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Evaluation of sequential herbicide application on transplanted paddy under sodic soil

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Abstract
A field experiment was carried out at Department of Agronomy, Anbil Dharmalingam Agricultural College and Research Institute, Trichy during *Samba*, 2018 to study the effect of sequential application of herbicides on weed dynamics, weed control efficiency, growth, yield and economics of transplanted paddy. The experiment was laid out in split plot design with four main plot and five sub plot treatments. Main plot treatments were pre plant application of herbicides namely glyphosate 2.50 kg/ha, glufosinate ammonium 1.00 kg/ha and halosulfuron methyl 67.5 gm/ha and control. Sub plot treatments consisted of different weed management practices in transplanted paddy namely pre emergence application of bensulfuron methyl + pretilachlor 660 gm/ha on 3 DAT + one hand weeding on 45 DAT, post emergence application of bispyribac sodium 25 gm/ha on 15 DAT + one hand weeding on 45 DAT, application of bensulfuron methyl + pretilachlor 660 gm/ha on 3 DAT + bispyribac sodium 25 gm/ha on 25 DAT, hand weeding twice at 25 and 45 DAT and unweeded control. The pre plant herbicides sprayed 15 days before puddling. These results revealed that pre plant application of glyphosate 2.50 kg/ha recorded significantly lower weed density (18.1 and 16.7 No/m^2), weed dry weight (14.5 and 15.0 gm/m^2) and higher in weed control efficiency (78.1 and 88.3%) at 40 and 60 DAT respectively, growth characters such as tillers (585 No/m^2), dry matter production (11517 kg/ha), yield characters like productive tillers (350 No/m^2) and filled grains (153 No/panicle) and grain yield (4232 kg/ha) than halosulfuron methyl and control. These results are on par with glufosinate ammonium 1.00 kg/ha. Highest net return (Rs. 54391/ha) and B:C ratio (2.51) were obtained with application of glyphosate 2.50 kg/ha and this was followed by glufosinate ammonium 1.00 kg/ha which registered net return of Rs. 51198/ha and B:C ratio of 2.39. Among the weed management practices followed in paddy, hand weeding twice at 25 and 45 DAT registered significantly lower weed density (11.8 and 9.4 No/m^2), weed dry weight (8.9 and 6.9 gm/m^2) and higher weed control efficiency (91.6 and 96.4%), dry matter production (12075 kg/ha) than unweeded control. This was on par with application of bensulfuron methyl + pretilachlor 660 gm/ha on 3 DAT + bispyribac sodium 25 gm/ha on 25 DAT, post emergence application of bispyribac sodium 25 gm/ha on 15 DAT + one hand weeding on 45 DAT. Post emergence application of bispyribac sodium 25 gm/ha on 15 DAT + one hand weeding on 45 DAT registered significantly higher productive tillers (338 No/m^2), filled grains (159 No/panicle) and grain yield (4327 kg/ha) than unweeded control. Higher net return (Rs. 53298 /ha) and B:C ratio (2.40) obtained with application bispyribac sodium 25 gm/ha on 15 DAT + one hand weeding on 45 DAT, followed by bensulfuron methyl + pretilachlor 660 gm/ha on 3 DAT + bispyribac sodium 25 gm/ha on 25 DAT.

Keywords: Weed management, transplanted paddy, pre plant application, glyphosate, glufosinate ammonium, halosulfuron methyl

Introduction
Rice (*Oryza sativa* L.) is the stable food for more than 60 per cent of the world population and its cultivation secures a livelihood for more than two billion people. In India, rice is grown in an area of 43.86 million hectares with a production of 104.80 million tonnes and an average productivity of 2.4 tonnes/ha. In Tamil Nadu, rice is grown in an area of 1.85 million hectares with production of 6.95 million tonnes and productivity of 3.7 tonnes/ha (Department of Economics and Statistics, 2019) [2].

