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# Weed flora management and productivity of rice (*Oryza sativa*) as influenced by herbicides

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## ABSTRACT

*Field experiments were conducted during two consecutive Kharif season of 2017 and 2018 on sandy loamsoil at Agricultural Farm, Institute of Agriculture, Visva-Bharati, (West Bengal)to study the effect of ready-mix herbicide on weed management in rice production and profitability. The results revealed that significantly lowest weeds density and dry weight as well as highest weed control efficiency was recorded with fenoxaprop 5% + Chlorimuron 0.6% + Pretilachlor 50% ME at 1200 and 1000 ml ha$^{-1}$ over chlorimuron ethyl, fenoxaprop-p-ethyl, pretilachlor and pyrazosulfuron ethyl aloneat 55 and 70 days after transplanting. Among herbicides, highest rice grain yield (6301 kg ha$^{-1}$) was recorded with fenoxaprop + Chlorimuron + Pretilachlor at 1200 but it was at par with 1000 ml ha$^{-1}$ (6274 kg ha$^{-1}$).Higher gross return (Rs.100035 ha$^{-1}$) and net return (Rs.76235 ha$^{-1}$) was recorded with application of fenoxaprop+Chlorimuron + Pretilachlor at 1200 ml ha$^{-1}$ followed by at 1000 ml ha$^{-1}$ (Rs. 99102) and (Rs. 75602). Highest benefit cost ratio (1:3.22) was recorded with application of fenoxaprop + Chlorimuron + Pretilachlor at 1000 ml ha$^{-1}$followed by 1200 ml ha$^{-1}$(1:3.20). Weedy check recorded the lowest gross return (Rs.67660 ha$^{-1}$) and net return (Rs.45660 ha$^{-1}$) as well as benefit cost ratio (1:2.08). Weeds allowed growing throughout the crop season reduced thegrain yield to the extent of 33.9 per cent.*

**Key words:** Rice, herbicides, weed flora, grain yield, weed control efficiency, economics

## INTRODUCTION

Agriculture is the mainstay of our country. Among cereals, rice occupies maximum area and production. It is cultivated in area of 43.79 million hectares with an annual production of 112.91 million tons having a productivity of 2.58 tones ha$^{-1}$ in India (Anonymous, 2018). West Bengal contributes more than 13% of total rice production in the country. Rice faces several biotic and abiotic stresses. Among biotic stress, weed problem is one which not only reduces the grain yield but also the nutritional quality of grain. Weeds compete for natural resources like soil moisture, solar radiation, nutrients and spacewith crops (Gupta and Singh, 2017). Weed infestation reduces grain yield from 29 to 83 per cent in transplanted rice (Bhuvaneswari*et al.*, 2009). So, weeding is essential for effectively control weed problems as well as enhance grain yield of rice. Conventional weeding like hand weeding is still popular for weeding but due to high labour cost, non-availability of labour in time and huge time requirement for weeding, rice growers are acceptable to adopt alternative measures like chemical weed control. Majority of the rice herbicides are narrow spectrum and control some species and rest are remain unaffected mainly in transplanted rice field where weeds flora is very much complex in nature (Mukherjee and Singh, 2005).Generally used herbicides in transplanted rice are butachlor, anilofos, thiobencarb, pretilachlor, fenoxaprop, chlorimuron etc which are unable to avoid unwanted weed shift(Singh *et al.*, 2004). Beside this, the most of the rice herbicides right now are pre-emergence and they are not capable to control weeds which are germinatedat early vegetative phase of rice. In this circumstance early post emergence herbicides in the form of tank-mix or ready-mix will be appropriate to control second flush of diverse weed flora. With this background, the present study was carried out to control complex weed flora through early post-emergence ready-mix herbicide of fenoxaprop 5% + chlorimuron 0.6% + pretilachlor 50% ME in transplanted *kharif* rice.

