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Effect of New Herbicides and Herbicide Mixtures on Growth and Yield of Transplanted Rice

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A B S T R A C T

A field experiment entitled "Effect of new herbicides and herbicide mixtures on growth and yield of transplanted rice"was conducted during *kharif* season, 2019 at College farm, College of Agriculture, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad to evaluate the effect of different weed management practices on growth and yield of transplanted rice crop. The soil of the experimental site was sandy loam in texture, slightly alkaline in reaction, low in organic carbon, low in available nitrogen, medium in available phosphorus and high available potassium. The experiment was consisted of twelve treatments (weed management practices) laid out in randomized block design with three replications. The results revealed that among the different weed management practices significantly higher plant height, tillers, dry matter production, yield attributes and yield were recorded with hand weeding at 20 and 40 DAT, which was statistically on par with flopyrauxifen- benzyl + cyhalofop butyl 10% EC 150 g ha^{-1} (PoE) *fb* hand weeding at 40 DAT, penoxsulam 1.02% (20 g ha^{-1}) + cyhalofop butyl 5.1% OD (100 g ha^{-1}) (PoE) *fb* hand weeding at 40 DAT and flopyrauxifen- benzyl + penoxsulam 12% EC 40.64 g ha^{-1} (PoE) *fb* hand weeding at 40 DAT.

Introduction

Rice (*Oryza sativa L.)* is the most important staple food for more than half of the world population. The warm and humid climatic conditions are prevailing in most part of Asia are well suited to rice production. India is the world second largest producer (105.3 M t) covering an area of 43.10 m ha with productivity level of 2.38 t ha^{-1}. However, the productivity of rice in India is very low compared to other rice growing countries like China (7.3 t ha^{-1}), Australia (10.1 t ha^{-1}), U.S (7.5 t ha^{-1}) and Russia (5.2 t ha^{-1}) (Yadav *et al.*, 2019). Rice is cultivated in different ecosystems to increase production levels due to climate change. Though different ecosystems are emerging day by day but, transplanting is the most dominant and traditional method of rice cultivation under irrigation. Weeds are the major constraints in rice production. Transplanted rice is infested by heterogeneous type of weed flora which causes yield reduction about 33-45 percent

(Duray *et al.,* 2015). Hand weeding though efficient, it is expensive, time consuming, difficult task and often limited by scarcity of labour at critical period may lead to unsatisfactory weed control. To get rid this hurdle usage of herbicides offer a selective and economical control of weeds right from beginning of crop.

Due to continuous usage of same mode of action of herbicides like butachlor, pretilachlor etc. weed shift is observed in transplanted rice. Weed shift from grasses to broad-leaf weeds and sedges were observed in transplanted rice due to continuous use of same herbicides (Mohapatra *et al.,* 2017). All traditional herbicides are narrow spectrum of control and at the same time dosage of herbicides is more compare to new low dose herbicides and pre-mix herbicides and also cause herbicide residues in soil leads to environmental pollution. Keeping in this view the present experiment was conducted to study the effect of new herbicides and herbicide mixtures on growth and yield of transplanted rice.

Materials and Methods

A field experiment was conducted at College Farm, College of Agriculture Rajendranagar, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad during *Kharif*-2019. The farm is geographically situated at 17 ^{0}19' 16.4'' North latitude and 78^{0} 24' 43'' East longitudes and at an altitude of 542.3 m above mean sea level. According to troll's climatic classification, it falls under semi- arid tropics (SAT). The soil of experimental site was sandy loam in texture with p ^{H} of 7.85, low available nitrogen (235.2), medium phosphorus (38.8) and high potassium content (379). The experiment was consisted of twelve weed management practices laid out in randomized block design with three replications. RNR – 15048 (Telangana sona) variety was transplanted in main field on 8 th August at the age of 28 days old seedlings with a spacing of 15 X 10 cm. All pre-emergence herbicides were applied within three days after transplanting and post emergence herbicides treatments were applied at 2 – 3 leaf stage of weeds. During crop growing period (July 10 th to November 17th) a total rainfall of 693.5 mm received in 45 rainy days. The data on growth parameters and yield was recorded randomly selected five plants from net plot. The data was statistically analysed.

Results and Discussion

Growth parameters

The data related to growth parameters were significantly influenced by different weed management practices over un weeded control. The higher plant height, number of tillers and dry matter production were registered with hand weeding at 20 and 40 DAT which was statistically on par with flopyrauxifen- benzyl + cyhalofop butyl 10% EC 150 g ha^{-1} (PoE) *fb* hand weeding at 40 DAT, penoxsulam 1.02% (20 g ha^{-1}) + cyhalofop butyl 5.1% OD (100 g ha^{-1}) (PoE) *fb* hand weeding at 40 DAT and flopyrauxifen- benzyl + penoxsulam 12% EC 40.64 g ha^{-1} (PoE) *fb* hand weeding at 40 DAT. And these treatments superior over remaining treatments.

