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Research Article

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Bio-efficacy of Ready-mix Herbicide on Weed Flora and Productivity of Transplanted Rice

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Abstract

A field experiment was conducted during 2017 and 2018 at Agricultural Farm, Institute of Agriculture, Visva-Bharati, West Bengal, India to evaluate the bio-efficacy of ready-mix herbicide in transplanted rice. The experiment consisting of ten treatments was laid out in randomized bloc design with three replications. The crop field was infested complex weed flora: grasses like*Echinochloa crus-galli* and *Panicum repens* sedges like *Cyperus iria, Cyperus difformis, Fimbristylis miliacae* and *Cyperus rotundus* and broad leaved weeds like *Eclipta alba, Ludwigia parviflora, Marsilea quadrifolia* and *Monochoria vaginalis.* The results revealed that ready-mix application of fenoxaprop 5%+Chlorimuron 0.6%+Pretilachlor 50% ME at 1200 and 1000 ml ha^{-1} gave higher weed control index of 84.90% and 81.60% against grassy weeds, 84.09% and 82.95% against broad leaved weeds and 81.89% and 79.79% against sedges during 2017 and 84.18% and 82.95% against grassy weeds, 80.04% and 80.84% against broad leaved weeds and 82.33% and 79.57% against sedges during 2018. Both doses of fenoxaprop+chlorimuron+pre tilachlor was better than chlorimuron ethyl, fenoxaprop-p-ethyl, pretilachlor and pyrazosulfuron ethyl. Fenoxaprop+Chlorimuron+Pretilachlor 1200 ml ha^{-1}and 1000 ml ha^{-1} resulted into the higher number of panicles m^{-2}, test weight and grain yield (6088 and 6058 kg ha^{-1} in 2017 and 6513 and 6490 kgha^{-1} in 2018). Both were superior to its lower doses (800 ml ha^{-1}) and chlorimuron ethyl, fenoxaprop-p-ethyl, pretilachlor and pyrazosulfuron ethyl during both the years. Weeds allowed to grow throughout the crop season reduced thegrain yield to the extent of 32.2 and 35.5% during 2017 and 2018, respectively.

Keywords: Transplanted rice, fenoxaprop+chlorimuron+pretilachlor, yield, weed complex

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1. Introduction

Rice (*Oryza sativa* L.) is most important staple food for 60% of the World's population. Rice contributes 43% of total food grain production and 46% of total cereal production in India. In 2018, rice cultivated on an area of 43.79 mha with an annual production 112.91 mt and productivity about 2.58 t ha^{-1} (Anonymous, 2018). Rice is the predominant crop of West Bengal and produces more than 13% of total rice production in the country. Rice crop is adversely affected by several types of biotic and abiotic tress during their growth and development. Among biotic stress, weed competition is one of the chief yield limiting factors in rice yield. Weeds compete with crops for soil moisture, light, nutrients and space. Weeds are the greatest competitors in their initial growth

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stages than at later stages and hence the growth of crops becomes slow down and finally grain yield decreases (Jacob and Syriac, 2005). It was reported that weed infestation in transplanted rice reduced the grain yield of 27-68% (Yadav et al., 2018).

Weed control by mechanical and cultural means is an expensive method in transplanted rice. Especially during peak period of labour crisis, occasionally weeding becomes delayed causing severe decrease in grain yield. Therefore, due to high labour cost, non-availability of labour in time and time taken for manual weeding, farmers are enforced to decide for cheaper alternative of chemical weed control. Chemical weed control offers economic and efficient weed control if applied at proper dose and stage (Kumar and Sharma, 2005). The weed flora is very much diverse, so single application of one herbicide does not provide satisfactory weed control throughout the crop growth period. Regular use of a single herbicide may develop herbicide resistance in weeds. Therefore, use of combined application of herbicides in the form of tank-mix or ready-mix having different mode of action have a capacity to control broad spectrum weed as well as delaying the development of herbicide resistance. Application of herbicide mixtures may be useful for controlling broad-spectrum weeds in rice. Post emergence application of mixture of pyrazosulfuron ethyl +molinate at 2000 g a.i. ha^{-1} is very effective against broad spectrum of weeds (Acharya and Bhattacharya, 2013). Similarly, post-emergence tank-mix application of bispyribac-Na with pre-mix chlorimuron+metsulfruon recommended for controlling complex weed flora and enhancing productivity of transplanted rice (Kaur et al., 2016). New herbicide XR-848 Benzyl Ester+Cyhalofop Butyl 12% EC (w/v) at 150 (25+125) g ha^{-1} at 2-3 leaf stage control weed and produced more grain yield of rice (Mahapatra et al., 2017). Pyrazosulfuron ethyl+Pretilachlor (ready-mix) at 3.5 kg ha^{-1} as post emergence is very effective against the composite weed flora in transplanted rice (Mondal et al., 2018). Early post-emergence triafamone+ethoxysulfuron (pre-mix) is very much effective against complex weed flora in transplanted rice (Yadav et al., 2019).