Weeds are the major biotic constraint to reduce the rice productivity in worldwide. In transplanted rice, about 60% of the weeds emerge in the period between one week to one month after transplanting. These emerging weeds are competing with rice in effective tillering stage and decline the quantity of panicles leads to reduction in grain yield (Soe thura, 2010) [18]. Uncontrolled weed growth in transplanted rice caused 45-51% loss in yield (Veeraputhiran and Balasubramanian, 2013) [16]. In India, sodic soils have occupied 37.8 lakh ha and in Tamil Nadu, it occupied 3.55 lakh ha, mostly found in Ramanathapuram, Cuddalore, Kanchipuram, Tirunelveli, Thanjavur, Pudukottai, Madurai and Tiruchirapalli districts.

In Samba season paddy (Sep-Jan), where one rice crop is being grown per year and rest of the period, the fields are left as fallow, weeds grown enormously during off season and poses serious threat in reducing the grain yield of paddy. Rainfall during August-September months and complete soaking of main field during nursery period causes more weeds infestation and multiplication. *Cyperus rotundus* is one of the dominant weeds of sodic soil causes difficulty in land preparation for paddy cultivation. In addition, regeneration of rhizomes and weeds infestation occur during early growth stages of rice due to improper land levelling and alternate wetting and drying irrigation pattern causes poor growth and yield of paddy. Hand weeding of *Cyperus rotundus* is laborious and increases the cost of weeding. Hence, pre plant application of herbicide can be used for controlling the emerged weeds particularly *Cyperus* before transplanting which causes easy land preparation and less weeds in the paddy field. In Cauvery delta zone, sequential application of herbicides viz., glyphosate 2.5 lit/ha at 15 days before transplanting followed by bensulfuron methyl + pretilachlor 660 gm/ha at 3 DAT was found promising for effective weed control in transplanted rice (Parthipan and Ravi, 2016) [7].

Weed management is a basic requirement for successful transplanted rice cultivation. Weed free condition during the critical period of competition is essential for obtaining optimum yield. This can be achieved by either application of pre emergence or post emergence or combination of both or manual weeding. Manual weeding although effective and most common practice of weed control in transplanted rice, increasing cost of labour and scarcity of labour during peak period of agricultural operation lead to the search for alternative methods. Herbicides offer the most effective, economical and practical way of weed management (Sureshkumar *et al*., 2016) [14]. Pre emergence herbicide provide weed free condition during initial stage because it arrest the germination of weeds. In transplanted paddy, later emerged weed make serious problem during critical period of crop weed competition. Hence, use of pre emergence or post emergence herbicides or combination of both essential for reduce crop weed interference. It is highly essential to control the weeds in transplanted paddy under sodic soil through sequential application of herbicides. Very fewer studies have been done on transplanted paddy using sequential application of herbicides to control the weeds. Hence, present experiment has been carried out to evaluate the sequential herbicide application on transplanted paddy under sodic soil condition.

Materials and Methods

A field experiment was conducted at Department of Agronomy, Anbil Dharmalingam Agricultural College and Research Institute, Tamil Nadu Agricultural University, Tiruchirappalli during *Samba* season (*Rabi*) 2018. The total rainfall received during cropping season was 234 mm in 12 rainy days. The mean maximum and minimum temperature prevailed during the cropping period were 31.8 ^{o}C and 22.7 ^{o}C, respectively. The mean relative humidity was 87 and 61 per cent during forenoon and afternoon, respectively. The mean bright sunshine hours per day was 6.3 hours. The mean evaporation per day was 3.3 mm/day. The mean wind velocity was 3.8 km/hr.

The soil of the experimental field was alkaline in nature (pH-9.1), sandy clay loam in texture, moderately drained and classified as *Vetric Ustropept.* The experimental soil was low in available nitrogen (112.9 kg/ha), medium in available phosphorus (14.2 kg/ha) and high in available potassium (288.4 kg/ha). The experiment was laid out in split plot design with four main plot and five sub plot treatments. Main plot treatments consisted of pre plant application of herbicides namely glyphosate 2.50 kg/ha, glufosinate ammonium 1.00 kg/ha and halosulfuron methyl 67.5 gm/ha and control. Sub plot treatments consisted of different weed management practices in transplanted paddy namely pre emergence application of bensulfuron methyl + pretilachlor 660 gm/ha on 3 DAT + one hand weeding on 45 DAT, post emergence application of bispyribac sodium 25 gm/ha on 15 DAT + one hand weeding on 45 DAT, application of bensulfuron methyl + pretilachlor 660 gm/ha on 3 DAT + bispyribac sodium 25 gm/ha on 25 DAT, hand weeding twice at 25 and 45 DAT and unweeded control. The paddy variety TRY 3 was grown during the course of investigation.

