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Development of Efficient Weed Management Practices for Drilled Paddy Production under Gujarat condition

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ABSTRACT

To study the weed management in drilled paddy an experiment was conducted at Agriculture Research Station, Anand Agricultural University, Derol Dist: panchmahal, Gujarat during *kharif* seasons of the years 2012-13, 2013-14, 2014-15 and 2015-16. Ten treatments for weed management were studied in randomized block design with four replications. Results that all the growth and yield attributes except plant height and test weight were significantly influenced due to different weed control treatments. The grain and straw yield of drilled paddy were also altered significant due to weed control treatments. In general, T_2 (two hand weeding at 20 and 40 DAS) recorded the highest yield among all. It was, however, at par with three other treatments which included pre and post emergence application of herbicides. Since, the application of Oxadiargyl @ 90 g/ha *f/b* Bisbyribac sodium @ 25 g/ha at 20 DAS is one among the dual application of herbicide, it can be recommended for drilled paddy in options of two hand weeding.

KEYWORDS
Drilled paddy, Herbicide, Weed control

INTRODUCTION

Rice (*Oryza sativa* L.) is a member of poaceae family and is relished as staple food by majority of world's population. In India, rice occupied 39.16 million hectares (m ha) area with a production of 85.59 million tone and average yield 2.2 t/ha (*Anonymous, 2013*). In India, rice is the foremost cereal crop occupying an area of about 48 million hectares with an annual production of 88.2 million tons (Singh *et al.*, 2013). Though India occupies about 28.6 per cent of Worlds rice acreage but its contribution towards world rice basket is only about 15 percent, which is mainly due to the low productivity (1.74 t ha-1) as compared to asses morpho-physiological trait of some promising rice entries(Singh *et al.*, 2012). Total area under rice cultivation is 438.56 lakh ha and productivity is 2390 kg/ha in Gujarat. Rice is the staple food of the tribal people of middle Gujarat. Though Gujarat has considerable area of upland rice its production is very low. Heavy weed infestation in drilled paddy is one of the important factors responsible for remarkable reduction in yield (Kumar *et al.*, 2013). Weeds offer competition to crop plants for nutrients, solar radiation and water and results in 50-60 per cent reduction in yield (Kumar *et al.*, 2016). The conventional method of weed control is very laborious and expensive. The screening of herbicides is therefore essential to provide an effective weed management measures for drilled paddy. Keeping this in view the present experiment is proposed.

MATERIALS AND METHODS

The experiment was carried out to study the Weed management in drilled paddy. The experiment was conducted at Agriculture Research Station, Anand Agricultural University, Derol, Dist: Panchmahal, Gujarat during *kharif* seasons of the years 2012-13, 2013-14 ,2014-15 and 2015 -16. Ten treatments of weed management for likewise, T_1: Un weeded control,T_2: Hand weeding twice at 20 & 40 DAS,T_3 : Pretilachlor 50 EC @ 750 g/ha at 7 DAS, T_4 : T_3 *f/b* Fenoxoprop-p-ethyl @ 70g/ha at 30DAS, T_5 : T_3 *f/b* Bisbyribac sodium @ 25 g/ha at 20 DAS, T_6 : T_3 *f/b* Pyrazosulfuron @ 25 g/ha at 25 DAS, T_7 : Oxadiargyl @ 90 g/ha as PE,T_8 : T_7 *f/b* Fenoxoprop-p-ethyl @70 g/ha at 30DAS, T_9: T_7 *f/b* Bisbyribac sodium @25 g/ha at 20 DAS and T_{10} : T_7 *f/b* Pyrazosulfuron @ 25 g/ha at 25 DAS were studied. The experiment was laid out in Randomized Block design with four replications. The plot size was 5.0 m x 3.0 m. The soil of the experimental field was sandy loam in texture having Medium in nitrogen, high in phosphorus and high in potassium. Pretilachlor and Oxadiargyl was applied as pre emergence while fenoxaprop-p-ethyl, Bisbyribac sodium and Pyrazosulfuron were applied as post emergence with flat fan nozzle using 500 litre water per hectare. The recommended dose of NPK and plant protection schedule was followed as per general recommendations. Data on weed count and dry biomass, crop growth and yield were recorded. Observation recorded. Weed control efficiency and benefit cost ratio were calculated. Weed data were square-root transformed before statistical analysis. Pooled analysis of four years was done and comparison was made at 5% level of significance.