In view of the above, the present study is undertaken to look out the broad spectrum weed control through a new early post-emergence ready-mix herbicide combination Fenoxaprop 5%+Chlorimuron 0.6%+Pretilachlor 50% ME on transplanted *kharif* rice.

2. Materials and Methods

This study was conducted during Kharif seasons of two consecutive years i.e.2017 and 2018, respectively at the Agricultural Farm, Institute of Agriculture, Visva-Bharati, Sriniketan, Birbhum district in West Bengal, India. The location is situated at20°39'N latitude and 87°42'E longitude with an average altitude of 58.9 mamsl under typical semi-arid tropical climate. The total rainfall received for the experimental period was 426.6 mm during 2017 and 675.3 mm during 2018. The soil of the experimental site was sandy loam in texture. The fertility status of the soil was 152.8 kg ha^{-1}alkaline permanganate oxidizable nitrogen (N) (Subbiah and Asija, 1956), 13.2 kg ha^{-1} available phosphorus (P) (Bray and Kurtz, 1945), 149.8 kg ha^{-1} 1 N ammonium acetate exchangeable potassium (K) (Hanway and Heidel, 1952) and 0.51% organic carbon (Walkley and Black, 1934). The pH of the soil was 6.15 (1:2.5 soil: water ratio) (Prasadet al., 2006). There are overall 10 treatments viz. Fenoxaprop 5%+Chlorimuron 0.6%+Pretilachlor 50% ME (800 ml ha^{-1}), Fenoxaprop 5%+Chlorimuron 0.6%+Pretilachlor 50% ME (1000 ml ha^{-1}), Fenoxaprop 5%+Chlorimuron 0.6%+Pretilachlor 50% ME (1200 ml ha^{-1}), Chlorimuron ethyl 25% WP (24 g ha^{-1}), Fenoxaprop-p-ethyl 9.3% w/w EC (625 ml ha^{-1}), Pretilachlor 50% EC (1500 ml ha^{-1}), Pyrazosulfuron ethyl 10% WP (150 g^{-1} ha), Hand weeding at 15 and 30 days after transplanting (DAT), weed free and weedy check. The treatments were replicated thrice in randomized complete block design keeping individual net plot size of 4×5 m^2. Rice variety 'Sahbaghi' was transplanted on 26th July, 2017 during first year and 28th July, 2018 during the second year at 20×10 cm^2 plant geometry using 2-3 seedlings $hill^{-1}$ and it was 115-120 days crop. A general dose of N:P_2O_5:K_2O was applied uniformly to each plot @100:50:50 kg ha^{-1} along with farm yard manure @ 5 t ha^{-1}. One fourth quantity of nitrogen and full amount of phosphorus and potassium were applied in each plot as basal on the day of transplanting. Rest three forth quantity of nitrogen was applied in two splits as top dressing i.e. half at active tillering stage and rest one fourth at panicle initiation stage. After sowing, a light irrigation was given to the crop for uniform germination. Herbicides were applied 10 days after transplanting (DAT) in the experimental plot as per treatment in both the years. Herbicide was sprayed on 5th August during 2017 and 7th August during 2018 with the help of battery operated knap-sack sprayer fitted with flat-fan nozzle using spray volume of 500 l ha^{-1}. Data on density and dry matter of weeds were recorded at 30 days after herbicide application i.e. 40 DAT with the help of 0.25 m^2 quadrate selected randomly in each plot. After identifying, the weed species were grouped into grassy, broadleaved and sedge separately. Weed density was calculated on the basis of the total number of an individual weed species m^2. On the basis of weed data, different weed indices were computed using the standard procedure as following details:

2.1. Weed control efficiency (WCE)

Weed control efficiency was computed by adopting the following formula given by Mani et al. (1973) as follows:

WCE (%)=(Weed dry weight in weedy check (g)-Weed dry weight in treatment (g))÷Weed dry weight in weedy check (g)×100

2.2. Weed index (WI)

Weed index is the per cent reduction in crop yield under a particular treatment due to the presence of weeds in comparison to weed free plot as suggested by Gill and Kumar (1969). This is used to assess the efficacy of a herbicide. Lesser the weed index, better is the efficiency of a herbicide. It is expressed in percentage and was determined with the help of following formula:

WI (%) =((X-Y)÷X)×100

Where, WI = Weed index; X = Crop yield from weed free plot and Y = Crop yield from the treated plot for which weed index is to be worked out. Crop was harvested at physiological maturity and data on yield attributes and yield were recorded. Before statistical analysis, the data on density of weeds and dry weight of data were subjected to square root (√ x+0.5) transformation to improve the homogeneity of the variance (ANOVA) separately for each year. The significant treatment effect was judged with the help of 'F' test at the 5% level of significance.

3. Results and Discussion

3.1. Weed flora

Weed flora composition of the experimental field during two years of investigation consisted of grassy weeds like *Echinochloa crus-galli* and *Panicum repens* sedges like *Cyperus iria, Cyperus difformis, Fimbristylis miliacae* and *Cyperus rotundus* and broad leaved weeds like *Eclipta alba, Ludwigia parviflora, Marsilea quadrifolia* and *Monochoria vaginalis* at the initial stages before application of the herbicide.

3.2. Effect on density of weeds

The results of experiments furnished in Table 1 revealed that significant reduction in all the weed control treatments

Table 1: Effect of weed control treatments on total density and dry weight weed at 40 days after transplanting

Treatments	Density of weeds (no. m^{-2})						Dry weight of weeds (g m^{-2})					
	Grassy weed		Broad leaved weed		Sedge		Grassy weed		Broad leaved weed		Sedge	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Fenoxaprop 5%+Chlorimuron 0.6% + Pretilachlor 50% ME (800 ml ha^{-1})	2.16 (4.19)	2.0 (3.77)	2.84 (7.55)	2.6 (6.28)	2.86 (7.67)	2.89 (7.86)	1.47 (1.66)	1.52 (1.84)	2.29 (4.74)	2.17 (4.23)	2.2 (4.36)	2.21 (4.38)
Fenoxaprop 5%+chlorimuron-ethyl 0.6%+ Pretilachlor 50% ME (1000 ml ha^{-1})	1.94 (3.26)	1.89 (3.1)	2.61 (6.34)	2.4 (5.24)	2.75 (7.1)	2.79 (7.3)	1.41 (1.51)	1.4 (1.47)	2.12 (3.98)	2.01 (3.54)	2.04 (3.67)	2.07 (3.8)
Fenoxaprop 5%+Chlorimuron 0.6%+pretilachlor 50% ME (1200 ml ha^{-1})	1.78 (2.67)	1.77 (2.64)	2.49 (5.72)	2.30 (4.77)	2.61 (6.29)	2.66 (6.56)	1.32 (1.23)	1.36 (1.36)	2.01 (3.55)	1.90 (3.13)	1.95 (3.29)	1.94 (3.28)
Chlorimuron ethyl 25% WP (24 g ha^{-1})	2.28 (4.76)	2.3 (4.78)	2.87 (7.71)	2.58 (6.18)	2.91 (7.95)	2.95 (8.2)	1.64 (2.18)	1.7 (2.38)	2.27 (4.64)	2.13 (4.05)	2.14 (4.09)	2.18 (4.26)
Fenoxaprop-p-ethyl 9.3% w/w EC (625 ml ha^{-1})	2.04 (3.68)	2.03 (3.62)	4.05 (15.9)	3.79 (13.8)	3.08 (8.99)	3.13 (9.27)	1.51 (1.78)	1.57 (1.96)	2.89 (7.84)	2.66 (6.57)	2.14 (4.07)	2.19 (4.32)
Pretilachlor 50% EC (1500 ml ha^{-1})	2.19 (4.3)	2.2 (4.35)	3.35 (10.76)	3.2 (9.73)	3.37 (10.84)	3.38 (10.9)	1.55 (1.9)	1.64 (2.18)	2.49 (5.72)	2.26 (4.62)	2.26 (4.61)	2.3 (4.81)
Pyrazosulfuron ethyl 10% WP (150 g ha^{-1})	2.22 (4.41)	2.26 (4.63)	3.41 (11.16)	3.37 (10.8)	3.12 (9.25)	3.18 (9.62)	1.52 (1.8)	1.63 (2.16)	2.36 (5.05)	2.16 (4.17)	2.22 (4.43)	2.24 (4.5)
Hand weeding at 15 & 30 DAT	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)
Weed Free	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)
Weedy check	4.43 (19.1)	4.6 (20.6)	6.57 (42.77)	6.03 (35.89	6.27 (38.78)	6.31 (39.3)	2.94 (8.15)	3.01 (8.58)	4.78 (22.3)	4.35 (18.4)	4.32 (18.1)	4.36 (18.5)
SEm±	0.09	0.07	0.07	0.04	0.05	0.05	0.03	0.05	0.04	0.03	0.04	0.05
CD (p=0.05)	0.25	0.21	0.22	0.11	0.14	0.15	0.09	0.15	0.12	0.09	0.11	0.15

