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Weed Management in Rice Under Mechanized System of Rice Intensification

G Priyanka, K V Ramana Murthy, A V Ramana and J Jagannadham
Department of Agronomy, Agricultural College, Naira 532 185, A P

ABSTRACT

An investigation was conducted on weed management in rice under mechanized SRI at Agricultural College Farm, Naira during *Kharif,* 2014 with ten weed management practices. Orthosulfamuron @ 100 g *a.i.* ha^{-1} as pre-emergence sand mix application + Orthosulfamuron @ 100 g *a.i.* ha^{-1} as post emergence at 20-25 DAP resulted in the highest growth parameters, number of tillers m^{-2} and dry matter production and yield attributes viz., productive tillers m^{-2}, filled grains $panicle^{-1}$ and yield (5489 kg ha^{-1}) as well as net returns (42673 0 ha^{-1}) and B:C ratio (1.21). With respect to weed parameters, lowest weed dry matter, weed index and highest weed control efficiency at 50 DAP were registered with T_{10} and it was on par with all other integrated weed management practices with all the parameters except with weed dry matter and weed control efficiency. Lowest growth parameters, yield attributes, yield as well as highest weed dry matter and weed index and lowest weed control efficiency were recorded with Weedy check. The study revealed that weeds in rice can successfully be managed under mechanized SRI in north coastal zone of Andhra Pradesh, with sequential application of Orthosulfamuron@ 100 g *a.i.* ha^{-1} as pre and post emergence for higher productivity.

Key words : : Integrated weed management, Growth parameters, Mechanized SRI, Orthosulfamuron, Oxadiargyl, Power weeder, Yield

Rice is the "Global Grain" in 89 nations with an annual production of 518 million tonnes. It plays a pivotal role in Indian economy with an area of 39.47 million hectares with an annual production of 87.83 million tones and productivity of 2284 kg ha^{-1}. In Andhra Pradesh rice is grown in an area of 40.06 lakh hectares with a production of 12.88 million tonnes and productivity of 3217 kg ha^{-1} (Ministry of Agriculture, Govt. of India, 2011-2012).Improving the productivity of rice is one the major challenge that Indiais facing today. However, an exciting approach has recently been developed—the mechanized system of rice intensification (MSRI). Mechanization combined with improved crop management results in yields of 6.5 t ha^{-1}, indicating a yield gap of more than 3 t ha^{-1}.

Among several factors responsible for low productivity of rice, weed competition is one of the most important. When rice fields are not flooded continuously and plants are widely spaced as recommended under SRI, weeds get a better chance to grow.Weeds when left uncontrolled reduced the grain yield of transplanted rice by 62.6% (Singh *et al*., 2005). Successful SRI cultivation will largely depend on effective weed control. The use of herbicides cause environmental pollution and induces the proliferation of resistant weed biotypes. These risks and the costs of labour for weeding prompt research on environment friendly, low volume and labour efficient methods through integrated weed management for mechanized SRI. In this backdrop, study was taken up to find out the effective weed management practice and its effect on growth and yield parameters of rice crop.

MATERIALS AND METHODS

An experiment for weed management practices in machine transplanted rice was carried out during *Kharif* 2014 at upland block, Agricultural College Farm, Naira with variety Pushyami (MTU-1075). The soil is sandy clay loam in texture, low in organic carbon and available nitrogen, medium in available phosphorous and potassium. The weather parameters, during the years of study did not deviate much from the normal values of the location and were favorable for the optimal performance of the crop. The treatments consisted of ten weed

