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Economically beneficial weed control practices for direct seeded rice under rainfed condition

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Abstract
A field experiment entitled "studies on economical weed control in direct seeded rice under rainfed condition" was conducted at agricultural college farm, Rajendranagar, Hyderabad, during *kharif*, 2010. The higher grain yield was obtained with T_5– [Cyhalofop-butyl+ (Chlorimuron-ethyl+ Mestulfuron-methyl) @ 90+20 g ha^{-1}] and it was found at par with T_8–(Fenoxaprop-p-ethyl + Ethoxysulfuron @ 60+15 g ha^{-1}), and also with farmers practice i.e. T_{10}–(Two Hand weedings at 20 and 40 DAS). N, P and K uptake by grain at harvest was significantly more in T_{10}–(Two Hand weedings at 20 and 40 DAS) followed by T_5–[Cyhalofop-butyl+ (Chlorimuron-ethyl+ Metsulfuron-methyl) @ 90+20 g ha^{-1}]. Both T10 and T5 were significantly superior to other weed control treatments. The highest gross (Rs.41256), net returns (Rs.24369) and BCR (2.44) were recorded by T_5–[Cyhalofop-butyl+ (Chlorimuron-ethyl+Metsulfuron-methyl) @ 90+20 g ha^{-1}].

Keywords: Economically beneficial weed, seeded rice, rainfed condition

1. Introduction
Rice (*Oryza sativa* L.) is the major food crop for the more than half of the global population and will continue to occupy the pivotal place in global food and livelihood security system. Hence called as ''Global Grain'' it is the staple cereal food grain of majority of India's over one billion population, contributes to nearly 44% of total food grain production. The production of conventional puddle transplanted rice faces severe constraints because of water and labour scarcity and climatic changes (Pathak *et al*., 2011) [4]. Imminent water crisis, water demanding nature of traditionally cultivated rice and climbing labour costs, ramble the search for alternative management methods to increase water productivity, system sustainability and profitability. Direct seeded rice (DSR) technique is becoming popular nowadays because of its low input demanding nature. Weeds are major biological constraints to obtain optimum yield and productivity (Rao and Nagamani, 2013) [6] and it causes yield loses from 15 to 76 % in rice (Mishra *et al.*, 2012).

2. Materials and Methods
Field experiment was conducted at the college farm, ANGRAU Rajendranagar, Hyderabad during *kharif* season of 2010-11. To find the best weed control practice in direct seeded rice. The farm is located at an altitude of 542.6 m above mean sea level with geographical bearing of 78º 21' E longitude and 17º 19' N latitude. The soil of the experimental field was sandy clay loam in texture with in moderate drainage. Composite soil samples were collected prior to the experiment and analyzed for various physical and chemical characteristics. The soil was low in available nitrogen (230 kg ha^{-1}), high in available phosphorus (28 kg ha^{-1}) and medium in available potassium (86 kg ha^{-1}), contents. The pH was 7.8 of the soil. The field experiment was comprises of eleven treatments of weed management practicesT_1–(Pyrzosulfuron-ethyl @ 25 g ha^{-1}), T_2-(Pretilachlor-S @ 750 g ha^{-1}), T_3-(Cyhalofop-butyl @ 90 g ha^{-1}), T_4–(Fenoxaprop-p-ethyl @ 60 g ha^{-1}),T_5–[Cyhalofop-buty+ (chlorimuron-ethyl+mestulfuron-methyl) @ 90+20 g ha^{-1}], T_6–[Fenoxaprop-p-ethyl + (chlorimuron-ethyl+mestulfuron-methyl) @ 60+20 g ha^{-1}], T_7-(Bispyribac sodium @ 25 g ha^{-1}), T_8–(Fenoxaprop-p-ethyl + Ethoxysulfuron @ 60+15 g ha^{-1}), T_9-(Oxyfluorfen followedby 2,4-D @ 300 fb 0.5 g ha^{-1}), T_{10}–(Two Hand weedings at 20 and 40 DAS) and T11 - Weedy check. The experiment was laid out in a randomized block design with three replications.
Medium duration rice variety MTU-1010 was used in the present experiment the good quality seeds were sown @ 100 kg ha^{-1}, by adopting a spacing of 15 x 10 cm. The crop was sown on 5th August 2010.

