36.43	NS

Relatively in the early post emergence herbicide applied plots and hand weeded plots, the weeds germinated after the implementation of treatment might not have accrued sufficient dry weight as that of unweeded check. Hence, better weed control efficiency was quite obvious. The results are in accordance with Gogoi (1998) who stated that hand removal of early emerged grassy weeds and sedges along with the broad leaved species allowed lower accumulation of dry matter and resulted in better crop growth, which in turn smothered the weed growth in comparison to others treatment, recording maximum weed control efficiency.

Productive tillers and test weight

The number of productive tillers m^{-2} recorded ranged between 441 in T_5 and 295 in unweeded control (T_{11}). The treatments, early post emergence application of penoxsulam + cyhalofop-butyl 135 g a.i ha^{-1} (T_5) and weed free check (T_{12}) were on par with each other and recorded the maximum number of 441 and 415 productive tillers m^{-2}, respectively. It is in accordance with productive tillers and other yield components were reported by Jabran *et al*., (2012). In the promising treatments, the early formed tillers were more per unit area. This might also be the reason for increased number of productive tillers.

The thousand grain weight (g) was not influenced by the different weed management practices. All the treatments were on par with each other. However, pre-emergence application of pyrazosulfuron-ethyl 10% WB 75 g a.i. ha^{-1} (T_9) and unweeded control (T_{11}) recorded numerically reduced test weight of 19.92 g and 19.56 g, respectively.

Table 2. Effect of new herbicide molecules on grain yield and straw yield

T.No	Treatment	Grain Yield (kg ha^{-1})	Straw Yield (kg ha^{-1})
T_1	PE butachlor 50% EC 1.5 kg a.i. ha^{-1}	6755	8137
T_2	PE flucetosulfuron 10% WG 20 g a.i. ha^{-1}	6667	8031
T_3	PE flucetosulfuron 10% WG 25 g a.i. ha^{-1}	7056	8499
T_4	EPOE penoxsulam + Cyhalofop-butyl 120 g a.i. ha^{-1}	7360	8866
T_5	EPOE penoxsulam + Cyhalofop-butyl 135 g a.i. ha^{-1}	7642	9206
T_6	EPOE bispyribac sodium 10% SC 35 g a.i. ha^{-1}	7487	8542
T_7	PE pretilachlor 50% EC 1 kg a.i. ha^{-1} + HW at 45 DAT	6718	8420
T_8	PE butachlor 50% EC 1 kg a.i. ha^{-1} + HW at 45 DAT	6542	8310
T_9	PE pyrazosulfuron-ethyl 10% WB 75 g a.i. ha^{-1}	6182	8026
T_{10}	Hand weeding twice at 20 and 40 DAT	7091	9019
T_{11}	Unweeded control	5194	6257
T_{12}	Weed free check	7717	9277
SEd		171.14	286.20
CD (p=0.05)		354.94	593.58

Grain and straw yield

The higher grain yield of 7642 kg ha^{-1} was recorded under $T_{5,}$ which was on par with T_6 and T_{12}. This might be attributed to effective control of weeds, which would have increased the crop growth attributes like plant height, leaf area index and dry matter production in turn had a synergetic effect on the yield components. The results were in accordance with Jabran *et al*. (2012). The maximum straw yield of 9277 kg ha^{-1} was recorded in weed free check (T_{12}). This was on par with early post emergence application of penoxsulam+ cyhalofop-butyl 135 g a.i. ha^{-1} (T_5) and hand weeding twice at 20 and 40 DAT (T_{10}) recording 9206 kg ha^{-1} and 9019 kg ha^{-1}, respectively. The results were concomitant with the findings of Pal *et al*. (2009).

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