RESULTS AND DISCUSSION

Weed count and weed dry biomass

The experimental field was infested with *Echinochloa crusgalli, Eragrostis major, Phyllanthus niruri, Eleusine indica, Digera arvensis, Dactyloctenium aegyptium, Cyperus iria* and *Boerhavia diffusa.* Weed count and weed dry weight (group wise) recorded at harvest revealed that significantly the lowest monocot, dicot and total weeds/m^2 were recorded in T_2 during in pooled analysis (Table 1).

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Table 1: Number of monocot, dicot and total weeds / m^2 as influenced by different treatments at harvest (Pooled data four year)

Treatments	Monocot weed	Dicot weed	Total weed
Un weeded control	4.3[a]	3.3[a]	5.4[a]
	(18.6)	(11.3)	(29.8)
Hand weeding twice (20 & 40 DAS)	2.2[e]	1.6[d]	2.7[d]
	(4.9)	(2.6)	(7.6)
Pretilachlor @ 750 g/ha at 7 DAS	3.5[bc]	2.5[b]	4.2[b]
	(12.7)	(6.6)	(18.1)
T3 *f/b* Fenoxoprop-p-ethyl @ 70 g/ha at 30 DAS	3.3[c]	2.5[b]	4.1[b]
	(10.8)	(6.6)	(17.4)
T3 *f/b* Bisbyribac sodium @ 25 g/ha at 20 DAS	2.7[d]	2.1[c]	3.3[c]
	(7.7)	(4.4)	(11.6)
T3 *f/b* Pyrazosulfuron @ 25 g/ha at 25 DAS	3.4[bc]	2.5[b]	4.3[b]
	(11.9)	(6.5)	(18.4)
Oxadiargyl @ 90 g/ha as PE	3.8[b]	2.5[b]	4.6[b]
	(14.6)	(6.4)	(21.1)
T7 *f/b* Fenoxoprop-p-ethyl @ 70 g/ha at 30 DAS	3.3[bc]	2.4[b]	4.2[b]
	(12.1)	(6.1)	(18.2)
T7 *f/b* Bisbyribac sodium @ 25 g/ha at 20 DAS	2.8[d]	2.0[c]	3.4[c]
	(8.1)	(4.1)	(11.8)
T7 *f/b* Pyrazosulfuron @ 25 g/ha at 25DAS	3.3[bc]	2.5[b]	4.2[b]
	(11.8)	(6.5)	(18.3)
S. Em. ±	0.13	0.11	0.13
F Test. **5 %**	Sig.	Sig.	Sig.
C.V. %	15.91	17.80	12.40
	0.26	0.21	0.25
	NS	NS	NS

Figures outside the parenthesis are square root transformed values and those inside are re-transformed values.
Treatment means followed by the same letter do not differ significantly by DNMRT at 5 per cent level of significance

Same trend was noticed in the case of dry weight of monocot, dicot and total weed kg/net plot (Table 2). The weed control efficiency was calculated and presented in (Table 2). The weed control efficiency of total weed was 82% in treatment T_2 (hand weeding carried out at 20 and 40 DAS). Walia *et al.* (2008) also reported that bisbyribac sodium and other pre-emergence herbicides, pretilachlor and oxadiargyl did not control these grass weeds. Similar results were reported by Kumar and Ladha (2011). Follow up spray of bisbyribac sodium after pretilachlor and oxadiargyl resulted in significantly lower weed dry biomass than alone application of pre-emergence herbicides, resulting in higher weed control efficiency. Single application of pre-emergence herbicides showed lower weed control efficiency (Table 2) (Kumar *et al.*, 2016).

Effects on growth and yield attributes

Effect of different weed control treatments on Initial plant stand was not influenced due to different weed control treatments in pooled analysis (Table 3), plant height of drilled paddy was not found significant during pooled analysis plant height was found significant (Table 3). The effect of different weed control treatments on number of tillers and panicles per m row length was found significant in in pooled analysis (Table 3). Among the different treatments, T_2 recorded significantly the highest number of tillers and panicles per m row length (Kumar *et al.*, 2016).