These treatments followed by pyrazosulfuron-ethyl 0.15 % @ 15 g ha $^{-1}$ + pretilachlor 6 % GR @ 600 g ha $^{-1}$ (PE) *fb* hand weeding at 30 DAT, orthosulfamuron + pretilachlor 6 % @ 600 g ha $^{-1}$ GR (PE) *fb* hand weeding at 30 DAT and penoxsulam 0.97 % @ 20 g ha $^{-1}$ + butachlor 38.8 % SE @ 820 g ha $^{-1}$ (PE) *fb* hand weeding at 30 DAT and they were on par with each other. Then followed by ipfencarbazone 25 % SC @ 156.25 g ha $^{-1}$ (PE) *fb* hand weeding at 30 DAT, penoxsulam

2.65 % OD @ 25 g ha $^{-1}$ (PoE) *fb* hand weeding at 40 DAT, bispyribac-sodium 10% SC 25 g ha $^{-1}$ (PoE) *fb* hand weeding at 40 DAT and pretilachlor (PE) 50 % EC @ 0.75 kg ha $^{-1}$ *fb* 2,4 – D 1.0 kg ha $^{-1}$ (PoE). Un weeded control plot recorded significantly lower plant height, number of tillers and dry matter production. Among the weed management practices application of herbicide mixture *fb* hand weeding recorded higher growth parameters compared to single herbicides *fb* hand weeding. This might be due to control of complex weed flora in time and avoids competition so, resulted in higher tillers and crop dry matter production. These results were in line with Yakadri *et al.*, (2016) and Rana *et al.*, (2018).

Table.1 Effect of new herbicides and herbicide mixtures on growth parameters of transplanted rice

Treatments	Plant height (cm)	No. of tillers (No. m $^{-2}$)	Dry matter (Kg ha $^{-1}$)
T_1 - Penoxsulam 0.97% (20 g ha^{-1}) + butachlor (38.8%) SE 820 g ha^{-1} (PE) *fb* HW at 30 DAT	94.7	354	13375
T_2 - Pyrazosulfuron-ethyl 0.15 % (15 g ha^{-1}) + pretilachlor 6% GR (600g ha^{-1}) (PE) *fb* HW at 30 DAT	97.0	370	13517
T_3 - Orthosulfamuron + pretilachlor 6% (600g ha^{-1}) GR (PE) *fb* HW at 30 DAT	95.8	364	13453
T_4 - Ipfencarbazone 25 % SC 156.25 g ha^{-1} (PE)*fb* HW at 30 DAT	89.7	338	12568
T_5 - Penoxsulam 2.65 % OD 25 g ha^{-1} (PoE) *fb* HW at 40 DAT	89.0	330	12474
T_6 - Penoxsulam 1.02% (20 g ha^{-1}) + cyhalofop butyl 5.1% OD (100 g ha^{-1}) (PoE) *fb* HW at 40 DAT	100.8	394	14663
T_7 - Pretilachlor 50 % EC 0.75 kg ha^{-1}(PE) *fb* 2,4 D 1.0 kg ha^{-1} (PoE)	87.7	319	11835
T_8 - Bispyribac sodium 10% SC 25 g ha^{-1} (PoE) *fb* HW at 40 DAT	88.5	326	12167
T_9 - Flopyrauxifen- benzyl + penoxsulam 12% EC 40.64 g ha^{-1} (PoE) *fb* HW at 40 DAT	99.3	391	14448
T_{10} - Flopyrauxifen- benzyl + cyhalofop butyl 10% EC 150 g ha^{-1} (PoE) *fb* HW at 40 DAT	104.5	401	14953
T_{11} - Hand weeding at 20 and 40 DAT	105.0	412	15014
T_{12} - Unweeded control	86.3	209	7732
SE(m)±	2.36	7.43	254.58
CD (P=0.05)	6.93	21.8	746.5

Table.2 Effect of new herbicides and herbicide mixtures onyield attributes and yield of transplanted rice