Total weed density and weed dry weight were recorded at 40 and 60 days after transplanting (DAT) and were subjected to square root x+0.5 transformation before statistical analysis to normalize their distribution. Weed control efficiency was worked out on the basis of weed dry matter recorded in each treatment by using formula as suggested by Mani *et al.* (1973) [5]. The growth and yield attributes like plant height, number of tillers, dry matter production, number of productive tillers, number of filled grains per panicle, grain yield were recorded. Economics of different treatments was calculated based on prevailing input and output market prices.

Results and Discussion

Weed flora: The weed flora consisted of *Cynodon dactylon*, *Echinochloa colona* in grasses, *Cyperus rotundus* in sedges and *Eclipta alba*, *Euphorbia prostrata*, *Lippia nodiflora*in broad leaved weeds. Sedges (77%) were found to be the predominant category followed by grasses (17%) and broad leaved weeds (6%) registered before pre plant application of herbicide. Similar weed species have been found in transplanted paddy under sodic soil (Revathi *et al.,* 2017) [11].

Effect on weeds: Sequential application of herbicides had a significant effect on weed density, dry weight and weed control efficiency in transplanted rice (Table 1). Pre plant application of glyphosate 2.50 kg/ha registered significantly lower weed density (18.1 and 16.7 No/m^2), dry weight (14.5 and 15.0 gm/m^2) and higher weed control efficiency (78.1 and 88.3%) on 40 and 60 DAT respectively. This was followed by application of glufosinate ammonium 1.00 kg/ha which recorded the lowest weed density (28.3 and 25 No/m^2), dry weight (18.1 and 17.2 gm/m^2) and higher weed control efficiency (72.7 and 86.6%) on 40 and 60 DAT respectively. However, application of glufosinate ammonium registered comparable in weed dry weight with glyphosate application. This is mainly because of application of glyphosate or glufosinate effectively control the weeds including *Cyperus* before puddling resulted in lesser weed density, dry weight and ultimately higher weed control efficiency in transplanted paddy. These results are in accordance with Subramanian *et al.* (2004) [13] who revealed that lower weed density and higher weed control efficiency were obtained under pre sowing application of glyphosate at 1.5 kg/ha + pre emergence application of pretilachlor with safener at 0.4 kg/ha in direct seeded rice. Application of halosulfuron methyl 67.5 gm/ha registered significantly higher weed density (47.5 and 48.5 No/m^2), dry weight (25.0 and 29.3 gm/m^2) and lower weed control efficiency (62.3 and 77.1%)

than glyphosate and glufosinate ammonium on 40 and 60 DAT. The control plot registered significantly higher weed density (55.3 and 75.7 No/m^2), dry weight (66.4 and 128.3 gm/m^2) on 40 and 60 DAT as compared to other treatments.

Among the weed management practices fallowed in transplanted paddy, hand weeding twice at 25 and 45 DAT registered significantly lower weed density (11.8 and 9.4 No/m^2), dry weight (8.9 and 6.9 gm/m^2) and higher weed control efficiency (91.6 and 96.4%) 40 and 60 DAT respectively. Manual weeding removed the all type of weeds especially *Cyperus* and paddy mimicry weeds which had grown along with rice, was the reason behind less weed density, dry weight and weed control efficiency. These results are in line with the findings of Parthipan and Ravi (2016) [7] who reported lower density, dry weight, and higher weed control obtained with two hand weeding at 25 and 45 DAT in transplanted paddy. This was on par with application of bensulfuron methyl + pretilachlor 660 g/ha on 3 DAT + bispyribac sodium 25 gm/ha on 25 DAT and post emergence application of bispyribac sodium 25 gm/ha on 15 DAT + one hand weeding on 45 DAT. Reduced weed density, dry weight and higher weed control efficiency might be due to broad spectrum control of weeds by application of bensulfuron methyl + pretilachlor 660 gm/ha on 3 DAT + bispyribac sodium 25 gm/ha on 25 DAT. These results are in accordance with the findings of Nivetha *et al.* (2017) [6] who reported that pre emergence application of bensulfuron methyl + pretilachlor followed by early post emergence application of bispyribac sodium which registered lesser weed density, dry weight and higher weed control efficiency on 40 and 60 DAT in transplanted paddy under sodic soil condition. The higher weed density (116.8 and 144.9 No/m^2) and dry weight (106.4 and 195.4 gm/m^2) were obtained with unweeded control.