Table 2: Dry weight of monocot, dicot and total weeds (kg / net plot)as influenced by different treatments at harvest (Pooled data four year)

Treat. No.	Treatments	Monocot weed	Dicot weed	Total weed	WCE at harvest (%)
T1	Un weeded control	1.627[a]	0.710[a]	1.779[a]	-
		(2.726)	(0.526)	(3.253)	
T2	Hand weeding twice (20 & 40 DAS)	0.689[g]	0.318[f]	0. 766[e]	82
		(0.492)	(0.107)	(0.599)	
T3	Pretilachlor @ 750 g/ha at 7 DAS	1.260[b]	0.589[ab]	1.395[b]	37
		(1.691)	(0.360)	(2.051)	
T4	T3 *f/b* Fenoxoprop-p-ethyl @ 70 g/ha at 30 DAS	1.060[ef]	0.521[bcde]	1.185[d]	53
		(1.241)	(0.295)	(1.536)	
T5	T3 *f/b* Bisbyribac sodium @ 25 g/ha at 20 DAS	1.039[f]	0.418[def]	1.128[d]	57
		(1.206)	(0.178)	(1.385)	
T6	T3 *f/b* Pyrazosulfuron @ 25 g/ha at 25 DAS	1.118[d]	0.555[bc]	1.250[cd]	46
		(1.400)	(0.352)	(1.752)	
T7	Oxadiargyl @ 90 g/ha as PE	1.235[b]	0.563[bc]	1.365[bc]	41
		(1.601)	(0.329)	(1.929)	
T8	T7 *f/b* Fenoxoprop-p-ethyl @ 70 g/ha at 30 DAS	1.016[f]	0.538[bcd]	1.156[d]	56
		(1.115)	(0.321)	(1.436)	
T9	T7 *f/b* Bisbyribac sodium @ 25 g/ha at 20 DAS	1.176[c]	0.401[ef]	1.247[cd]	48
		(1.538)	(0.163)	(1.701)	
T10	T7 *f/b* Pyrazosulfuron @ 25 g/ha at 25DAS	1.113[de]	0.438[cdef]	1.203[d]	53
		(1.344)	(0.199)	(1.543)	
	S. Em. ±	0.04	0.02	0.04	-
	F Test. **5 %**	Sig.	Sig.	Sig.	-
	C.V. %	14.72	13.37	12.31	-
	Y x T S. Em. ±	0.08	0.03	0.08	
	F Test. **5 %**	Sig.	Sig.	Sig.	-

Figures outside the parenthesis are square root transformed values and those inside are re-transformed values.
Treatment means followed by the same letter do not differ significantly by DNMRT at 5 per cent level of significance.

Table 3: Growth and yield attributes Plant height (cm) of drilled paddy as influenced by different treatments at harvest (Pooled data four year)

Treat. No.	Treatments	Initial plant stand per m row length	Plant height (cm)	Number of tillers per m row length	Number of panicles per m row length
T_1	Un weeded control	20.0	96.13^{d}	38.23^{f}	32.59^{c}
T_2	Hand weeding twice (20 & 40 DAS)	19.9	104.11^{a}	53.81^{a}	45.96^{a}
T_3	Pretilachlor @ 750 g/ha at 7 DAS	20.2	101.11^{abc}	44.44^{c}	38.75^{b}
T_4	T_3 *f/b* Fenoxoprop-p-ethyl @ 70 g/ha at 30 DAS	20.3	101.28^{ab}	46.01^{bc}	39.39^{b}
T_5	T_3 *f/b* Bisbyribac sodium @ 25 g/ha at 20 DAS	19.9	103.19^{a}	47.80^{bc}	42.31^{ab}
T_6	T_3 *f/b* Pyrazosulfuron @ 25 g/ha at 25 DAS	20.4	103.14^{a}	44.26^{cd}	38.96^{b}
T_7	Oxadiargyl @ 90 g/ha as PE	20.6	103.21^{a}	45.77^{bc}	39.89^{b}
T_8	T_7 *f/b* Fenoxoprop-p-ethyl @ 70 g/ha at 30 DAS	20.6	102.78^{a}	43.84^{cde}	39.04^{b}
T_9	T_7 *f/b* Bisbyribac sodium @ 25 g/ha at 20 DAS	19.9	103.18^{a}	49.53^{ab}	42.81^{ab}
T_{10}	T_7 *f/b* Pyrazosulfuron @ 25 g/ha at 25DAS	20.5	103.39^{a}	45.03^{bc}	39.31^{b}
	S. Em. ±	0.50	1.64	1.54	1.60
	F Test. **5 %**	NS	Sig.	Sig.	Sig.
	C.V. %	9.96	7.01	10.50	11.05
	Y x T S. Em. ±	1.02	3.58	2.41	2.21
	F Test. **5 %**	NS	NS	Sig.	Sig.