Treatments	No of productive tillers m $^{-2}$	No. of filled grains panicle $^{-1}$	Test weight (g)	Grain yield (kg ha $^{-1}$)	Straw yield (kg ha $^{-1}$)
T_1 - Penoxsulam 0.97% (20 g ha^{-1}) + butachlor (38.8%) SE 820 g ha^{-1} (PE) *fb* HW at 30 DAT	325	140	12.90	5931	7004
T_2 - Pyrazosulfuron-ethyl 0.15 % (15 g ha^{-1}) + pretilachlor 6% GR (600g ha^{-1}) (PE) *fb* HW at 30 DAT	334	144	13.00	6016	7045
T_3 - Orthosulfamuron + pretilachlor 6% (600g ha^{-1}) GR (PE) *fb* HW at 30 DAT	327	141	13.00	5977	7015
T_4 - Ipfencarbazone 25 % SC 156.25 g ha^{-1} (PE)*fb* HW at 30 DAT	315	130	12.87	5524	6471
T_5 - Penoxsulam 2.65 % OD 25 g ha^{-1} (PoE) *fb* HW at 40 DAT	313	127	12.80	5497	6425
T_6 - Penoxsulam 1.02% (20 g ha^{-1}) + cyhalofop butyl 5.1% OD (100 g ha^{-1}) (PoE) *fb* HW at 40 DAT	351	157	13.07	6985	7818
T_7 - Pretilachlor 50 % EC 0.75 kg ha^{-1}(PE)*fb* 2,4 D 1.0 kg ha^{-1} (PoE)	307	122	12.09	5262	6187
T_8 - Bispyribac sodium 10% SC 25 g ha^{-1} (PoE) *fb* HW at 40 DAT	308	124	12.80	5333	6282
T_9 - Flopyrauxifen- benzyl + penoxsulam 12% EC 40.64 g ha^{-1} (PoE) *fb* HW at 40 DAT	348	155	13.03	6867	7715
T_{10} - Flopyrauxifen- benzyl + cyhalofop butyl 10% EC 150 g ha^{-1} (PoE) *fb* HW at 40 DAT	355	161	13.20	7045	7921
T_{11} - Hand weeding at 20 and 40 DAT	356	162	13.23	7120	7992
T_{12} - Unweeded control	225	118	12.40	3110	4219
SE(m)±	6.04	3.73	11.00	146.3	171.54
CD (P=0.05)	17.73	10.95	NS	429.0	503.02

Table.3 Effect of new herbicides and herbicide mixtures on weed density and dry weight at 30 DAT

Treatments	Weed density (No. m^{-2})	Weed dry weight (g m^{-2})
T_1 - Penoxsulam 0.97% (20 g ha^{-1}) + butachlor (38.8%) SE 820 g ha^{-1} (PE) *fb* HW at 30 DAT	4.5(19.0)	3.9 (14.5)
T_2 - Pyrazosulfuron-ethyl 0.15 % (15 g ha^{-1}) + pretilachlor 6% GR (600g ha^{-1}) (PE) *fb* HW at 30 DAT	4.1(15.7)	3.8 (13.3)
T_3 - Orthosulfamuron + pretilachlor 6% (600g ha^{-1}) GR (PE) *fb* HW at 30 DAT	4.4(18.3)	3.9 (14.0)
T_4 - Ipfencarbazone 25 % SC 156.25 g ha^{-1} (PE)*fb* HW at 30 DAT	4.7(21.0)	4.2 (16.8)
T_5 - Penoxsulam 2.65 % OD 25 g ha^{-1} (PoE) *fb* HW at 40 DAT	5.0(23.7)	4.3 (18.0)
T_6 - Penoxsulam 1.02% (20 g ha^{-1}) + cyhalofop butyl 5.1% OD (100 g ha^{-1}) (PoE) *fb* HW at 40 DAT	3.3 (9.7)	2.9 (7.4)
T_7 - Pretilachlor 50 % EC 0.75 kg ha^{-1} (PE) *fb* 2,4 D 1.0 kg ha^{-1} (PoE)	5.1(25.0)	4.5 (19.2)
T_8 - Bispyribac sodium 10% SC 25 g ha^{-1} (PoE) *fb* HW at 40 DAT	5.0(24.3)	4.4 (18.6)
T_9 - Flopyrauxifen- benzyl + penoxsulam 12% EC 40.64 g ha^{-1} (PoE) *fb* HW at 40 DAT	3.3(10.0)	2.9 (7.7)
T_{10} - Flopyrauxifen- benzyl + cyhalofop butyl 10% EC 150 g ha^{-1} (PoE) *fb* HW at 40 DAT	3.1 (8.7)	2.7 (6.3)
T_{11} - Hand weeding at 20 and 40 DAT	2.8 (7.3)	2.6 (6.0)
T_{12} - Unweeded control	8.7(74.0)	8.2 (65.7)
SE(m)±	0.18	0.17
CD (P=0.05)	0.53	0.51