## MATERIALS AND METHODS

The field experiments were conducted during kharif season of 2017 and 2018 in *Kharif*season at the Agricultural Farm, InstituteofAgriculture, Visva-Bharati, Sriniketan in West Bengal, (20$^0$39$^/$N latitude and 87$^0$42$^/$E longitude with an average altitude of 58.9 m amsl under typical semi-arid tropical climate.

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Total rainfall received during the crop growth period (August to December) 426.6 mm during 2017 and 675.3 mm during 2018. The soil had 152.8 kg N ha$^{-1}$,13.2 kg P ha$^{-1}$, 149.8 kg K ha$^{-1}$and 5.1 g kg$^{-1}$organic carbon. The pH of the soil was 6.15. The experiment was laid out in complete randomised block design. The treatments comprise of $T_1$-Fenoxaprop 5% + Chlorimuron 0.6% + Pretilachlor 50% ME (800 ml ha$^{-1}$), $T_2$-Fenoxaprop 5% + Chlorimuron 0.6% + Pretilachlor 50% ME (1000 ml ha$^{-1}$), $T_3$-Fenoxaprop 5% + Chlorimuron 0.6% + Pretilachlor 50% ME (1200 ml ha$^{-1}$), $T_4$-Chlorimuron ethyl 25% WP (24 g ha$^{-1}$), $T_5$-Fenoxaprop-p-ethyl 9.3% w/w EC (625 ml ha$^{-1}$), $T_6$-Pretilachlor 50% EC (1500 ml ha$^{-1}$), $T_7$-Pyrazosulfuron ethyl 10% WP (150 gha$^{-1}$), $T_8$-Hand weeding at 15 and 30 days after transplanting (DAT), $T_9$-weed free and $T_{10}$-weedy check. The treatments were replicated thrice in 4m×5m. Rice variety '*SahbaghiDhan'* was used as a test crop. The crop was sown on 26$^{th}$ Julyin the first year and 28$^{th}$ Julyin the second year.The 100 kg N, 50 kg $P_2O_5$ and 50 kg $K_2O$ ha$^{-1}$ were applied as urea, single superphosphate and muriate of potash, respectively. Full dose of phosphorus and potash and one fourth nitrogen were applied as basal. Rest three fourth quantity of nitrogen was applied in two splits; half at active tillering stage and rest one fourth at panicle initiation stage. Herbicide was applied on 5$^{th}$ August in first year and 7$^{st}$ August in second yearwith the help of battery operated knap-sack sprayer fitted with flat-fan nozzle and water of water 500 litre ha$^{-1}$. Data on density anddry matter of weeds were recorded at 55 and 70 DAT withthe help of 0.25 m$^2$ quadrate selected randomly ineach plot. Weed density was calculated on the basisof the total number of an individual weed species m$^{-2}$. Weed control efficiency and weed index were calculated by using the standard procedure. Crop was harvested at physiological maturity and data on yield attributes, yield and economics were recorded. Before statistical analysis, the data on density of weeds and dry weight of data were subjected to square root ($\sqrt{x+0.5}$) 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.

## RESULTS AND DISCUSSION

### Weed flora

Weed flora in the experimental field during two years of investigation consisted of grassy weeds like *Echinochloa crus-galli* and *Panicumrepens* sedges like *Cyperusiria, Cyperusdifformis, Fimbristylismiliacae* and *Cyperusrotundus;* among sedge *Cyperusiria*and*Fimbristylismiliacae*are dominant and broad leaved weeds like *Ecliptaalba, Ludwigiaparviflora, Marsileaquadrifolia* and *Monochoria vaginalis;*among broad leaved weeds *Ludwigia parviflora*and *Monochoria vaginalis*are dominant at the initial stages before application of the herbicide.