management practices (T_1-Weedy check, T_2-Hand weeding at 20 and 40 DAT, T_3-Oxadiargyl @100g *a.i.* ha^{-1} pre emergence as sand mix application(SMA),T_4-Running power weeder at 20 and 40 DAP, T_5-Orthosulfamuron@100g *a.i.* ha^{-1} as pre-emergence sand mix application,T_6-Orthosulfamuron@ 100 g *a.i.* ha^{-1} as post-emergence at 20-25 DAP, T_7- Oxadiargyl @100g *a.i.* ha^{-1} pre emergence as sand mix application(SMA) (T_3) *fb* Running power weeder at 20 and 40 DAP (T_4), T_8- Oxadiargyl @100g *a.i.* ha^{-1} pre emergence as sand mix application(SMA) (T_3) *fb* Orthosulfamuron@ 100 g *a.i.* ha^{-1} as post-emergence at 20-25 DAP (T_6), T_9-Orthosulfamuron@100g *a.i.* ha^{-1} as pre-emergence sand mix application (T_5) *fb* Running power weeder at 20 and 40 DAP (T_4), T_{10}-Orthosulfamuron@100g *a.i.* ha^{-1} as pre-emergence sand mix application (T_5) *fb* Orthosulfamuron@ 100 g *a.i.* ha^{-1} as post-emergence at 20-25 DAP (T_6). The experiment was laid out randomized block design and replicated thrice. Transplantation was done by using Yanmar machine with fourteen day's aged seedlings by adopting 30 cm × 14 cm. A fertilizer dose of 120-60-40 kg N, P_2O_5 and K_2O ha^{-1} was applied uniformly to all the experimental plots. Nitrogen was applied in three equal splits, one each at basal, active tillering and panicle initiation. All the other cultural practices were followed as per the recommended package of practices. Observations on weed parameters and pre and post harvest observations on crop were recorded. The data recorded on various growth and yield parameters of rice crop were analysed following standard statistical analysis of variance procedure as suggested by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Growth parameters

The highest total number of tillers m^{-2} and plant dry matter accumulation at harvest (Table 1) was recorded with Orthosulfamuron @ 100 g *a.i.* ha^{-1} as pre-emergence sand mix application + Orthosulfamuron @ 100 g *a.i.* ha^{-1} as post emergence at 20-25 DAP (T_{10}) and it was on par with all other integrated weed management practices viz., Oxadiargyl @ 100 g *a.i.* ha^{-1} as pre-emergence sand mix application + running power weeder at 20 and 40 DAP (T_7), Oxadiargyl @ 100 g *a.i.* ha^{-1} as pre-emergence sand mix application + Orthosulfamuron @ 100 g *a.i.* ha^{-1} as post emergence application at 20-25 DAP (T_8) and Orthosulfamuron @100 g *a.i.* ha^{-1} as pre-emergence sand mix application + running power weeder at 20 and 40 DAP (T_9) including hand weeding at 20 and 40 DAP (T_2) and running power weeder at 20 and 40 DAP (T_4) while the lowest was observed with Weedy check (T_1).

It appears that higher degree of positive response on effective weed management with the sequential application of herbicides, thereby facilitating luxurious crop growth through favourable environment for utilization of basic resources (nutrients, moisture, space and light) as resulted in highest number of total tillers m^{-2} andhighest dry matter accumulation. Similar results were also reported by Bhandare *et al.* (2011) and Kavitha *et al.* (2010).The next highest total number of tillers m^{-2} and dry matter production obtained with integrated weed management practices of T_7, T_8 and T_9. This might be due to the better weed management practices with combination of cultural and herbicidal treatments. Similar results were also reported earlier by SoeThura (2010) with integrated weed management practices.

Yield attributes and Yield

The highest number of productive tillers m^{-2} (Table 1) were recorded with Orthosulfamuron @ 100 g *a.i.* ha^{-1} as pre-emergence sand mix application + Orthosulfamuron @ 100 g *a.i.* ha^{-1} as post emergence at 20-25 DAP (T_{10}) and it was on par with all other integrated weed management practices *viz*., Oxadiargyl @ 100 g *a.i.* ha^{-1} as pre-emergence sand mix application + running power weeder at 20 and 40 DAP (T_7), Orthosulfamuron @100 g *a.i.* ha^{-1} as pre-emergence sand mix application + running power weeder at 20 and 40 DAP (T_9) and Oxadiargyl @ 100 g *a.i.* ha^{-1} as pre-emergence sand mix application + Orthosulfamuron @ 100 g *a.i.* ha^{-1} as post emergence application at 20-25 DAP (T_8) and similar trend of results were also recorded with number of filled grains panicle^{-1} but highest was with Oxadiargyl @ 100 g *a.i.* ha^{-1} as pre-emergence sand mix application + running power weeder at 20 and 40 DAP (T_7).

Table 1. Growth and yield parameters of rice under MSRI as influenced by different weed management practices.