Treatment means followed by the same letter do not differ significantly by DNMRT at 5 per cent level of significance.

The effect of different weed control treatments on panicle length was found non-significant in pooled analysis (Table 4). In pooled analysis, T_2 recorded maximum panicle length and it was closely followed by T_9. The effect of different weed control treatments on number of grains per panicle was found significant in pooled analysis (Table 4). In all; T_2 produced significantly higher number of grains per panicle as compared to rest of treatments. Test weight was not altered due to different weed control treatments in in pooled analysis (Table 3). Grain and straw yield of drilled paddy was influenced

Table 4: Growth and yield attributes Plant height (cm) of drilled paddy as influenced by different treatments at harvest (Pooled data four year)

Treat. No.	Treatments	Panicle length (cm)	Number of grain per panicle	Test weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
T_1	Un weeded control	20.10^{c}	94.17^{c}	23.88	1131^{f}	2222^{d}
T_2	Hand weeding twice (20 & 40 DAS)	23.85^{a}	121.59^{a}	25.37	2103^{a}	3919^{a}
T_3	Pretilachlor @ 750 g/ha at 7 DAS	21.98^{b}	104.88^{bc}	24.28	1550^{e}	2930^{c}
T_4	T_3 *f/b* Fenoxoprop-p-ethyl @ 70 g/ha at 30 DAS	23.08^{ab}	111.78^{ab}	24.38	1849^{abcd}	3105^{c}
T_5	T_3 *f/b* Bisbyribac sodium @ 25 g/ha at 20 DAS	23.02^{ab}	113.99^{ab}	24.86	1981^{abc}	3469^{abc}
T_6	T_3 *f/b* Pyrazosulfuron @ 25 g/ha at 25 DAS	22.73^{ab}	111.40^{ab}	24.67	1797^{bcde}	3402^{abc}
T_7	Oxadiargyl @ 90 g/ha as PE	22.75^{ab}	114.18^{ab}	25.36	1721^{cde}	3243^{bc}
T_8	T_7 *f/b* Fenoxoprop-p-ethyl @ 70 g/ha at 30 DAS	22.74^{ab}	110.81^{ab}	25.00	1697de	3376^{abc}
T_9	T_7 *f/b* Bisbyribac sodium @ 25 g/ha at 20 DAS	23.10^{ab}	117.86^{a}	24.72	2036^{ab}	3808^{ab}
T_{10}	T_7 *f/b* Pyrazosulfuron @ 25 g/ha at 25DAS	22.41^{b}	112.08^{ab}	25.12	1815^{bcde}	3439^{abc}
	S. Em. ±	0.395	3.89	0.35	84.2	177.1
	F Test. **5 %**	Sig.	Sig.	NS	Sig.	Sig.
	C.V. %	7.30	8.72	6.00	14.18	14.67
	Y x T S. Em. ±	0.82	4.85	0.74	125.4	241.4
	F Test. **5 %**	NS	Sig.	NS	Sig.	Sig.

Treatment means followed by the same letter do not differ significantly by DNMRT at 5 per cent level of significance.

significantly due to different weed control treatments during in pooled analysis (Table 4). During in pooled analysis, treatment T_2 (hand weeding twice) recorded the highest grain and straw yield among all. On pooled basis, it was at par with T_9 and T_5, in case of grain yield and at par with T_9, T_5, T_{10}, T_6 and T_8 in case of straw yield. Better crop growth in these treatments might be due to attributed to more availability of nutrients, water, light and space to crop as a result of effective weed control. Follow-up application of bisbyribac sodium significantly more grain and straw yield as compared with single application of pre-emergence herbicides. These results are conformity with the finding of Walia *et al.*(2009) and Mahajan and Timsina (2011). The difference in yield might be due to differences in application mode and efficacy of herbicides against weed species (Kumar *et al.*, 2016).

