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Efficacy of application of new herbicides on WCE and nutrient utilization in paddy

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Abstract
The field experiment was carried out at Annamalai Univeristy Experimental Farm, Annamalainagar to study the efficacy of application of new herbicides on weed control efficiency and nutrient intake in paddy. The experiment was laid out in a RBD with eleven treatments and three replications. The treatments comprised of T_1–Unweededcontrol, T_2– Pretilachlor 0.6 kgha^{-1} on 3 DAT, T_3–Metsulfuron methyl + Chlorimuronethyl 0.004kgha^{-1}on 3 DAT, T_4 – Bensulfuron methyl + pretilachlor 0.66 kg ha^{-1} on 3 DAT, T_5 – Pretilachlor 0.6 kg ha^{-1} on 3 DAT fb 2,4-D 1 kg ha^{-1} on 30 DAT, T_6 – Metsulfuron methyl and Chlorimuron ethyl 0.004 kg ha^{-1} on 3 DAT fb 2,4-D 1 kg ha^{-1} on 30 DAT, T_7 – Bensulfuron methyl + Pretilachlor 0.6 kg ha^{-1} on 3 DAT fb 2,4-D 1 kg ha^{-1} on 30 DAT, T_8 – Pretilachlor 0.6 kg ha^{-1} on 3 DAT fb Bispyribac sodium 0.02 kg ha^{-1} on 30 DAT, T_9 – Metsulfuron methyl + Chlorimuron ethyl 0.004 kg ha^{-1} on 3 DAT fb bispyribac sodium 0.02 kg ha^{-1} on 30 DAT, T_{10} – Bensulfuron methyl + Pretilachlor 0.66 kg ha^{-1} on 3 DAT fb Bispyribac sodium 0.02 kg ha^{-1} on 30 DAT and T_{11} – Two HW on 15 and 30 DAT. Among the therapies, application of PE- herbicide bensulfuron methyl + pretilachlor 0.66 kg ha^{-1} on 3 DAT followed by PoE- herbicide bispyribac sodium 0.02 kg ha^{-1} on 30 DAT recorded the highest weed control efficiency and nutrient uptake in transplanted rice.

Keywords: WCE, pre-emergence herbicides, post emergence herbicides, weed management, nutrient uptake and rice

Introduction
Rice is one of the stable major food crops growing widely in India; more than 90% of the world's rice is grown and consumed in Asia. Rice production is hindered by a variety of biotic and abiotic restrictions, with weed competition becoming one of the biological restraints. Yield reduction due to unmanaged weeds in transplanted paddy fields is estimated to be 50 per cent in Asia (Johnson, 1996) [4] and Weeds alone have been accounted for 12 percent of crop yield losses (Ananya, 1999) [1]. Weeds affect crops by altering the pH of the soil, reducing nutrient availability and thereby reducing straw output by 13 to 28% and grain yield by 25 to 47%. (Manandhar et al., 2007) [5]. Transplanted rice, in particular is infested by heterogeneous type of weed flora under low land ecosystems which reduces yield up to 48 per cent and a yearly loss of 15 million tones due to weed competition (Saha Sanjay and K.S. Rao, 2009) [8]. For successful rice production, weed competition must be avoided and a weed-free environment must be provided during the vital phase of rice growth. Chemical weed control methods also have the advantage of saving time and money, making them a cost-effective weed management strategy.Chemicals considerably reduced the weed population and resulted in higher rice yields than weed control, according to Rajkhowa et al. (2001) [7]. Several new herbicides are coming back to plug and its necessitates to check the potency of recent herbicides alone or together for the management of weeds in transplanted rice.Keeping these in view, the field experiment was conducted at AU, Experimental Farm, Annamalainagar, to study the impact of application of new herbicides *viz.*, Metsulfuron methyl + Chlorimuron ethyl, Bensulfuron methyl + Pretilachlor, 2,4Bensulfuron methyl + Pretilachlor, 2,4-D and Bispyribac sodium on WCE and nutrient uptake in transplanted paddy.