One light irrigation was given immediately after sowing for proper germination and establishment. Biometric observations were recorded both on weed and crop at different stages. For the purpose of recording data on weed and crop, one square meter area in each net plot was randomly demarcated.

3. Results and Discussion

The weed flora associated with experimental crop consisted of grasses *viz; Echinochloa colona, Echinochloacrusgalli*, *Cynadondactylon*, *Digitariasangunalis*, sedges *viz; Cyperusrotundus*, *Cyperusdifformis* and broad leaf weeds *viz; Phyllanthusniruri*, *Physalis minima*, *Alternanthrasessillis*, *Commelina bengalensis*, *Digeraarvensis*, *Celosia argentina*, *Parthiniumhysterophorus*, *Cleom viscose* and *Eclipta alba*. Among these, broad leaf weeds are dominant weeds followed by sedges and grasses in dry seeded rainfed rice.

Significantly lower weed density was recorded by T_5-[Cyhalofop-butyl+ (Chlorimuron-ethyl+ Metsulfuron-methyl) @ 90+20 g ha-1] (15.33) at harvest recorded less weed density at harvest but the weed dry weight was very high due to the predominance of broad leaf weed species like *Celosia argentia*, *Parthenium hysterophorus*, *Alternanthrasessillis*, *Cleome viscose* which contributed more dry weight. Similar results were reported by Ramaiah and Krishnan, (1992) [5] in direct seeded semi dry rice and Riaz *et al*. (2007) [7] in direct seeded rice crop.

The treatments T_5–[Cyhalofop-butyl+ @ 90+20 g ha^{-1}], T_6–[Fenoxaprop-p-ethyl + (Chlorimuron-ethyl+Metsulfuron-methyl) @ 60+20 g ha^{-1}], T_7–(Bispyribac sodium @ 25 g ha^{-1}) and T_9–(Oxyfluorfen fb 2,4-D @ 300 fb 500g ha^{-1}) maintained their superiority in terms of plant height, number of tillers per m^2 by effectively controlling weeds over other treatments. Among all chemical treatments T_4–(Fenoxaprop-p-ethyl @ 60 g ha^{-1}) (208.66) recorded the lowest number of tillers followed by T_3-(Cyhalofop-butyll @ 90 g ha^{-1}) (226.66), T_2–(Pretilachlor-S @ 750 g ha^{-1}) (238.33) and T_1–(Pyrzosulfuron-ethyl @ 25 g ha^{-1}) (236.33). The efficacy of those herbicides applied as early post emergence was reflected in tiller number at later crop growth stages. Similar results were reported by Saini *et al.* (2001) [8], and Bali *et al.* (2006) [1].

The results indicated that the treatment T_5–[Cyhalofop-butyl + (Chlorimuron-ethyl+ Metsulfuron-methyl) @ 90+20 g ha^{-1}] recorded maximum grain yield of 3820 kg ha^{-1} and remained at par with T_{10} –(Two hand weedings at 20 and 40 DAS) (3987 kg ha^{-1}) and found significantly superior to the rest of treatments. Next to T_5–[Cyhalofop-butyl + (Chlorimuron-ethyl+Metsulfuron-methyl) @ 90+20 g ha^{-1}], T_8–(Fenoxaprop-p-ethyl + Ethoxysulfuron @ 60+15 g ha^{-1}) (3464 kg ha^{-1}) followed by T_6–[Fenoxaprop-p-ethyl + (Chlorimuron-ethyl+ Metsulfuron-methyl) @ 60+20 g ha^{-1}] (3426 kg ha^{-1}), T_9–(Oxyfluorfen fb 2,4-D @ 300 fb 500g ha^{-1}) (3414 kg ha^{-1}) and T_7-(Bispyribac sodium @ 25 g ha^{-1}) (3387 kg ha^{-1}) recorded higher grain yield and also at par with each other. The lowest grain yield was obtained with T_{11} - Weedy check plot (1244 kg ha^{-1}). The maximum grain production by T_5–[Cyhalofop-butyl + (Chlorimuron-ethyl+ Metsulfuron-methyl) @ 90+20 g ha^{-1}] was due to its effectiveness in controlling weeds and improvement in the growth and development of crop and higher yield attributes of rice crop. Similar results were reported by Bali *et al*, (2006) [1], Saini, (2005), Mukherjee and Singh (2005) [3], Kathivelann and Vaiyapuri, (2004), Saini *et al*, Saini *et al*, (2001) [8], and Choubey*et al*. (2001)