ECONOMICS

The economics of different treatments was worked on the basis of average production and present market price of inputs (Table 5). Among the different treatments, two hand weedings remunerated maximum net income of Rs. 22110/ha along with BCR value of 1.49 and it was closely followed by the treatment T_9 (Oxadiargyl @ 90 g a.i./ha as pre-emergence followed Bisbyribac sodium @ 25 g/ha at 20 DAS) which remunerated net income of Rs. 19875/ha along with BCR value of 1.24 (Kumar *et al.*, 2016).

Table 5: Yield and economics of drilled paddy as influenced by weed management practices

Treat. No.	Treatment	Grain Yield (Kg/ha)	Straw Yield (Kg/ha)	Gross Return (Rs/ha)	Cost of cultiva-tion (Rs/ha)	Net Return (Rs/ha)	BC ratio	WCE at harvest (%)
T1	Un weeded control	1131	2222	20238	10383	9855	0.95	-
T2	Hand weeding twice (20 & 40 DAS)	2103	3919	36993	14883	22110	1.49	82
T3	Pretilachlor @ 750 g/ha at 7 DAS	1550	2930	27390	11913	15477	1.30	37
T4	T_3 *f/b* Fenoxoprop-p-ethyl @ 70 g/ha at 30 DAS	1849	3105	31503	13605	17898	1.32	53
T5	T_3 *f/b* Bisbyribac sodium @ 25 g/ha at 20 DAS	1981	3463	34161	15951	18210	1.14	57
T6	T_3 *f/b* Pyrazosulfuron @ 25 g/ha at 25 DAS	1797	3402	31770	13588	18182	1.34	46
T7	Oxadiargyl @ 90 g/ha as PE	1721	3243	30381	11943	18438	1.54	41
T8	T_7 *f/b* Fenoxoprop-p-ethyl @ 70 g/ha at 30 DAS	1697	3376	30492	13635	16857	1.24	56
T9	T_7 *f/b* Bisbyribac sodium @ 25 g/ha at 20 DAS	2036	3808	35856	15981	19875	1.24	48
T10	T_7 *f/b* Pyrazosulfuron @ 25 g/ha at 25DAS	1815	3439	32097	13618	18479	1.36	53

Price of produce :
Paddy grain : Rs. 12/k g
Paddy straw : Rs. 3/kg

Cost of inputs :
Urea : Rs 300/50kg
DAP:Rs1250/50kg.

BC ratio = $\frac{\textbf{Net return}}{\text{Cost of cultivation}}$

Herbicide application Rs. 600/ha
HW : = Rs. 4500/ha

Cost of Inputs: Pretilachlor @ 750 g/ha (Rifit 50 EC) @ 1.5 lit/ha x Rs. 620/lit = Rs.930/ha
Fenoxoprop-p-ethyl @ 70 g/ha (Whip Super 9.3 EC) @ 0.753 lit/ha x Rs. 1450/lit = Rs.1092/ha
Bisbyribac sodium @ 25 g/ha (Nominee Gold 10% SC) @ 0.250 lit/ha x Rs. 13750/lit = Rs.3438/ha
Pyrazosulfuron @ 25 g/ha (Saathi 10% WP) @ 0.250 lit/ha x Rs. 4300/lit = Rs.1075/ha
Oxadiargyl @ 90 g/ha (Topstar 80 WP) @ 0.113 kg/ha x Rs. 8500/kg = Rs.960/ha

CONCLUSION

It can be concluded from the above results that all the growth and yield attributes except plant height and test weight were significantly influenced due different weed control treatments. The grain and straw yield of drilled paddy were also altered significant due to weed control treatments. In general, T_2 (two hand weedings at 20 and 40 DAS) recorded the highest yield among all. It was, however, at par with three other treatments which included pre and post emergence application of herbicides. Since, the application of Oxadiargyl @ 90 g/ha f/b Bisbyribac sodium @ 25 g/ha at 20 DAS is one among the dual application of herbicide, it can be recommended for drilled paddy in options of two hand weeding.

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