Materials and Methods
An Annamalai University Experimental Farm was used for conducting the field experiment. The experimental farm is situated at 11^0 24' North Latitude, 79^{0}44' East Longitude with an altitude of +5.79 m MSL. Annamalainagar's weather is moderately mild; with hot summer months.The crop season recorded a maximum temperature which ranged from 31.7 - 34.2^0 C with mean of 32.9^{0}C. The minimum temperature spanned from 24.6 - 21.4^0 C with a mean of 23.0^0 C. The relative humidity extended from 81to 92 per cent with a mean of 86.5 per cent. The experimental field soil was clay loam with pH of 6.7. In terms of soil fertility, the soil was assessed as having low available N, medium available P, and high available K content. With 11 treatments and 3 replications, the experiment was made in a randomized block design. The treatments of T_1–Unweededcontrol, T_2– Pretilachlor 0.6 kgha^{-1}on 3 DAT, T_3–Metsulfuron methyl+Chlorimuronethyl 0.004kgha^{-1}on 3 DAT,T_4–Bensulfuron methyl + pretilachlor 0.66 kg ha^{-1} on 3 DAT, T_5 – Pretilachlor 0.6 kg ha^{-1} on 3 DAT fb 2,4-D 1 kg ha^{-1} on 30 DAT, T_6 – Metsulfuron methyl and Chlorimuron ethyl 0.004 kg ha^{-1} on 3 DAT fb 2,4-D 1 kg ha^{-1} on 30 DAT, T_7 – Bensulfuron methyl + Pretilachlor 0.6 kg

ha^{-1} on 3 DAT fb 2,4-D 1 kg ha^{-1} on 30 DAT, T_8 – Pretilachlor 0.6 kg ha^{-1} on 3 DAT fb Bispyribac sodium 0.02 kg ha^{-1} on 30 DAT, T_9 – Metsulfuron methyl + Chlorimuron ethyl 0.004 kg ha^{-1} on 3 DAT fb bispyribac sodium 0.02 kg ha^{-1} on 30 DAT, T_{10} – Bensulfuron methyl + Pretilachlor 0.66 kg ha^{-1} on 3 DAT fb Bispyribac sodium 0.02 kg ha^{-1} on 30 DAT and T_{11} – Two hand weeding on 15 and 30 DAT.

The observations on weed control efficiency were recorded at 60 DAS. The formula was used to compute the weed control efficiency of each, which was then expressed as a percentage.

$$WCE(\%) = \frac{\text{Weed count in unweeded control plot} - \text{Weed count in treated plot}}{\text{Weed count in unweeded control plot}} x100$$

Crop samples from individual plots were collected at harvest stage and dried in the shade, then dried in the oven, then ground in a Willy mill and tested independently according to conventional protocols.nitrogen (Microkjeldhal digestion by Yoshida *et al.,* (1976)) [9], phosphorus (Colorimetry-Triple acid digestion by Jackson (1973)) and potassium (Flame Photometer by Jackson (1973) [3]. The nutrient uptake by crops were computed from their respective elemental (NPK) concentration and dry matter production and presented as kg ha^{-1}. Standard techniques were used to evaluate the plant samples for nitrogen, phosphate, and potassium.

$$\text{Nutrient uptake (kg ha}^{-1}) = \frac{\text{Percentage of nutrient} \times \text{Total dry matter production (kg ha}^{-1})}{100}$$

The values were represented in kg ha^{-1}. Sodium 0.02 kg ha^{-1} on 30 DAT recorded the highest

Results and Discussion

Weed control efficiency

The computed data on WCE at 60 DAT are given in Table1. Among the different treatments that have been tried, application of PE herbicide bensulfuron methyl + pretilachlor 0.66 kg ha^{-1} on 3 DAT followed by PoE bispyribac sodium 0.02 kg ha^{-1} on 30 DAT (T_{10}) recorded the highest WCE of 88.10 per cent at 60 DAT. This herbicide initially restricted weed seed emergence and establishment while diminishing soil seed stores and late emerging weeds can be controlled by using bispyribac sodium on 30 DAT. The next best treatment was application of pre emergence herbicide metsulfuron methyl + chlorimuron ethyl 0.004 kg ha^{-1} on 3 DAT followed by post emergence herbicide bispyribac WCE of 82.50 per cent of at 60 DAT. Similar results were also reported (Hasan *et al.,* (2003) [2] ; Padmanabhan *et al.,* (2014)). [6].

