EFFECT OF WEED MANAGEMENT PRACTICES ON NUTRIENT UPTAKE AND REMOVAL IN TRANSPLANTED RICE

Abstract

Different pre and post emergence herbicides, herbicide mixtures along with hand weeding in transplanted rice were evaluated at College Farm, College of Agriculture, Rajendranagar, Professor Jayashankar Telangana State Agricultural University. Higher nutrient uptake by grain and straw were recorded with application of flopyrauxifen-benzyl + cyhalofop-butyl 10% EC 150 g ha $^{-1}$(PoE)*fb* hand weeding at 40 DAT and lower nutrient removal by weeds were recorded with application of herbicide mixtures along with hand weeding than single herbicide application followed by hand weeding. Where as in case of unweeded control lower nutrient uptake and higher nutrient removal by weeds over all the treatments.

Key words: Nutrient uptake, Nutrient removal, Transplanted rice, Herbicide mixtures and Hand weeding

Introduction:

Rice crop suffers from various biotic and abiotic production constraints. Weed infestation has been established as one of the important biotic factor responsible for lower productivity. The degree of competition and extent of yield losses vary greatly with period of weed competition. Weed competition under transplanted conditions caused yield reductions up to 45% (Manhas *et al*. 2012). Weeds compete with crop plants for moisture, nutrients, light, space and other growth factors. Fertilizer usage in rice and its consumption has increased substantially in the past decades. The quantity of rice grain produced per unit of applied fertilizer (partial factor productivity) has constantly decreased to very low values (Hemalatha *et al*. 2020). It has been observed that more than 60% of applied fertilizer was taken up by weeds which results lower nutrient availability for crop (Puniya *et al*., 2007). And the quantity of nutrient losses due to weeds again depends on the period of weed growth but, control of weeds in transplanted rice at critical stages by hand weeding only is very difficult nowadays due to labour scarcity and higher wages. Usage of herbicides with single mode of action will not control broad spectrum of weeds. So, for control of these broad spectrum weeds we need to depends on herbicides mixtures with different modes action and integrated with hand weeding will results effective control of weeds, lower nutrient removal by weeds and higher nutrient uptake by crop. In this context we need investigate which herbicide mixture is most effective for control of weeds and higher nutrient use efficiency.

Material 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 8th 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. Weed and plant samples were collected for estimation of dry matter were used for nutrient analysis. These samples were dried and ground to fine powder using willey mill and can be used for analysis of uptake of nutrients by crop and nutrient removal by weeds. Nitrogen content (%) in the plant and weed samples were estimated by the micro kjeldhal method (Jackson, 1979) using Kelplus N analyser after digesting the samples with H_2SO4 and H_2O_2 (Piper, 1966). The tri-acid (HNO_3 and $HCLO_4$) in the ratio of (3:1) respectively digested plant and weed samples were analyzed for phosphorus and potassium. The data was statistically analyzed.

Results and discussion:

Effect on crop dry matter:

All the weed management practices significantly recorded higher crop dry matter production over control plot (Table:01). The higher 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. 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. Yadav *et al,* (2018).

Effect on nutrient uptake by grain and straw:

Higher nutrient uptake was noticed with herbicide mixture flopyrauxifen- benzyl + cyhalofop butyl 10% EC 150 g ha^{-1} (PoE) *fb* hand weeding at 40 DAT which is statistically on par with hand weeding at 20 and 40 DAT. Lower uptake of nutrient were recorded with un weeded control (Table: 1&2). In the present experiment, higher nutrient uptake by grain and straw due to better availability of resources that maintained the favorable environment for the crop with limited competition from weeds and availability of nutrients throughout the growth stages leading to better uptake of nutrients. The results were in accordance with findings of Singh *et al*. (2018) and Parameshwari *et al*. (2014). Phosphorus accumulation is more in grain compared to straw because of higher content organic compounds like inositol phosphate, phospholipids, nuclic acids and phosphoprotiens *etc* (Yamaji *et al*., 2017).

Effect on weed dry matter:

Higher weed dry weight was recorded with un weeded control over all the treatments and lower weed dry weight was noticed with application of broad spectrum herbicide mixture flopyrauxifen- benzyl + cyhalofop butyl 10% EC 150 g ha^{-1} (PoE) *fb* hand weeding at 40 DAT. Initial herbicide application followed by hand weeding results in extended period of weed control will resulted in lower weed dry matter. Mohapatra *et al.* (2017) and Sreedevi *et al*.(2018).