Figures in parentheses are the original values. The data was transformed to SQRT (x+ 0.5) before analysis with respect to weed density of grassy, broadleaved and sedge over the weedy check (Table 1). The highest reduction in density of weeds were recorded under two hand weeding due to complete removal of the weeds whereas fenoxaprop+chlorimuron +pretilachlor at 1200 ml ha^{-1} found more superior among the herbicides treatments in reducing the weed density of grassy weed (2.67 number m^{-2}), broad leaved weed (5.72 number m^{-2}) and sedges (6.29 number m^{-2}) during 2017 whereas during 2018, it was 2.64 number m^{-2} for grassy weed, 4.77 number m^{-2} for broad leaved weed and 6.56 number m^{-2} for sedges followed by fenoxaprop+chlorimuro n+pretilachlor at 1000 ml ha^{-1} as compared to weedy check. Sole application of chlorimuron ethyl, fenoxaprop-p-ethyl, pretilachlor and pyrazosulfuron ethyl were less effective in controlling complex weeds flora as compared to their ready-mix application during both the years of experiment. The ready-mix herbicide fenoxaprop+chlorimuron+ pretilachlor provided higher order of performance in terms of reducing weed density of broad-leaf, sedge and grassy weed. These findings are in accordance with Teja et al. (2016), Yadav et al. (2018) and Yadav et al. (2019). This combination exhibit property of foliar activity that inhibits the synthesis of fatty acids in the meristem tissues, inhibits plant enzyme acetolactase synthase thereby, blocking branches chain of amino acid biosynthesis and inhibits growth and reduces cell division. Due to this, phloem transport of the plant is hampered. A secondary effect is stunted growth on account of cessation of cell division and slow plant death (Meena et al., 2019).

3.3. Effect on dry weight of weeds

All the herbicides reduced the dry weight of grassy weeds, broad-leaf weeds and sedges significantly as compared to the untreated weedy check at 40 DAT (Table 1). The dry weight of grassy weeds *Echinochloa crus-galli* and *Panicum repens*,dry weight of broad leaved weeds *Eclipta alba, Ludwigia parviflora, Marsilea quadrifolia* and *Monochoria* vaginalis as well as dry weight of sedges *Cyperus iria, Cyperus difformis, Fimbristylis miliacae* and *Cyperus rotundus* decreased with increase in dose of fenoxaprop+chlorimuron+pretilachlor during both the years.Fenoxaprop+chlorimuron+pretilachl or1200 ml ha^{-1} and 1000 ml ha^{-1} were superior to chlorimuron ethyl (24 g ha^{-1}), fenoxaprop-p-ethyl (625 ml ha^{-1}), pretilachlor (1500 ml ha^{-1}) and pyrazosulfuron ethyl (150 g ha^{-1}) and weedy check during both the years. Many researchers reported that application of herbicides used in combination have been very effective against complex weed flora in transplanted rice (Teja et al., 2016, Yadav et al., 2018 and Yadav et al., 2019).