4. Economics

The highest gross returns (Rs.41256), net returns (Rs.24369) and BCR (2.44) were obtained with T_5–[Cyhalofop-butyl + (Chlorimuron-ethyl + Metsulfuron-methyl) @ 90+20 g ha^{-1}] and were higher as compared to other weed control treatments. Next to T_5 T_8 – (Fenoxaprop-p-ethyl + Ethoxysulfuron @ 60+15 g ha^{-1}) gave better results. The performance of T5 and T8 was superior to the rest of the treatments. These two early post-emergence herbicides are suitable for controlling weeds in direct seeded rainfed rice and comparable to two hand weedings treatment. In the event of labour shortage and continuous rains, the herbicide Cyhalofop-butyl + (Chlorimuron-ethyl+Metsulfuron-methyl) could be used for effective weed control in direct seeded rainfed rice.

Table 2: Effect of weed control treatments on weed index (WI), grain yield (kg ha^{-1}) and B: C ratio of dry-seeded rainfed rice

S. no	Treatments	Time of application (DAS)	Dose (g ha^{-1})	Weed index (WI)	Grain yield (kg ha^{-1})	B:C Ratio
T_1	Pyrzosulfuron-ethyl	3-7	25	27.11	2906.00	2.08
T_2	Pretilachlor-S	0-5	750	27.58	2887.00	1.93
T_3	Cyhalofop-butyl	25	90	49.53	2012.00	1.36
T_4	Fenoxaprop-ethyl	30	60	50.06	1987.00	1.42
T_5	Cyhalofop-butyl + (Chlorimuron-ethyl + Mestulfuron methyl)	25-30	90+20	4.18	3820.00	2.44
T_6	Fenoxaprop-ethyl +(Chlorimuron-ethyl + Mestulfuron methyl)	25-30	60+20	14.07	3426.00	2.33
T_7	Bispyribac sodium	20	25	15.04	3387.00	2.24
T_8	Fenoxaprop-ethyl + Ethoxysulfuron	25-30	60+15	13.11	3464.00	2.33
T_9	Oxyfluorfen + 2,4-D	0-5 fb 30	300 fb 0.5	14.37	3414.000	2.38
T_{10}	Two Hand Weedings	20 and 40		0.00	3987.00	2.08
T_{11}	Weedy check	_		68.79	1244.00	0.96
	S.Em(+_)			-	107.32	-
	C.D (p=0.05)			-	318.83	-

5. Conclusions

Among the weed control treatments, the chemical treatment *i.e.* Cyhalofop - butyl + (Chlorimuron –ethyl + Metsulfuron methyl) @ 90+20 g ha^{-1} was found effective in controlling different weeds and recorded higher WCE of 82.13% in direct seeded rainfed rice. The early post-emergence herbicides were found effective as compared to pre-emergence herbicides for better growth of rice and higher grain yield. Among the early post-emergence herbicides, application of Cyhalofop-butyl + (Chlorimuron-ethyl+ Metsulfuron-methyl) @ 90+20 g ha^{-1} recorded at par grain yield with that of hand weeding treatment (at 20 and 40 DAS).

Cyhalofop-butyl + (Chlorimuron-ethyl+Metsulfuron-methyl) @ 90+20 g ha^{-1}] was found economically beneficial weed control practice and recorded maximum BCR (2.22) over two hand weedings treatment (2.08).

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