Treatments	Crop dry matter at harvest (kg ha^{-1})	Total tillers at harvest m^{-2}	Productive tillers m^{-2}	Filled grains panicle^{-1}	Grain yield (kg ha^{-1})
T_1- Weedy check	5152	108	63	64	3645
T_2- Hand weeding at 20&40 DAP	10760	238	208	152	5181
T_3- Oxadiargyl @ 100g *a.i* ha^{-1} as pre emergence SMA application	6986	187	120	114	4518
T_4- Running power weeder at 20 and 40 DAP	10720	238	178	132	4856
T_5- Orthosulfamuron @100g *a.i* ha^{-1} as pre emergence SMA application	8992	216	176	127	4995
T_6- Orthosulfamuron @ 100 g *a.i* ha^{-1} as post-emergence at 20-25 DAP	9696	220	177	135	5144
T_7- Oxadiargyl @ 100g *a.i* ha^{-1} as pre emergence SMA application (T_3)*fb* Running power weeder at 20 and 40 DAP (T_4)	11379	254	229	156	5381
T_8- Oxadiargyl @ 100g *a.i* ha^{-1} as pre emergence SMA application (T_3) *fb*Orthosulfamuron @ 100 g *a.i* ha^{-1} as post emergence at 20-25 DAP (T_6)	11507	249	224	152	5192
T_9- Orthosulfamuron @100g *a.i* ha^{-1} as pre emergence SMA application (T_5) *fb* Running power weeder at 20 and 40 DAP (T_4)	10845	255	227	152	5333
T_{10}- Orthosulfamuron @100g *a.i* ha^{-1} as pre emergence SMA application (T_5) *fb* Orthosul famuron @ 100 g *a.i* ha^{-1} as post emergence at 20-25 DAP (T_6)	11962	270	232	154	5489
SEm±	429.26	11.80	10.21	6.46	157.71
CD (P = 0.05)	1275	35	30	19	221
CV(%)	7.59	9.14	9.64	8.35	5.49

The highest number of productive tillers m^{-2} and higher number of filled grains per panicle^{-1} with T_{10} might be due to Application of Orthosulfamuron helped the rice plants with profuse tillering and therefore, lead to good stand establishment and healthy canopy development due to absence of weeds thus enabled the crop plants to convert more number of total tillers to productive tillers and better partitioning of assimilates to sink leading to more number of filled grains per panicle. These results are in accordance with findings of Chadar *et al.* (2014). The highest grain yield (5489 kg ha^{-1}) was recorded with Orthosulfamuron @ 100 g *a.i.* ha^{-1} as pre-emergence sand mix application + Orthosulfamuron @ 100 g *a.i.* ha^{-1} as post emergence at 20-25 DAP (T_{10}). Oxadiargyl @ 100 g *a.i.* ha^{-1} as pre-emergence sand mix application + running power weeder at 20 and 40 DAP (T_7) was the next best treatment. However, it was on par with Orthosulfamuron @100 g *a.i.* ha^{-1} as pre-emergence sand mix application + running power weeder at 20 and 40 DAP (T_9). An increase in

Table 2. Weed dry mater, weed indices and economics of rice under MSRI as influenced by different weed management practices.

Treatments	Weed total dry matter at 50 DAP (g m^{-2})	WCE at 50 DAP	Weed Index	Net returns (0 ha^{-1})	B:C ratio
T_1- Weedy check	11.85 (139.36)	0.33 (0.00)	5.78 (33.56)	20077	0.64
T_2- Hand weeding at 20&40 DAP	1.91 (3.14)	81.59 (97.75)	2.41 (5.42)	29420	0.67
T_3- Oxadiargyl @ 100g *a.i* ha^{-1} as pre emergence SMA application	3.99 (15.45)	70.56 (88.94)	4.26 (17.70)	30645	0.92
T_4- Running power weeder at 20 and 40 DAP	2.43 (5.43)	78.64 (96.11)	3.41 (11.53)	31571	0.85
T_5- Orthosulfamuron @100g *a.i* ha^{-1} as pre emergence SMA application	4.86 (23.17)	66.03 (83.47)	2.83 (8.95)	37165	1.11
T_6- Orthosulfamuron @ 100 g *a.i* ha^{-1} as post-emergence at 20-25 DAP	2.95 (8.59)	75.93 (93.80)	2.54 (6.57)	39193	1.17
T_7- Oxadiargyl @ 100g *a.i* ha^{-1} as pre emergence SMA application (T_3)*fb* Running power weeder at 20 and 40 DAP (T_4)	1.88 (3.05)	81.59 (97.82)	1.48 (1.97)	37872	0.98
T_8- Oxadiargyl @ 100g *a.i* ha^{-1} as pre emergence SMA application (T_3) *fb*Orthosulfamuron @ 100 g *a.i* ha^{-1} as post emergence at 20-25 DAP (T_6)	1.61 (2.17)	83.02 (98.46)	2.31 (5.60)	38527	1.10
T_9- Orthosulfamuron @100g *a.i* ha^{-1} as pre emergence SMA application (T_5) *fb* Running power weeder at 20 and 40 DAP (T_4)	1.80 (2.83)	81.95 (97.95)	1.69 (2.84)	36690	0.94
T_{10}- Orthosulfamuron @100g *a.i* ha^{-1} as pre emergence SMA application (T_5) *fb* Orthosul famuron @ 100 g *a.i* ha^{-1} as post emergence at 20-25 DAP (T_6)	0.84 (0.20)	87.85 (99.86)	0.71 (0.00)	42673	1.21
SEm±	0.19	0.94	0.41	2141.64	0.06
CD (P = 0.05)	0.55	2.80	1.21	6362	0.19
CV(%)	9.4	2.3	25.8	10.79	11.58