### Density of weeds

The results (Table 1) showed that weed control treatments had significant effect on weed density of grassy, broadleaved and sedge over the weedy check. On the basis of mean data, the maximum reduction of weeds density wasobtained under two hand weeding due to total removal of the weeds whereas fenoxaprop + chlorimuron+ pretilachlorat1200 ml ha$^{-1}$has found superior among the herbicides overweedy check but it was at par with fenoxaprop + chlorimuron+ pretilachlorat1000 ml ha$^{-1}$.Sole application of chlorimuron ethyl, fenoxaprop-p-ethyl, pretilachlor and pyrazosulfuron ethyl were less effective in controlling complex weeds flora over their ready-mix application during both the years of experiment. The maximum values of weed density in all the three types of weeds were recorded under weedy check. These findings are in agreement with those of Teja*et al.*(2016), Yadav *et al.* (2018) and Yadav *et al.* (2019). This ready-mix herbicide exhibit property of foliar activity that inhibits the synthesis of fatty acids in the meristem tissues, inhibits plant enzyme acetolactase synthase thereby, blocking the biosynthesis of branches chain of amino acid and inhibits growth and reduces cell division.

### 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 55 and 70 DAT (Table 2). The dry

Table 1: Effect of weed control treatments on individual density (no. $m^{-2}$) of grassy, broad leaved weedand sedge (mean of 2 years)

| Treatments | *Echinochloa crus-galli* | | *Panicumrepens* | | *Ludwigia Parviflora* | | *Monochoria vaginalis* | | *Cyperusiria* | | *Fimbristy-lismiliacia* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 55 DAT | 70 DAT | 55 DAT | 70 DAT | 55 DAT | 70 DAT | 55 DAT | 70 DAT | 55 DAT | 70 DAT | 55 DAT | 70 DAT |
| $T_1$ | 1.60 (2.06) | 1.33 (1.26) | 1.61 (2.09) | 1.39 (1.43) | 1.9 (3.17) | 1.76 (2.61) | 1.43 (1.54) | 1.39 (1.43) | 1.76 (2.62) | 1.53 (1.85) | 2.01 (3.54) | 1.77 (2.63) |
| $T_2$ | 1.47 (1.66) | 1.27 (1.11) | 1.56 (1.94) | 1.34 (1.3) | 1.8 (2.73) | 1.52 (1.82) | 1.36 (1.34) | 1.33 (1.26) | 1.73 (2.49) | 1.51 (1.77) | 1.87 (3.02) | 1.63 (2.17) |
| T3 | 1.37 (1.39) | 1.14 (0.79) | 1.46 (1.62) | 1.19 (0.92) | 1.75 (2.56) | 1.46 (1.63) | 1.3 (1.2) | 1.27 (1.1) | 1.64 (2.18) | 1.38 (1.41) | 1.82 (2.85) | 1.6 (2.05) |
| $T_4$ | 1.76 (2.59) | 1.61 (2.11) | 1.88 (3.02) | 1.72 (2.46) | 1.93 (3.24) | 1.62 (2.12) | 1.48 (1.69) | 1.39 (1.45) | 1.76 (2.61) | 1.55 (1.91) | 2.06 (3.74) | 1.66 (2.26) |
| $T_5$ | 1.55 (1.91) | 1.34 (1.3) | 1.62 (2.13) | 1.39 (1.44) | 2.47 (5.58) | 2.2 (4.34) | 2.2 (4.35) | 2.1 (3.93) | 1.81 (2.79) | 1.69 (2.36) | 2.13 (4.06) | 1.84 (2.87) |
| $T_6$ | 1.64 (2.19) | 1.54 (1.88) | 1.75 (2.56) | 1.64 (2.19) | 2.31 (4.86) | 2.08 (3.83) | 1.82 (2.82) | 1.7 (2.38) | 1.92 (3.2) | 1.77 (2.64) | 2.21 (4.38) | 1.9 (3.12) |
| $T_7$ | 1.73 (2.49) | 1.62 (2.14) | 1.84 (2.91) | 1.73 (2.49) | 2.38 (5.16) | 2.21 (4.39) | 1.82 (2.8) | 1.7 (2.39) | 1.89 (3.09) | 1.75 (2.56) | 2.16 (4.17) | 1.88 (3.05) |
| T8 | 1.24 (1.05) | 1.07 (0.65) | 1.31 (1.23) | 1.12 (0.76) | 2.14 (4.1) | 1.92 (3.17) | 1.23 (1) | 1.35 (1.33) | 1.61 (2.08) | 1.56 (1.92) | 1.72 (2.47) | 1.77 (2.62) |
| $T_9$ | 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) |
| $T_{10}$ | 3.29 (10.3) | 3.21 (9.82) | 3.54 (12.0) | 3.45 (11.4) | 4.07 (16.0) | 3.92 (14.8) | 3.46 (11.4) | 3.17 (9.52) | 3.98 (15.3) | 3.39 (11.0) | 3.93 (14.9). | 3.60 (12.5) |
| SEm (±) | 0.05 | 0.05 | 0.05 | 0.06 | 0.03 | 0.04 | 0.02 | 0.02 | 0.04 | 0.04 | 0.05 | 0.03 |
| LSD at 5% | 0.14 | 0.14 | 0.14 | 0.18 | 0.10 | 0.13 | 0.07 | 0.06 | 0.11 | 0.13 | 0.14 | 0.10 |