** Values in the parenthesis are original and ($\sqrt{x+1}$) transformed

Yield attributes and yield

Yield attributes and yield significantly influenced by different weed management practices. Higher number of productive tillers m $^{-2}$, number of filled grains panicle $^{-1}$, grain and straw yield were registered with hand weeding at 20 and 40 DAT which was statistically on par with the flopyrauxifen-benzyl + cyhalofop butyl 10% EC 150 g ha^{-1} (PoE) *fb* hand weeding at 40 DAT, penoxsulam 1.02% (20 g ha^{-1}) + cyhalofop butyl 5.1% OD (100 g ha^{-1}) (PoE) *fb* hand weeding at 40 DAT and flopyrauxifen- benzyl + penoxsulam 12% EC 40.64 g ha^{-1} (PoE) *fb* hand weeding at 40 DAT. These treatments followed by pyrazosulfuron-ethyl 0.15 % @ 15 g ha $^{-1}$ + pretilachlor 6 % GR @ 600 g ha $^{-1}$ (PE) *fb* hand weeding at 30 DAT, orthosulfamuron + pretilachlor 6 % @ 600 g ha $^{-1}$ GR (PE) *fb* hand weeding at 30 DAT and penoxsulam 0.97 % @ 20 g ha $^{-1}$ + butachlor 38.8 % SE @ 820 g ha $^{-1}$ (PE) *fb* hand weeding at 30 DAT and which were superior over remaining treatments. Then followed by ipfencarbazone 25 % SC @ 156.25 g ha $^{-1}$ (PE) *fb* hand weeding at 30 DAT, penoxsulam 2.65 % OD @ 25 g ha $^{-1}$ (PoE) *fb* hand weeding at 40 DAT, bispyribac-sodium 10% SC 25 g ha $^{-1}$ (PoE) *fb* hand weeding at 40 DAT and pretilachlor (PE) 50 % EC @ 0.75 kg ha $^{-1}$*fb* 2,4 – D 1.0 kg ha $^{-1}$ (PoE). Un weeded control plot recorded significantly lowernumber of yield attributes and yield. Weed management practices not only reduce weed density and dry matter allows the plant to use available resources which resulted in higher growth parameters and yield attributes ultimately led to higher yield over un weeded control. Similar reports were by Chowdhary and Dixit (2018), Singh *et al.,* (2019) and Ramesha *et al.,* (2019).

Weed density and weed dry weight

Lower total weed density and total weed dry weight at 30 DAT, was observed with hand weeding at 20 and 40 DAT and which was statistically comparable to the flopyrauxifen-benzyl + cyhalofop-butyl 10% EC 150 g ha $^{-1}$(PoE)*fb* hand weeding at 40 DAT, penoxsulam 1.02% @ 20 g ha $^{-1}$ + cyhalofop butyl 5.1 % OD @ 100 g ha $^{-1}$ (PoE) *fb* hand weeding at 40 DAT and flopyrauxifen-benzyl + penoxsulam 12 % EC @ 40.64 g ha $^{-1}$ (PoE)*fb* hand weeding at 40 DAT. These treatments followed pyrazosulfuron-ethyl 0.15 % @ 15 g ha $^{-1}$ + pretilachlor 6 % GR @ 600 g ha $^{-1}$(PE) *fb* hand weeding at 30 DAT, orthosulfamuron + pretilachlor 6 % @ 600 g ha $^{-1}$ GR (PE)*fb* hand weeding at 30 DAT and penoxsulam 0.97 % @ 20 g ha $^{-1}$ + butachlor 38.8 % SE @ 820 g ha $^{-1}$(PE)*fb* hand weeding at 30 DAT were recorded lower total weed density and weed dry weight than rest of treatments. Then followed by ipfencarbazone 25 % SC @ 156.25 g ha $^{-1}$(PE)*fb* hand weeding at 30 DAT, penoxsulam 2.65 % OD @ 25 g ha $^{-1}$ (PoE)*fb* hand weeding at 40 DAT, bispyribac-sodium 10% SC 25 g ha $^{-1}$(PoE)*fb* hand weeding at 40 DAT and pretilachlor (PE) 50 % EC @ 0.75 kg ha $^{-1}$*fb* 2,4 – D 1.0 kg ha $^{-1}$ (PoE) were on par with each other. Higher weed density and weed dry weight was recorded with un weeded control over all the treatments. Lower weed density in different weed management practices might be due to effective control of weeds Hossain and Mondal (2014) and Yadav *et al.*, (2019b).

In conclusion the hand weeding twice 20 and 40 DAT, Post emergence (2- 3 leaf stage of weeds) application of herbicide mixtures flopyrauxifen- benzyl + cyhalofop butyl 10% EC 150 g ha^{-1}, Penoxsulam 1.02% (20 g ha^{-1}) + cyhalofop butyl 5.1% OD (100 g ha^{-1}) and flopyrauxifen- benzyl + penoxsulam 12% EC 40.64 g ha^{-1} along with hand weeding at 40 DAT were effective in influencing of growth parameters, yield attributes and yield of transplanted rice.

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