Effect on plant growth parameters: The plant height, number of tillers and dry matter production of paddy were significantly influenced by weed management practices (Table 2). Among the pre plant herbicides glufosinate ammonium 1.00 kg/ha recorded significantly taller plants (108.6 cm) over control. This was on par with application of glyphosate 2.50 kg/ha (107.8 cm). Application of halosulfuron methyl 67.5 gm/ha registered significantly shorter plants than glyphosate and glufosinate. However, this was on par with control. Hand weeding twice at 25 and 45 DAT recorded significantly taller plants (111.1 cm) than control. This was on par with bensulfuron methyl + pretilachlor 660 gm/ha on 3 DAT + one hand weeding on 45 DAT (110.4 cm). It might be due to adoption of different weed management practices improved the growth parameters of transplanted rice by way of higher nutrient availability for crop plants through elimination of competition by weeds during the critical period leads to higher plant height. These findings are similar with Teja *et al.* (2015) [15] who revealed hand weeding twice 20 and 40 DAT observed taller plants, it was statistically on par with pre emergence application of bensulfuron methyl 0.6% + pretilachlor 6% at 60 + 600 gm/ ha in paddy. Post emergence application of bispyribac sodium 25 gm/ha on 15 DAT + one hand weeding on 45 DAT recorded significantly shorter plants (105.0 cm) and it was on par with application of bensulfuron methyl + pretilachlor 660 gm/ha on 3 DAT + bispyribac sodium 25 gm/ha on 25 DAT (104.0) and control (101.2 cm).

Significantly higher number of tillers (585 /m^2) and dry matter production (11517 kg/ha) was obtained with application of glyphosate 2.50 kg/ha over control. This was on par with glufosinate ammonium 1.00 kg/ha. The lowest number of tillers (484 /m^2) and dry matter production (10273 kg/ha) were obtained with control. Post emergence application of bispyribac sodium 25 gm/ha on 15 DAT + one hand weeding on 45 DAT registered significantly higher number of tillers (581 /m^2) than control. This might be due to reduced crop weed competition during critical period resulted in increased availability of water, nutrients and light. These findings are in accordance with Kumar *et al.* (2013) [4] who recorded post emergence application of application of bispyribac sodium at 20-30 gm/ha produced higher number of tillers and effective tillers. However, this was on par with application of bensulfuron methyl + pretilachlor 660 gm/ha on 3 DAT + bispyribac sodium 25 gm/ha on 25 DAT (572 no/m^2), hand weeding twice at 25 and 45 DAT (563 no/m^2) and application of bensulfuron methyl + pretilachlor 660 gm/ha on 3 DAT + one hand weeding on 45 DAT (555 no/m^2). The lowest number of tillers (463 /m^2) obtained with unweeded control. With reference to dry matter production, hand weeding twice at 25 and 45 DAT recorded significantly higher dry matter production (12075 kg/ha) over control. However, this was on par with bensulfuron methyl + pretilachlor 660 gm/ha on 3 DAT + bispyribac sodium 25 gm/ha on 25 DAT, post emergence application of bispyribac sodium 25 gm/ha on 15 DAT + one hand weeding on 45 DAT and pre emergence application of bensulfuron methyl + pretilachlor 660 gm/ha on 3 DAT + one hand weeding on 45 DAT. The increased dry matter production might be due to better control of weeds, which resulted in increased leaf area and better photosynthesis. These findings are similar with Subha Lakshmi and Venkata Ramana (2008) [12] who indicated that hand weeding twice at 20 and 40 DAT recorded higher dry matter production.