*The original figures in parentheses were subjected to square root transformation ($\sqrt{x+0.5}$) before statistical analysis*

*$T_1$- Fenoxaprop 5% + Chlorimuron 0.6% + Pretilachlor 50% ME (800 ml $ha^{-1}$), $T_2$-Fenoxaprop 5% + Chlorimuron-ethyl 0.6% + Pretilachlor 50% ME (1000 ml $ha^{-1}$), $T_3$- Fenoxaprop 5% + Chlorimuron 0.6% + Pretilachlor 50% ME (1200 ml $ha^{-1}$), $T_4$- Chlorimuron ethyl 25% WP (24 g $ha^{-1}$), $T_5$- Fenoxaprop-p-ethyl 9.3% w/w EC (625 ml $ha^{-1}$), $T_6$- Pretilachlor 50% EC (1500 ml $ha^{-1}$), $T_7$- Pyrazosulfuron ethyl 10% WP (150 g $ha^{-1}$), $T_8$- Hand weeding at 15 and 30 DAT, $T_9$-Weed Free, $T_{10}$- Weedy check*

weight of grassy weeds *Echinochloa crus-galli* and *Panicumrepens*,dry weight of broad leaved weeds *Ludwigiaparviflora*and *Monochori-avaginalis* as well as dry weight of sedges *Cyperusiria*and *Fimbristylismili-acae*were decreased with increase in dose of fenoxaprop + chlorimuron+pretilachlor.Both doses of fenoxaprop + chlorimuron + pretilachlorat 1200 ml $ha^{-1}$ and at 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.Among sole application, lower dry weight of grassy weedwas recorded with fenoxaprop-p-ethyl and broad leaved weed and sedge withchlorimuron ethyl.

Results revealed that grassy type weeds were most affected by fenoxaprop + chlorimuron + pretilachlor followed by broad leaved weed and sedge. Weedy check produced the maximum weed dry weight in all the three types of weeds due to higher weed density and its dominance in utilizing the space, sunlight, nutrients, moisture.The application of ready-mix or tank-mix herbicides were very much effective against complex weed flora in transplanted rice (Duary*et al.*, 2015, Teja*et al.*, 2016, Yadav *et al.*, 2018, Yadav *et al.*, 2019, Pramanik *et al.*, 2020).