Effect on nutrient removal by weeds:

Unweeded control recorded significantly higher nutrient removal by weeds at 30 and 60 DAT (Table:3 & 4). At 30 DAT lower nutrient removal was observed with treatment hand weeding at 20 and 40 DAT which was statistically same to flopyrauxifen-benzyl + cyhalofop-butyl 10% EC 150 g ha $^{-1}$(PoE)*fb* handweeding 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. Lower nutrient removal by weeds in weed management practices might be due to effective control of weeds during critical period and after that, weeds effectively suppressed by crop. Similar findings were reported by Gupta *et al*. (2019).

Conclusion:

From this investigation the application of herbicides mixtures followed by hand weeding will results higher nutrient uptake and lower nutrient removal compared to single herbicide application followed by hand weeding. Among all weed management practices application of flopyrauxifen-benzyl + cyhalofop-butyl 10% EC 150 g ha $^{-1}$(PoE)*fb* handweeding at 40 DAT was most effective one.

Table: 01 Influence of weed management practices on crop dry matter production and nutrient uptake (kg ha $^{-1}$) by grain at harvest

Treatments	**Dry matter (kg ha^{-1})**	**N**	P	K
T_1 - Penoxsulam 0.97% (20 g ha^{-1}) + butachlor (38.8%) SE 820 g ha^{-1} (PE) *fb* HW at 30 DAT	13375	73.0	12.7	30.0
T_2 - Pyrazosulfuron-ethyl 0.15 % (15 g ha^{-1}) + pretilachlor 6% GR (600g ha^{-1}) (PE) *fb* HW at 30 DAT	13517	75.0	14.3	34.3
T_3 - Orthosulfamuron + pretilachlor 6% (600g ha^{-1}) GR (PE) *fb* HW at 30 DAT	13453	74.0	13.0	31.7
T_4 - Ipfencarbazone 25 % SC 156.25 g ha^{-1} (PE)*fb* HW at 30 DAT	12568	64.0	11.3	28.0
T_5 - Penoxsulam 2.65 % OD 25 g ha^{-1} (PoE) *fb* HW at 40 DAT	12474	62.0	10.5	27.3
T_6 - Penoxsulam 1.02% (20 g ha^{-1}) + cyhalofop butyl 5.1% OD (100 g ha^{-1}) (PoE) *fb* HW at 40 DAT	14663	81.0	16.0	38.0
T_7 - Pretilachlor (PE) 50 % EC 0.75 kg ha^{-1}*fb* 2,4 D 1.0 kg ha^{-1} (PoE)	11835	60.7	10.0	24.3
T_8 - Bispyribac sodium 10% SC 25 g ha^{-1} (PoE) *fb* HW at 40 DAT	12167	61.3	10.2	26.7
T_9 - Flopyrauxifen- benzyl + penoxsulam 12% EC 40.64 g ha^{-1} (PoE) *fb* HW at 40 DAT	14448	79.0	15.5	37.0
T_{10} - Flopyrauxifen- benzyl + cyhalofop butyl 10% EC 150 g ha^{-1} (PoE) *fb* HW at 40 DAT	14953	83.0	16.7	38.7
T_{11} - Hand weeding at 20 and 40 DAT	15014	83.3	17.3	40.7
T_{12} - Unweeded control	7732	38.5	7.1	15.3
SE(m)±	254.58	1.83	0.66	1.6
CD (P=0.05)	746.5	5.37	1.94	4.68

Table :02 Influence of weed management practices on nutrient uptake (kg ha $^{-1}$) by straw at harvest

Treatments	N	P	K
T_1 - Penoxsulam 0.97% (20 g ha^{-1}) + butachlor (38.8%) SE 820 g ha^{-1} (PE) *fb* HW at 30 DAT	52.0	8.0	98.0
T_2 - Pyrazosulfuron-ethyl 0.15 % (15 g ha^{-1}) + pretilachlor 6% GR (600g ha^{-1}) (PE) *fb* HW at 30 DAT	54.8	8.8	101.0
T_3 - Orthosulfamuron + pretilachlor 6% (600g ha^{-1}) GR (PE) *fb* HW at 30 DAT	54.0	8.3	99.0
T_4 - Ipfencarbazone 25 % SC 156.25 g ha^{-1} (PE)*fb* HW at 30 DAT	48.0	6.0	92.0
T_5 - Penoxsulam 2.65 % OD 25 g ha^{-1} (PoE) *fb* HW at 40 DAT	46.5	5.6	90.0
T_6 - Penoxsulam 1.02% (20 g ha^{-1}) + cyhalofop butyl 5.1% OD (100 g ha^{-1}) (PoE) *fb* HW at 40 DAT	59.0	11.4	106.0
T_7 - Pretilachlor (PE) 50 % EC 0.75 kg ha^{-1}*fb* 2,4 D 1.0 kg ha^{-1} (PoE)	43.0	5.0	87.7
T_8 - Bispyribac sodium 10% SC 25 g ha^{-1} (PoE) *fb* HW at 40 DAT	45.0	5.0	89.7
T_9 - Flopyrauxifen- benzyl + penoxsulam 12% EC 40.64 g ha^{-1} (PoE) *fb* HW at 40 DAT	57.7	11.0	103.3
T_{10} - Flopyrauxifen- benzyl + cyhalofop butyl 10% EC 150 g ha^{-1} (PoE) *fb* HW at 40 DAT	61.7	12.0	108.0
T_{11} - Hand weeding at 20 and 40 DAT	62.0	12.6	110.0
T_{12} - Unweeded control	32.3	4.6	51.3
SE(m)±	2.05	0.51	2.75
CD (P=0.05)	6.00	1.50	8.06