Effect on yield attributes: Application of glyphosate 2.50 kg/ha as a pre plant herbicide registered significantly higher number of productive tillers (350/m^2) and filled grains (153/panicle) over other treatments (Table 2). This was on par with glufosinate ammonium 1.00 kg/ha which recorded higher number of productive tillers (331/m^2) and filled grains (146/panicle). This is mainly because of application of glyphosate effectively control the weeds including *Cyperus* before puddling facilitated the crop to absorb more nutrients from the soil and produce more photosynthates resulted in higher number of productive tillers and filled grains. The lowest number of productive tillers (263/m^2) and filled grains (131/panicle) obtained with control but this was comparable with halosulfuron methyl 67.5 gm/ha.

Weed management practices in paddy exerted significant influence on yield attributes of transplanted rice. Application of bispyribac sodium 25 gm/ha on 15 DAT + one hand weeding on 45 DAT significantly recorded higher number of productive tillers (338/m^2) and filled grains (159/panicle) and this was on par with pre emergence application of bensulfuron methyl + pretilachlor 660 gm/ha on 3 DAT + post emergence application of bispyribac sodium 25 gm/ha on 25 DAT which registered higher number of productive tillers (329/m^2) and filled grains (150/panicle). Post emergence herbicide, bispyribac sodium 25 gm/ha effectively controlled the emerged weeds during critical stages and maintain the crop free from crop weed competition and resulted in lesser competition by weeds for nutrients, space and light ultimately resulted in increased productive tillers and filled grains.These

results was similar with Prashanth *et al.* (2015) [8] who reported that application of bispyribac sodium at 25 gm/ha at 15 DAT recorded maximum number of productive tillers. Veeraputhiran and Balasubramanian (2013) [16] also reported higher number of grains per panicle observed with weed free plot, that was on par with post emergence application of bispyribac sodium in transplanted paddy. Pre emergence application of bensulfuron methyl + pretilachlor 660 gm/ha on 3 DAT + one hand weeding on 45 DAT and hand weeding twice at 25 and 45 DAT were comparable with each other with number of productive tillers and filled grains. Lower number of productive tillers (223 /m^2) and filled grains (116 /panicle) were obtained with unweeded control.

Grain yield: Pre plant application of herbicides and weed management practices in paddy positively influenced the grain yield of transplanted paddy (Table 3). Among the pre plant herbicides, glyphosate 2.50 kg/ha recorded significantly higher grain yield (4232 kg/ha) over control. However, this was on par with glufosinate ammonia 1.00 kg/ha (4145 kg/ha). The increment in grain yield was mainly due to pre plant application of herbicides controlled the weeds particularly *Cyperus* before transplanting of paddy resulted lesser crop weed population and weed dry weight caused lesser weed competition reflected in production of higher yield attributes and grain yield. These results are similar with findings of Veeraputhiran and Balasubramanian (2010) [17] who reported that pre plant application of glyphosate at 15 days before transplanting followed by application of bensulfuron methyl + pretilachlor at 3 DAT registered higher grain yield in transplanted paddy. The lowest grain yield (3565 kg/ha) was obtained with control plot.

Among the weed management practices followed in paddy, post emergence application of bispyribac sodium 25 gm/ha on 15 DAT + one hand weeding on 45 DAT registered significantly higher grain yield (4327 kg/ha) over control. This was comparable with bensulfuron methyl + pretilachlor 660 gm/ha on 3 DAT + bispyribac sodium 25 gm/ha on 25 DAT (4299 kg/ha), hand weeding twice at 25 and 45 DAT (4187 kg/ha) and pre emergence application of bensulfuron methyl + pretilachlor 660 gm/ha on 3 DAT + one hand weeding on 45 DAT (4143 kg/ha). Adoption of weed management practices either pre or post emergence herbicides followed by HW on 45 DAT or combination of both pre and post emergence herbicides reduced the weed density and weed competition resulted in reduced nutrient removal by weeds and increased nutrient uptake by crop, better light transmission for photosynthesis and finally better crop growth and yield. These results are in line with findings of Prashanth *et al*. (2016) [9] who reported that post emergence application of bispyribac sodium at 25 gm/ha at 15 DAT recorded significantly higher grain yield in transplanted paddy. The lower grain yield (2923 kg/ha) was obtained with unweeded control.