**Weed control efficiency**

The results (Table 3) indicated that the minimum weed control efficiency was recorded in weedy check (0.00%) whereas the highest (100.0%) was recorded in weed free plot and hand weeding at 25 and 40 DAT. Weed control efficiency of fenoxaprop + chlorimuron + pretilachlor against weeds were increased with increase in its dose from 1000 ml $ha^{-1}$ to 1200 ml$ha^{-1}$and both doses were superior over chlorimuron ethyl (24 g$ha^{-1}$), fenoxaprop-p-ethyl (625 ml $ha^{-1}$), pretilachlor (1500 ml $ha^{-1}$) and

Table 2: Effect of weed control treatments on dry weight (g $m^{-2}$) of grassy and broad leavedweedand sedge (mean of 2 years)

| Treatments | *Echinochloa crus-galli* | | *Panicumrepens* | | *Ludwigia Parviflora* | | *Monochoria vaginalis* | | *Cyperusiria* | | *Fimbristy-lismiliacia* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 55 DAT | 70 DAT | 55 DAT | 70 DAT | 55 DAT | 70 DAT | 55 DAT | 70 DAT | 55 DAT | 70 DAT | 55 DAT | 70 DAT |
| $T_1$ | 1.23 (1.02) | 1.27 (1.12) | 1.29 (1.18) | 1.31 (1.22) | 1.56 (1.94) | 1.49 (1.73) | 1.30 (1.2) | 1.30 (1.2) | 1.38 (1.4) | 1.36 (1.35) | 1.54 (1.86) | 1.48 (1.68) |
| $T_2$ | 1.15 (0.84) | 1.15 (0.82) | 1.24 (1.04) | 1.22 1.01) | 1.43 (1.54) | 1.38 (1.42) | 1.2 (0.93) | 1.21 (0.97) | 1.3 (1.2) | 1.28 (1.15) | 1.45 (1.6) | 1.4 (1.47) |
| T3 | 1.1 (0.7) | 1.09 (0.68) | 1.16 (0.85) | 1.13 (0.78) | 1.35 (1.33) | 1.32 (1.24) | 1.16 (0.84) | 1.17 (0.87) | 1.26 (1.09) | 1.25 (1.06) | 1.43 (1.54) | 1.38 (1.39) |
| $T_4$ | 1.33 (1.27) | 1.34 (1.3) | 1.42 (1.51) | 1.38 (1.41) | 1.5 (1.77) | 1.43 (1.57) | 1.33 (1.26) | 1.32 (1.24) | 1.34 (1.29) | 1.31 (1.22) | 1.52 (1.82) | 1.47 (1.67) |
| $T_5$ | 1.25 (1.07) | 1.24 (1.03) | 1.32 (1.24) | 1.3 (1.19) | 1.75 (2.56) | 1.71 (2.41) | 1.37 (1.38) | 1.38 (1.42) | 1.4 (1.45) | 1.38 (1.4) | 1.58 (2) | 1.49 (1.72) |
| $T_6$ | 1.33 (1.27) | 1.33 (1.26) | 1.41 (1.5) | 1.38 (1.4) | 1.57 (1.97) | 1.52 (1.81) | 1.36 (1.34) | 1.34 (1.3) | 1.37 (1.37) | 1.35 (1.34) | 1.63 (2.14) | 1.51 (1.77) |
| $T_7$ | 1.27 (1.12) | 1.28 (1.15) | 1.35 (1.32) | 1.32 (1.25) | 1.54 (1.87) | 1.51 (1.8) | 1.33 (1.28) | 1.33 (1.27) | 1.37 (1.39) | 1.35 (1.32) | 1.59 (2.02) | 1.5 (1.74) |
| $T_8$ | 1.05 (0.6) | 1.07 (0.66) | 1.1 (0.72) | 1.13 (0.78) | 1.3 (1.2) | 1.31 (1.23) | 1.06 (0.64) | 1.12 (0.76) | 1.16 (0.85) | 1.16 (0.84) | 1.31 (1.21) | 1.31 (1.23) |
| $T_9$ | 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) |
| $T_{10}$ | 2.2 (4.33) | 2.13 (4.05) | 2.35 (5.02) | 2.22 (4.42) | 2.82 (7.46) | 2.62 (6.34) | 2.25 (4.55) | 2.17 (4.19) | 2.44 (5.44) | 2.37 (5.1) | 2.78 (7.2) | 2.53 (5.88) |
| SEm (±) | 0.03 | 0.04 | 0.03 | 0.04 | 0.03 | 0.04 | 0.02 | 0.03 | 0.03 | 0.02 | 0.03 | 0.02 |
| LSD at 5% | 0.10 | 0.12 | 0.08 | 0.10 | 0.09 | 0.12 | 0.05 | 0.10 | 0.08 | 0.07 | 0.09 | 0.05 |