Table: 03 Influence of weed management practices on weed dry matter (g m^{-2})and nutrient removal (kg ha^{-1}) by weeds at 30 DAT

Treatments	Dry weight of weeds	N	P	K
T_1 - Penoxsulam 0.97% (20 g ha^{-1}) + butachlor (38.8%) SE 820 g ha^{-1} (PE) *fb* HW at 30 DAT	3.9(14.5)	1.13	0.37	1.48
T_2 - Pyrazosulfuron-ethyl 0.15 % (15 g ha^{-1}) + pretilachlor 6% GR (600g ha^{-1}) (PE) *fb* HW at 30 DAT	3.8(13.3)	1.01	0.30	1.20
T_3 - Orthosulfamuron + pretilachlor 6% (600g ha^{-1}) GR (PE) *fb* HW at 30 DAT	3.9(14.0)	1.05	0.35	1.42
T_4 - Ipfencarbazone 25 % SC 156.25 g ha^{-1} (PE)*fb* HW at 30 DAT	4.2(16.8)	1.28	0.43	1.71
T_5 - Penoxsulam 2.65 % OD 25 g ha^{-1} (PoE) *fb* HW at 40 DAT	4.3(18.0)	1.35	0.44	1.81
T_6 - Penoxsulam 1.02% (20 g ha^{-1}) + cyhalofop butyl 5.1% OD (100 g ha^{-1}) (PoE) *fb* HW at 40 DAT	2.9 (7.4)	0.63	0.20	0.77
T_7 - Pretilachlor (PE) 50 % EC 0.75 kg ha^{-1}*fb* 2,4 D 1.0 kg ha^{-1} (PoE)	4.5(19.2)	1.44	0.47	1.86
T_8 - Bispyribac sodium 10% SC 25 g ha^{-1} (PoE) *fb* HW at 40 DAT	4.4(18.6)	1.39	0.45	1.84
T_9 - Flopyrauxifen- benzyl + penoxsulam 12% EC 40.64 g ha^{-1} (PoE) *fb* HW at 40 DAT	2.9 (7.7)	0.69	0.21	0.80
T_{10} - Flopyrauxifen- benzyl + cyhalofop butyl 10% EC 150 g ha^{-1} (PoE) *fb* HW at 40 DAT	2.7 (6.3)	0.50	0.18	0.69
T_{11} - Hand weeding at 20 and 40 DAT	2.6 (6.0)	0.44	0.16	0.59
T_{12} - Unweeded control	8.2(65.7)	6.63	1.15	4.91
SE(m)±	0.17	0.09	0.02	0.12
CD (P=0.05)	0.51	0.25	0.08	0.35

* PE: application: 3 DAT, PoE: Application: 2-3 leaf stage of weeds ** Values in the parenthesis are original and ($\sqrt{x+1}$) transformed

Table: 04 Influence of weed management practices on weed dry matter (g m^{-2}) and nutrient removal (kg ha^{-1}) by weeds at 60 DAT