Economics: Among the pre plant application of herbicides, glyphosate 2.50 kg/ha registered higher net return (Rs. 54391 /ha) and B:C ratio (2.51) than other treatments (Table 3). This was followed by glufosinate ammonium 1.00 kg/ha which gave higher net return of Rs. 51198 /ha and B:C ratio of 2.39. This might be due to better weed control efficiency and higher yield under glyphosate treated plots resulted higher net return and B:C ratio. These results are in accordance with the findings of Ramachandra *et al.* (2014) who reported that pre plant application of glyphosate 0.75 kg/ha at 15 days before transplanting in combination with pre emergence application of bensulfuron methyl + pretilachlor applied at 5 DAT observed higher net returns and B:C ratio. Halosulfuron methyl 67.5 gm/ha registered lesser B:C ratio (2.10) then control, mainly due to poor weed control as well as higher cost of herbicide.

Among the weed management practices in paddy, post emergence application of bispyribac sodium 25 gm/ha on 15 DAT + one hand weeding on 45 DAT recorded higher net return (Rs. 53298 /ha) and B:C ratio (2.40). This was followed by application of bensulfuron methyl + pretilachlor 660 gm/ha on 3 DAT + bispyribac sodium 25 gm/ha on 25 DAT. The superior performance of this treatment might be accredited with better weed control efficiency, higher yield attributes and yield. These findings are similar with Veeraputhiran and Balasubramanian (2013) [16] who reported that post emergence application of bispyribac sodium at 25 gm/ha registered higher net profit in transplanted paddy. Application of bensulfuron methyl + pretilachlor 660 gm/ha on 3 DAT + one hand weeding on 45 DAT registered lower net return (Rs. 51179 /ha) and B:C ratio (2.37) than bensulfuron methyl + pretilachlor 660 gm/ha on 3 DAT + bispyribac sodium 25 gm/ha on 25 DAT. The lower net return (Rs. 31585 /ha) and B:C ratio (2.00) obtained with unweeded control.

Thus, pre plant application of glyphosate 2.50 kg/ha at 15 days before puddling followed by post emergence application of bispyribac sodium 25 gm/ha on 15 DAT + one hand weeding on 45 DAT could be recommended for effective weed control, higher productivity and profitability of transplanted paddy under sodic soil ecosystem.

Table 1: Evaluation of sequential herbicide application on weed density, weed dry weight, weed control efficiency of transplanted rice under sodic soil

Treatments	Weed density (No/m^2)		Weed dry weight (gm/m^2)		Weed control* efficiency (%)	
	40 DAT	60 DAT	40 DAT	60 DAT	40 DAT	60 DAT
Main plots (Pre plant application)						
M_1- Glyphosate 2.50 kg/ha	4.02(18.1)	3.68(16.7)	3.55(14.5)	3.49(15.0)	78.1	88.3
M_2- Glufosinate ammonium 1.00 kg/ha	4.88(28.3)	4.61(25.0)	3.87(18.1)	3.77 (17.2)	72.7	86.6
M_3- Halosulfuron methyl 67.5 gm/ha	5.92(47.5)	6.09(48.5)	4.70(25.0)	4.91(29.3)	62.3	77.1
M_4- Control	6.61(55.3)	7.09(75.7)	6.58(66.4)	8.04(128.3)	-	-
SEd	0.15	0.23	0.15	0.26	-	-
CD (P=0.05)	0.39	0.57	0.38	0.64	-	-
Sub plots (Weed management in paddy)						
S_1- PE bensulfuron methyl + pretilachlor 660 gm/ha on 3 DAT + one HW on 45 DAT	5.38(29.2)	4.49(21.0)	4.33(18.9)	3.70(13.8)	82.3	92.9
S_2- POE of bispyribac sodium 25 gm/ha on 15 DAT + one HW on 45	3.88(15.3)	3.66(13.5)	3.43(11.7)	3.46(12.0)	89.0	93.9