3.4. Weed control efficiency

The data on weed control efficiency against total grassy weed, broad leaved weed and sedge weed were presented in Table 2. The minimum weed control efficiency was observed in weedy check (0.00%) whereas the highest (100.0%) was recorded in a plot treated with weed free plot and hand weeding at 40 DAT. Weed control efficiency of fenoxaprop+

Table 2: Weed control efficiency of different treatments against total grassy, broad leaved andsedge weed at 40 days after transplanting

Treatments	Weed control efficiency (%)					
	Grassy weed		Broad leaved weed		Sedge	
	2017	2018	2017	2018	2017	2018
Fenoxaprop 5%+Chlorimuron 0.6%+ Pretilachlor 50% ME (800 ml ha^{-1})	79.61	78.81	78.82	77.11	76.03	76.40
Fenoxaprop 5%+chlorimuron-ethyl 0.6%+ Pretilachlor 50% ME (1000 ml ha^{-1})	81.60	82.95	82.17	80.84	79.79	79.57
Fenoxaprop 5%+Chlorimuron 0.6%+pretilachlor 50% ME (1200 ml ha^{-1})	84.90	84.18	84.09	83.04	81.89	82.33
Chlorimuron ethyl 25% WP (24 g ha^{-1})	73.07	71.92	79.26	78.07	77.51	77.05
Fenoxaprop-p-ethyl 9.3% w/w EC (625 ml ha^{-1})	78.14	76.96	64.90	64.42	77.63	76.75
Pretilachlor 50% EC (1500 ml ha^{-1})	76.65	74.38	74.44	74.97	74.66	74.08
Pyrazosulfuron ethyl 10% WP (150 g ha^{-1})	77.87	74.78	77.36	77.38	75.68	75.74
Hand weeding at 15 & 30 DAT	100.00	100.00	100.00	100.00	100.00	100.00
Weed Free	100.00	100.00	100.00	100.00	100.00	100.00
Weedy check	-	-	-	-	-	-

chlorimuron+pretilachlor increased with increase in its dose from 800 ml ha^{-1} (79.61 and 78.81%) to 1000 ml ha^{-1} (81.60 and 82.95%) and 1200 ml ha^{-1} (84.90 and 84.18%) against total grassy weeds during first and second year, respectively. Similarly, weed control efficiency increased with increase in its dose from 800 ml ha^{-1} to 1200 ml ha^{-1} against total broad leaved and sedge weeds. Weed control of efficiency of fenoxaprop+chlorimuron+pretilachlor at 1000 ml ha^{-1} and

1200 ml ha^{-1} was higher than chlorimuron ethyl (24 g ha^{-1}), fenoxaprop-p-ethyl (625 ml ha^{-1}), pretilachlor (1500 ml ha^{-1}) and pyrazosulfuron ethyl (150 g ha^{-1}). Thus, based on two years data, 1200 ml ha^{-1} or 1000 ml ha was recognized the most optimal dose of fenoxaprop+chlorimuron+pretilachlor. This result was in accordance with Yadav et al. (2019) who reported that penoxsulam+butachlor (ready-mix) reduced the weed infestation in transplanted rice as well as enhanced weed control efficiency against diverse weed flora in comparison with the weedy check.