*The original figures in parentheses were subjected to square root transformation ($\sqrt{x + 0.5}$) before statistical analysis*

pyrazosulfuron ethyl (150 g $ha^{-1}$). Fenoxaprop + chlorimuron + pretilachlor1200 and 1000 ml $ha^{-1}$ was recorded higher weed control efficiency against grassy weed followed by broad leaved and sedge weeds.Sole herbicide, fenoxaprop-p-ethyl recorded higher weed control efficiency against grassy weed whereas chlorimuron ethyl against broad leaved weed and sedge over other sole applied herbicides. This result was in accordance with Yadav *et al.* (2019) who reported that penoxsulam + butachlor (ready-mix) reduced the complex weed infestation in transplanted rice as well as enhanced weed control efficiency in comparison with the weedy check.

Table 3: Weed control efficiency (%) of different treatments against grassy, broad leaved weedand sedge (mean of 2 years)

| Treatments | *Echinochloa crusgalli* | | *Panicumrepens* | | *Ludwigia Parviflora* | | *Monochoria vaginalis* | | *Cyperusiria* | | *Fimbristy-lismiliacia* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 55DAT | 70DAT | 55DAT | 70 DAT | 55DAT | 70 DAT | 55DAT | 70DAT | 55DAT | 70DAT | 55DAT | 70DAT |
| $T_1$ | 76.3 | 71.9 | 76.5 | 72.4 | 73.8 | 72.5 | 73.5 | 71.3 | 74.4 | 73.4 | 74.2 | 71.3 |
| $T_2$ | 80.6 | 78.6 | 79.3 | 77.1 | 79.1 | 77.6 | 79.4 | 76.6 | 77.9 | 77.3 | 77.8 | 74.7 |
| T3 | 83.6 | 82.5 | 83.0 | 82.3 | 82.1 | 80.4 | 81.5 | 79.1 | 80.0 | 79.1 | 78.6 | 76.2 |
| $T_4$ | 70.2 | 67.3 | 69.9 | 67.9 | 76.1 | 75.2 | 72.1 | 70.5 | 76.4 | 76.0 | 74.8 | 71.7 |
| $T_5$ | 75.2 | 74.0 | 75.1 | 72.9 | 65.7 | 62.0 | 69.4 | 66.2 | 73.2 | 72.4 | 72.1 | 70.7 |
| $T_6$ | 70.6 | 68.3 | 70.0 | 68.4 | 73.4 | 71.4 | 70.4 | 69.0 | 74.7 | 73.6 | 70.3 | 69.9 |
| $T_7$ | 73.8 | 71.5 | 73.7 | 71.6 | 75.0 | 71.2 | 71.7 | 69.4 | 74.5 | 74.0 | 72.0 | 70.5 |
| $T_8$ | 85.9 | 83.6 | 85.6 | 82.3 | 83.9 | 80.5 | 85.9 | 81.7 | 84.3 | 83.5 | 83.1 | 79.1 |
| $T_9$ | 100.0 | 100.0 | 100. | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100. |
| $T_{10}$ | - | - | - | - | - | - | - | - | - | - | - | - |