DAT						
S_3- PE bensulfuron methyl + pretilachlor 660 gm/ha on 3 DAT + POE bispyribac sodium 25 gm/ha on 25 DAT	3.68(13.4)	4.24(18.7)	3.08(9.2)	2.99(9.0)	91.3	95.4
S_4- HW twice at 25 and 45 DAT	3.41(11.8)	3.07(9.4)	2.99(8.9)	2.99(6.9)	91.6	96.4
S_5- Unweeded Control	10.44(116.8)	11.37(144.9)	9.55(106.4)	12.13(195.4)	-	-
SEd	0.26	0.31	0.22	0.27	-	-
CD (P=0.05)	0.53	0.63	0.46	0.55	-	-

The data were transformed to $\sqrt{X + 0.5}$. The figures in the parenthesis are original values.
* The data not statistically analysed
PE: Pre Emergence, POE: Post Emergence, HW: Hand Weeding

Table 2: Evaluation of sequential herbicide application on growth and yield attributes of transplanted rice under sodic soil

Treatment	Plant height (cm)	Dry matter production (Kg/ha)	Tillers (No/m^2)	Productive tillers (No/m^2)	Filled grains (No/panicle)
Main plots (Pre plant application)					
M_1- Glyphosate 2.50 kg/ha	107.8	11517	585	350	153
M_2- Glufosinate ammonium 1.00 kg/ha	108.6	11467	570	331	146
M_3- Halosulfuron methyl 67.5 gm/ha	105.5	10992	548	281	137
M_4- Control	103.4	10273	484	263	131
SEd	1.2	128	13	8	4
CD (P=0.05)	3.0	312	32	20	9
Sub plots (Weed management in paddy)					
S_1- PE bensulfuron methyl + pretilachlor 660 gm/ha on 3 DAT + one HW on 45 DAT	110.4	11308	555	314	138
S_2- POE of bispyribac sodium 25 gm/ha on 15 DAT + one HW on 45 DAT	105.0	11769	581	338	159
S_3- PE bensulfuron methyl + pretilachlor 660 gm/ha on 3 DAT + POE bispyribac sodium 25 gm/ha on 25 DAT	104.0	11896	572	329	150
S_4- HW twice at 25 and 45 DAT	111.1	12075	563	318	146
S_5- Unweeded Control	101.2	9263	463	233	116
SEd	2.9	415	25	10	6
CD (P=0.05)	5.9	846	51	21	13

PE: Pre Emergence, POE: Post Emergence, HW: Hand Weeding

Table 3: Evaluation of sequential herbicide application on grain yield and economics of transplanted paddy under sodic soil

Treatment	Grain yield (Kg/ha)	Net return (Rs/ha)	B:C ratio
Main plots (Pre plant application)			
M_1- Glyphosate 2.50 kg/ha	4232	54391	2.51
M_2- Glufosinate ammonium 1.00 kg/ha	4145	51198	2.39
M_3- Halosulfuron methyl 67.5 gm/ha	3959	44399	2.10
M_4- Control	3565	40665	2.11
SEd	110	-	-
CD (P=0.05)	269	-	-
Sub plots (Weed management in paddy)			
S_1-PE bensulfuron methyl + pretilachlor 660 gm/ha on 3 DAT + one HW on 45 DAT	4143	51179	2.37
S_2-POE of bispyribac sodium 25 gm/ha on 15 DAT + one HW on 45 DAT	4327	53298	2.40
S_3-PE bensulfuron methyl + pretilachlor 660 gm/ha on 3 DAT + POE bispyribac sodium 25 gm/ha on 25 DAT	4299	53100	2.37
S_4- HW twice at 25 and 45 DAT	4187	49155	2.25
S_5- Unweeded Control	2923	31585	2.00
SEd	101	-	-
CD (P=0.05)	206	-	-

PE: Pre Emergence, POE: Post Emergence, HW: Hand Weeding

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