3.5. *Effect on crop*

There was significant effect of herbicidal treatments on number of panicles m^{-2}, test weight, number of grains panicle^{-1} and grain yield of the crop during both the years (Table 3). Fe noxaprop+chlorimuron+pretilachlor 1200 ml ha^{-1} resulted into maximum number of panicles m^{-2} (467 and 499), test weight (23.4 and 24.1 g), number of grains panicle^{-1} (140 and 144) and grain yield (6088 kg ha^{-1} in 2017 and 6513 kg ha^{-1} in 2018) among all the herbicidal treatments, which were at par with fenoxaprop+chlorimuron+pretilachlor 1000 ml ha^{-1} and weed free check. Grain yield under fenoxaprop+chlorimuron+pretil achlor 1200 ml ha^{-1} was at par with fenoxaprop+chlorimuron+ pretilachlor at 1000 ml ha^{-1} and superior to chlorimuron ethyl (24 g ha^{-1}), fenoxaprop-p-ethyl (625 ml ha^{-1}), pretilachlor (1500 ml ha^{-1}) and pyrazosulfuron ethyl (150 g ha^{-1}) during both the years.The fenoxaprop+chlorimuron+pretilachlor 1200 ml ha^{-1}, fenoxaprop+chlorimuron+pretilachlor 1000 ml ha^{-1}, chlorimuron ethyl (24 g ha^{-1}), fenoxaprop-p-ethyl (625 ml ha^{-1}), pretilachlor (1500 ml ha^{-1}) and pyrazosulfuron ethyl (150 g ha^{-1}) increased the grain yield of rice over weedy check was 42.5, 41.8, 27.5, 27.1, 28.6 and 29.4%, respectively during 2017. Whereas, the corresponding figures during 2018 were 50.8, 50.3, 28.3, 28.4, 30.0 and 30.9%, respectively. Effective management of complex weeds as well as higher yields of transplanted rice due to combined application of herbicides has been apprehended earlier workers also (Teja et al., 2015, Yadav et al., 2018, Yadav et al., 2019). Weeds allowed to grow throughout the crop season reduced the grain yield to the extent of 32.2 and 35.5% during 2017 and 2018, respectively.

Table 3: Effect of different treatments on yield attributes, grain yield and weed index of transplanted rice

Treatments	Panicle m^{-2}		Grains panicle^{-1}		Test weight (g)		Grain yield (kg ha^{-1})		Weed Index (%)	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Fenoxaprop 5%+Chlorimuron 0.6% + Pretilachlor 50% ME (800 ml ha^{-1})	350	360	126	129	21.8	21.8	5410	5568	14.1	16.8
Fenoxaprop 5%+chlorimuron-ethyl 0.6%+ Pretilachlor 50% ME (1000 ml ha^{-1})	440	452	134	137	22.5	23.1	6058	6490	3.8	3.0
Fenoxaprop 5%+Chlorimuron 0.6%+pretilachlor 50% ME (1200 ml ha^{-1})	467	499	140	144	23.4	24.1	6088	6513	3.4	2.7
Chlorimuron ethyl 25% WP (24 g ha^{-1})	347	352	126	127	21.8	22.1	5450	5540	13.5	17.2
Fenoxaprop-p-ethyl 9.3% w/w EC (625 ml ha^{-1})	370	378	127	129	21.6	22.1	5433	5546	13.8	17.1
Pretilachlor 50% EC (1500 ml ha^{-1})	387	395	130	132	21.1	21.6	5493	5614	12.8	16.1
Pyrazosulfuron ethyl 10% WP (150 g ha^{-1})	360	368	128	129	21.7	22.2	5530	5652	12.2	15.6
Hand weeding at 15 & 30 DAT	423	433	134	135	21.6	21.4	5860	5989	7.0	10.5
Weed Free	469	502	139	147	22.4	23.2	6300	6694	0.0	0.0
Weedy check	276	279	97	98	19.8	19.7	4273	4318	32.2	35.5
SEm±	22.5	23.2	3.0	3.2	0.4	0.5	269	303	-	-
CD (p=0.05)	66.9	68.9	8.9	9.6	1.3	1.5	801	901	-	-

Figures in parentheses are the original values. The data was transformed to SQRT (x+ 0.5) before analysis

4. Conclusion

Fenoxaprop+chlorimuron+pretilachlor 1000 ml ha^{-1} applied as spray in 500 L water ha^{-1} at 10 DAT provided effective control of complex weed flora in transplanted rice and increased grain yields.