Treatments	60 DAT	N	P	K
T_1 - Penoxsulam 0.97% (20 g ha^{-1}) + butachlor (38.8%) SE 820 g ha^{-1} (PE) *fb* HW at 30 DAT	6.1(35.7)	2.93	0.93	2.40
T_2 - Pyrazosulfuron-ethyl 0.15 % (15 g ha^{-1}) + pretilachlor 6% GR (600g ha^{-1}) (PE) *fb* HW at 30 DAT	5.7(32.0)	2.80	0.81	2.20
T_3 - Orthosulfamuron + pretilachlor 6% (600g ha^{-1}) GR (PE) *fb* HW at 30 DAT	5.9(34.0)	2.83	0.92	2.30
T_4 - Ipfencarbazone 25 % SC 156.25 g ha^{-1} (PE)*fb* HW at 30 DAT	6.2(37.0)	3.07	0.95	2.63
T_5 - Penoxsulam 2.65 % OD 25 g ha^{-1} (PoE) *fb* HW at 40 DAT	4.0(15.3)	1.39	0.42	1.19
T_6 - Penoxsulam 1.02% (20 g ha^{-1}) + cyhalofop butyl 5.1% OD (100 g ha^{-1}) (PoE) *fb* HW at 40 DAT	3.8(13.3)	1.26	0.41	1.12
T_7 - Pretilachlor (PE) 50 % EC 0.75 kg ha^{-1}*fb* 2,4 D 1.0 kg ha^{-1} (PoE)	7.7(58.0)	4.20	1.24	3.62
T_8 - Bispyribac sodium 10% SC 25 g ha^{-1} (PoE) *fb* HW at 40 DAT	4.1(16.7)	1.43	0.44	1.24
T_9 - Flopyrauxifen- benzyl + penoxsulam 12% EC 40.64 g ha^{-1} (PoE) *fb* HW at 40 DAT	3.9(14.3)	1.34	0.43	1.14
T_{10} - Flopyrauxifen- benzyl + cyhalofop butyl 10% EC 150 g ha^{-1} (PoE) *fb* HW at 40 DAT	3.7(13.0)	1.23	0.41	1.02
T_{11} - Hand weeding at 20 and 40 DAT	3.6(12.0)	1.18	0.39	0.89
T_{12} - Unweeded control	12.1(144.)	10.13	3.48	8.23
SE(m)±	0.29	0.13	0.05	0.23
CD (P=0.05)	0.87	0.44	0.15	0.69

* PE: application: 3 DAT, PoE: Application: 2-3 leaf stage of weeds ** Values in the parenthesis are original and (√x+1) transformed

Literature cited:

Mohapatra, S, Tripathy SK, Tripathy S and Mohanty AK. Effect of sequential application of herbicides on productivity and profitability of transplanted rice. *Indian Journal of Weed Science*. 2021; *53*(2):129-134.

Manhas SS, Singh G, Singh D and Khajuria V. Effect of tank-mixed herbicides on weeds and transplanted rice (Oryza sativa L.). Annals of Agricultural Research. 2012; 33: 25–31.

Hemalatha K, Singh Y and Kumar S. Leaf colour chart-based nitrogen and weed management impacts on weeds, yield and nutrient uptake in dry direct-seeded rice. *Indian Journal of Weed Science*. 2020; *52*(4):318-321.

Yadav DB, Singh N, Kumar J and Yadav A. Penoxsulam+ butachlor: A new ready-mix herbicide for control of complex weed flora in transplanted rice. *Indian Journal of Weed Science*. 2019; 51(4): 324-327.

Puniya R, Pandey PC, Bisht PS and Singh DK. Nutrient uptake by crop and weeds as influenced by trisulfuron, trisulfuron + pretilachlor and bensulfuron methyl in transplanted rice. Indian Journal of Weed Science. 2007; 39 (3&4): 239-240.

Piper CS. Soil and plant Analysis. *Inter Science Publishers*, New York. 1966.

Jackson HL. Soil Chemical Analysis. *Prentice hall of India Private Limited*, New Delhi: 1979; 111-226.

Yadav DB, Singh N, Duhan A, Yadav A and Punia SS. Penoxsulam+ cyhalofop-butyl (premix) evaluation for control of complex weed flora in transplanted rice and its residual effects in rice-wheat cropping system. *Indian Journal of Weed Science*. 2018; 50(4): 333-339.

Singh AK, Tomar SK and Singh DP. Bio-efficacy of herbicides and their mixture on weeds and yield of rice (Oryza sativa) under rice-wheat cropping system. *Indian Journal of Agronomy*. 2018; 63(2): 145-149.

Parameswari YS and Srinivas A. Influence of weed management practices on nutrient uptake and productivity of rice under different methods of crop establishment. *Journal of Rice Research*. 2014;7(1): 77.

Mohapatra S, Tripathy SK, Nayak BR and Mohanty AK. Efficacy of pre-emergence herbicides for control of complex weed flora in transplanted rice. *Indian Journal of Weed Science*. 2017; 49(3): 216-218.

Sreedevi B, Kumar RM, Singh A and Voleti SR. Assessing the efficacy of new low dose herbicide molecule in puddled direct seeded rice. *Journal of Rice Research*. 2018; 11 (2): 44-49.

Gupta PK and Tomar AK. Weed management in transplanted rice with special reference to *Commelina benghalensis* in the Kymore Plateau Satpura hills region of Madhya Pradesh. *Indian Journal of Weed Science*. 2019;51 (3): 236-239.

Yamaji N, Takemoto Y, Miyaji T, Mitani-Ueno N, Yoshida KT and Ma JF. Reducing phosphorus accumulation in rice grains with an impaired transporter in the node. *Nature*. 2017; *541*(7635):92-95.