yield of 50.6% over weedy check was observed in case of T_{10} treatment. The elevated stature of these results might be due to effective control of weeds at early stages of crop growth with pre emergence application and that of the late emerged weeds, due to post emergence application of Orthosulfamuron which provided the favourable growing conditions for the crop, at critical period of crop weed competition. Further, production of higher level of dry matter and thereby effective translocation of photosynthates efficiently to sink, might have contributed to the better development of yield contributing characters, *viz*., higher number of productive tillers m^{-2}, filled grains $panicle^{-1}$ and thousand grain weight (g), which ultimately resulted in higher grain yield. These results were in close conformity with those of Subrata *et al*. (2005), Sindhu *et al.* (2007) and Latheef Pasha *et al*. (2012). Obviously, lowest grain yield (5489 kg ha^{-1}) was in weedy check (T_1). Similar results are reported by Malay *et al*. (2014).

Effect on weed

The lowest total weed dry matter and highest weed control efficiency at 50 DAP (Table 2) was recorded with Orthosulfamuron @100 g *a.i* ha^{-1} as pre-emergence sand mix application + Orthosulfamuron @ 100 g *a.i* ha^{-1} as post emergence application at 20-25 DAP (T_{10}) which was found be significantly superior to rest of the weed management practices. Oxadiargyl @ 100 g *a.i* ha^{-1} as pre-emergence sand mix application + Orthosulfamuron @ 100 g *a.i* ha^{-1} as post emergence application at 20-25 DAP (T_8) was the next best treatment. However, it was on par with Orthosulfamuron @100 g *a.i* ha^{-1} as pre-emergence sand mix application + running power weeder at 20 and 40 DAP (T_9), Oxadiargyl @ 100 g *a.i* ha^{-1} as pre-emergence sand mix application + running power weeder at 20 and 40 DAP (T_7) and hand weeding at 20 and 40 DAP (T_2). Significantly highest weed dry matter was recorded with weedy check (T_1). Similar trend of results were also recorded with Weed Index (WI) but the best treatment T_{10} was on par with all the integrated treatments.

Results indicating that phytotoxcity of pre-emergence herbicide Orthosulfamuron on germinating weeds which inhibits the cell division in the meristematic tissues, resulting in death of most of the weeds within a few days of their emergence and an effective weed control by post emergence application of the same herbicide. These findings are in conformity with those of Akhilesh Kumar *et al*. (2012) and Saha and Rao (2010).The next lowest total dry matter of weeds were recorded with T_9, T_8 and T_7. This might be due to reduced weed density and dry matter even up to harvest with synergistic action of sequential application of herbicides Oxadiargyl and Orthosulfamuron and with mechanical weeding. Effective control of weeds through weeder was also reported by Nair *et al*. (2002).

Net returns and BCR were the highest with Orthosulfamuron @100 g *a.i* ha^{-1} as pre-emergence sand mix application + Orthosulfamuron @ 100 g *a.i* ha^{-1} as post emergence application at 20-25 DAP (T_{10}) and lowest were recorded with weedy check. It was on par with Orthosulfamuron@100g *a.i.* ha^{-1} as pre-emergence sand mix application (T_5)and Orthosulfamuron@ 100 g *a.i.* ha^{-1} as post-emergence at 20-25 DAP (T_6). This might be due to lower cost of chemical and less requirement of labour and also higher grain yield realized with this treatment.

In conclusion, the study revealed that rice can be successfully grown under mechanized SRI in north coastal zone of Andhra Pradesh, with sequential application of Orthosulfamuron@ 100 g *a.i.* ha^{-1} as pre and post emergence for higher productivity.

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