5. References

Anonymous, 2018. Agricultural Statistics at a Glance 2018. Department of Agriculture, Cooperation and Farmers welfare, Ministry of Agriculture & Farmers Welfare, Govt. of India.

Acharya, S.S., Bhattacharya, S.P., 2013. Comparative efficacy of pyrazosulfuron ethyl and bentazon with acetamides for weed control in transplanted boro rice (*Oryza sativa* L.) in the lower gangetic plain zone of West Bengal, India. International Journal of Bio-resource and Stress Management 4, 506–509.

Bray, R.H., Kurtz, L.T., 1945. Determination of total organic and available forms of phosphorous in soil. Soil Science 59, 39–45.

Gill, G.S., Kumar, V., 1969. Weed index, a new method for reporting weed control trials. Indian Journal of Agronomy 142, 96–98.

Hanway, J.J., Heidel, H., 1952. Soil analysis methods as used in Iowa State College Soil Testing Laboratory, Bulletin 57. Ames, IA: Iowa State College of Agriculture.

Jacob, D., Syriac, E.K., 2005. Performance of transplanted scented rice (*Oryza sativa* L.) under different spacing and weed management regimes in southern Kerala. Journal of Tropical Agriculture 43(1/2),71–73.

Kaur, S., Bhullar, M.S., Kaur, T., 2016. Management of mixed weed flora in transplanted rice using herbicide combinations. Agricultural Research Journal 53(4), 483–487.

Kumar, M., Sharma, G., 2005. Effect of herbicides alone and in combination on direct seeded rice. Indian Journal of Weed Science 37(3&4), 197–201.

Mahapatra, A., Saha, S., Munda, S., Shukla, R.K., 2017. Studies on phytotoxicity of herbicides and herbicide mixtures and its effect on yield of direct sown rice (*Oryza sativa* L.). International Journal of Bio-resource and Stress Management 8(6), 853–856.

Mani, V.S., Malla, M.L., Gautam, K.C., Das, B., 1973. Weed killing chemical in potato cultivation. Proceedings of the National Academy of Sciences 23, 17–18.

Meena, V., Kaushik, M.K., Dotaniya, M.L., Meena, B.P., Das, H., 2019. Bio-efficacy of readi-mix herbicides on weeds and productivity in late-sown wheat. Indian Journal of Weed Science 51(4), 344–351.

Mondal, D., Ghosh, A., Bandopadhyay, P., Ghosh, R., 2018. Influence of herbicide mixture on composite weed flora and yield of transplanted rice under system of rice intensification. Journal of Hill Agriculture 9(1), 49–54.

Prasad, R., Shivay, Y.S., Kumar, D., Sharma, S.N., 2006. Learning by Doing Exercise in Soil Fertility– A Practical Manual for Soil Fertility. New Delhi: Division of Agronomy, IARI.

Subbiah, B.V., Asija, G.L., 1956. A rapid procedure for assessment of available nitrogen in rice soils. Current Science 25, 259–260.

Teja, K.C., Duary, B., Kumar, M., Bhowmick, M.K., 2015. Effect of bensulfuron-methyl+pretilachlor and other herbicides on mixed weed flora of wet season transplanted rice. International Journal of Agriculture, Environment and Biotechnology 8(2), 323–329.

Teja, K.C., Duary, B., Das, S., 2016. Sole and combined application of herbicides on complex weed flora of transplanted rice. Indian Journal of Weed Science 48(3), 254–258.

Walkley, A.J., Black., I.A., 1934. An examination of the Degtjareff method for determination of soil organic matter and a proposed modification of the chronic acid titration method. Soil Science 37, 29–38.

Yadav, D.B., Yadav, A., Punia, S.S., Singh, N., Duhan, A., 2018. Pretilachlor+pyrazosulfuron-ethyl (ready mix) against complex weed flora in transplanted rice and its residual effects. Indian Journal of Weed Science 50(3), 257–261.

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

Yadav, D.B., Yadav, A., Punia, S.S., 2019. Effectiveness of triafamone+ethoxysulfuron (pre-mix) against complex weed flora in transplanted rice and its residual effects on wheat. Indian Journal of Weed Science 51(2), 106–110.