## Yield and weed index

The results (Table 4) indicated that fenoxaprop + chlorimuron + pretilachlor1200 mlha$^{-1}$ recorded maximum grain yield (6301 kg ha$^{-1}$) among all the herbicidal treatments, which was at par with fenoxaprop + chlorimuron + pretilachlor 1000 ml ha$^{-1}$(6274 kg ha$^{-1}$) and weed free check (6497 kg ha$^{-1}$) in Table 7. Fenoxaprop + chlorimuron + pretilachlor 1200 ml ha$^{-1}$, fenoxaprop + chlorimuron + pretilachlor 1000 ml ha$^{-1}$, fenoxaprop + chlorimuron + pretilachlor 800 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 gha$^{-1}$) increased the grain yield of rice over weedy check was47.5, 46.8, 28.5, 28.6, 28.5, 30.0 and 30.8%, respectively.Sedge type of weeds have more adverse effect on grain yield of rice in this experiment. Weed index value showed that weeds allowed to grow throughout the crop season reduced the grain yield to the extent of 33.9%. Effective management of complex weed floraas well as higher grain yield of transplanted rice due to application of ready-mix or tank-mix herbicides has been apprehended earlier workers also (Duary*et al.*, 2015, Teja*et al.*, 2015, Yadav *et al.*, 2018, Yadav *et al.*, 2019, Pramanik *et al.*, 2020).

Table 4: Effect of different treatments on grain yield, weed index and economics of transplanted rice (mean of 2 years)

| Treatments | Grain yield (kg ha$^{-1}$) | Weed Index (%) | Total Cost (Rs. ha$^{-1}$) | Gross returns (Rs.ha$^{-1}$) | Net returns (Rs.ha$^{-1}$) | B:C ratio |
|---|---|---|---|---|---|---|
| $T_1$ | 5489 | 15.5 | 23200 | 86472 | 63272 | 1:2.73 |
| $T_2$ | 6274 | 3.4 | 23500 | 99102 | 75602 | 1:3.22 |
| $T_3$ | 6301 | 3.0 | 23800 | 100035 | 76235 | 1:3.20 |
| $T_4$ | 5495 | 15.4 | 22270 | 86558 | 64288 | 1:2.89 |
| $T_5$ | 5490 | 15.5 | 23000 | 86474 | 63474 | 1:2.76 |
| $T_6$ | 5554 | 14.5 | 22675 | 87483 | 64808 | 1:2.86 |
| $T_7$ | 5591 | 13.9 | 23200 | 88074 | 64874 | 1:2.80 |
| T8 | 5925 | 8.8 | 24200 | 93327 | 69127 | 1:2.86 |
| $T_9$ | 6497 | 0.0 | 27500 | 99547 | 72047 | 1:2.62 |
| T10 | 4296 | 33.9 | 22000 | 67660 | 45660 | 1:2.08 |
| LSD at 5% | 844 | - | - | - | - | - |

## Economics

The results revealed that fenoxaprop + chlorimuron + pretilachlor1200 ml ha$^{-1}$ recorded higher gross return (Rs.100035 ha$^{-1}$) and net return (Rs.76235 ha$^{-1}$) while higher benefit cost ratio (1:3.22) was recorded with application of fenoxaprop + Chlorimuron + Pretilachlor at 1000 ml ha$^{-1}$ (Table 4). Gupta and Singh (2017) reported similar variation in net returns and B:C ratio among treatments due to variation in yield and expenditure incurred in treatments. The minimum net returns of Rs. 45660 ha$^{-1}$ along with B:C ratio of 1:2.08 were recorded in weedy check owing to lower grain yield.

It may be concluded from the results that among the weed control treatments application of fenoxaprop + chlorimuron + pretilachlor 1000 ml ha$^{-1}$at10DAT provided effective control of complex weed flora and resulted in increased grain yield and benefit: cost ratio of transplanted rice.

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