Nutrient intake by rice

The analyzed data recorded on uptake of nutrient by rice crop at harvest stage are furnished in Table 1. Significant difference was noticed with regard to nutrient uptake by rice crop. Application of PE bensulfuron methyl + pretilachlor 0.66 kg ha^{-1} on 3 DAT followed by post emergence herbicide bispyribac sodium 0.02 kg ha^{-1} on 30 DAT (T_{10}) recorded the highest nutrient uptake by rice crop of 94.27, 33.52 and 73.56 kg N, P and K ha^{-1}, respectively. The second best treatment was pre-emergence herbicide metsulfuron methyl + chlorimuron ethyl 0.004 kg ha^{-1} on 3 DAT, followed by PoE bispyribac sodium 0.02 kg ha^{-1} on 30 DAT (T9), with nutrient uptake of 92.30, 32.31, and 70.25 kg N, P, and K ha^{-1}, respectively. It was absorbed by roots, shoots and germinating weeds and inhibits the synthesis of essential branched chain amino acid, cell division and early development and thus effectively controlled the weeds and performed better than other herbicides. The weed infestation was controlled effectively which led to higher nutrient uptake by rice crop. T_1 treatment had the lowest nutrient uptake by rice crop, with values of 80.24, 27.35, and 49.15 kg N, P, and K ha^{-1}, respectively. This may be due to severe weed competition from the beginning of the crop duration interfered with nutrient uptake. Hasan *et al.*(2003)[2] reported a similar finding.

Table1: Efficacy of application of new herbicides on WCE and nutrient utilization by paddy

Treatments	Weed control efficiency (%)	Nitrogen (Kg ha^{-1})	Phosphorus (Kg ha^{-1})	Potassium (Kg ha^{-1})
T_1 – Unweeded control	-	80.24	27.35	49.15
T_2 – Pretilachlor 0.6 kg ha^{-1} on 3 DAT	12.30	82.32	27.93	51.34
T_3 – Metsulfuron methyl + Chlorimuron ethyl 0.004 kg ha^{-1} on 3 DAT	25.72	84.12	28.32	53.81
T_4 – Bensulfuron methyl + Pretilachlor 0.66 kg ha^{-1} on 3 DAT	37.20	85.50	28.95	56.17
T_5 – Pretilachlor 0.6 kg ha^{-1} on 3 DAT fb 2,4-D 1 kg ha^{-1} on 30 DAT	49.30	86.76	30.05	58.46
T_6 – T_3 fb 2,4-D 1 kg ha^{-1} on 30 DAT	55.40	87.19	30.14	60.17
T_7 – Bensulfuron methyl + Pretilachlor 0.66 kg ha^{-1} on 3 DAT fb 2,4-D 1 kg ha^{-1} on 30 DAT	68.00	88.92	30.57	63.96
T_8 – Pretilachlor 0.6 kg ha^{-1} on 3 DAT fb Bispyribacsodium 0.02 kg ha^{-1} on 30 DAT	76.29	90.49	31.02	66.34
T_9 – Metsulfuron methyl + Chlorimuron ethyl 0.004 kgha^{-1}on 3 DAT fb Bispyribac sodium 0.02 kg ha^{-1} on 30 DAT	82.50	92.30	32.31	70.25
T_{10} – Bensulfuron methyl + Pretilachlor 0.66 kg ha^{-1} on 3 DAT fb Bispyribac sodium 0.02 kg ha^{-1} on 30 DAT	88.10	94.27	33.52	73.56
T_{11} – Two hand weeding on 15 and 30 DAT	62.00	88.12	30.35	61.98
S.Ed	-	0.55	0.11	0.97
CD (p=0.05)	-	1.15	0.25	2.03

Conclusion

Based on the findings, it can be concluded that pre-emergence herbicide bensulfuron methyl + pretilachlor 0.66 kg ha-1 on 3 DAT followed by post-emergence herbicide bispyribac sodium 0.02 kg ha-1 on 30 DAT provides efficient and cost-effective weed management in paddy.

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