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Comparative Efficiency of Some New Generation Herbicides in Controlling Mixed Weed Flora in Transplanted Summer Rice (*Oryza sativa* L.)

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ABSTRACT

An experiment has been conducted during *boro* season of 2021 at the Uttar Banga Krishi Viswavidyalaya, Cooch Behar, West Bengal to find out relative efficiency of some new generation herbicides in controlling mixed weed flora of summer rice. Experiment was fitted out in randomized block design with six treatments and four replications. Four herbicidal application, namely Imazosulfuron 1% + Pretilachlor 8% GR @100 +800 g a.i/ha, Pretilachlor 50% EC @750 g a.i/ha, Pretilachlor 6% + Pyrazosulfuron Ethyl 0.15% GR @ 600 g a.i/ha and Metsulfuron Methyl 20% WP @ 4 g a.i/ha were compared with untreated check and weed free. Field was dominated by *Echinochloa crusgalli, Cyperus irria*, *Ludwigia parviflora, Eclipta alba* and *Monochoria vaginalis*. Twice hand weeded plot (weed free) performed best with regard to reduction of weed population, control efficiency and thereby produced maximum grain yield of 4.58 t ha^{-1}. Among the herbicide treatments, application of Imazosulfuron 1% + Pretilachlor 8% GR @100 +800 g a.i/ha proved superiority in reduction of weed population and provide better control efficiency of mixed weed flora of summer rice which gave yield advantage of 6.91, 27.73, 31.21& 60.37% respectively over Pretilachlor 6% + Pyrazosulfuron Ethyl 0.15% GR @ 600 g a.i/ha, Pretilachlor 50% EC @750 g a.i/ha, Metsulfuron Methyl 20% WP @ 4 g a.i/ha and untreated check.

Key words : Imazosulfuron, Metsulfuron Methyl, Pretilachlor, Pyrazosulfuron Ethyl and Summer rice

Introduction

Weed management is an integral part of sustainable rice production, particularly in transplanted rice systems, where weed competition significantly reduces crop yield and quality. Weeds compete with rice plants for light, nutrients, and water, often causing yield losses as high as 30–70% if not managed effectively (Singh *et al.*, 2016 and Rao *et al.*, 2007). Effective weed control measures are therefore essential to minimize resource competition and maximize rice productivity. Traditionally, manual weeding has been the most widely used weed management practice in rice fields. However, its labour-intensive nature, high costs, and declining availability of agricultural labour have limited its feasibility (Chauhan & Johnson,

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2010). As a result, chemical herbicides have gained prominence for their efficiency and cost-effectiveness in managing diverse weed populations (Kumar *et al.*, 2013). Advances in herbicide formulations have led to the development of selective and combination herbicides that enhance weed control efficacy and reduce environmental risks. Evaluating the performance of herbicides under field conditions is essential for optimizing their application and integrating them into weed management systems.

Chemical weed control methods, have been reported to significantly enhance productivity and reduce weed pressure when properly managed (Rao *et al.*, 2015 and Chauhan *et al.*, 2012). By comparing Imazosulfuron + Pretilachlor, Metsulfuron Methyl, Pretilachlor and Pretilachlor + Pyrazosulfuron Ethyl with traditional manual weeding, the study seeks to identify sustainable and effective strategies for integrated weed management in transplanted rice. The findings will provide valuable insights for optimizing weed control practices to ensure resource-efficient and environmentally sustainable rice production systems. This study investigates the efficacy of six weed management treatments in transplanted rice, including four herbicide-based treatments, an untreated check, and a weed-free check maintained through manual weeding.

Materials and Methods :

The field experiment was conducted at Instructional Farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal, India. The farm is situated at $26^0$19'86" N latitude and $89^0$23'53" E longitude at an elevation of 43 meters above mean sea level. The soil at the experimental site was sandy loam in texture and acidic in nature having pH of 5.64. The initial soil status revealedorganic carbon 0.93%, available nitrogen 154.32 kg ha^{-1}, available phosphorus 22.78 kg ha^{-1} and available potash 102.13 kg ha^{-1}. Rice variety Ranjit was transplanted at a spacing of 25 cm x 20 cm during 5th February, 2021. All the recommended improved package of practices was followed in this experiment including the plant protection measures. Full doses of phosphorus through single super phosphate and potash through muriate of potash each @ 50 kg ha^{-1} was applied as basal. Recommended dose of nitrogen @ 100 kg ha^{-1} through urea was applied in 4 splits at basal, 25, 45 and 65 DAT. The experiment fitted out in completely randomized block design, with six treatments and four replications. Treatments consisted of T_1: Imazosulfuron 1% + Pretilachlor 8% GR @100 +800 g a.i/ha; T_2: Pretilachlor 50% EC @750 g a.i/ha; T_3: Pretilachlor 6% + Pyrazosulfuron Ethyl 0.15% GR @ 600 g a.i/ha and T_4: Metsulfuron Methyl 20% WP @ 4 g a.i/ha; T_5: Untreated check and T_6: Weed free check (Two hand weeding). All the herbicides were applied on 6th February, 2021 with a spray volume of 500 l ha^{-1} by knapsack sprayer fitted with flat fan deflector nozzle.

Observations on species wise weed count (per sq. m area) was recorded 30 and 60 days after application (DAA) of tested herbicides from each plot using 1 X 1 m^2 quadrate in marked area. The weed samples were sun dried for four days and then transferred to hot air oven for drying

at 60^0 C. Weeds dry weight of each sample was recorded in g/m^2 at 30 and 60 DAA. Weed control efficiency (WCE) was calculated on the basis of data recorded at 30 & 60 DAA of the tested herbicide in rice as per the formula (Patra *et al.*, 2017) given below :

$$\text{Weed Control Efficiency (\%)} = \frac{\text{WDC - WDT}}{\text{WDC}} \times 10$$

Where, WDC = Weed dry weight in untreated control plot (g m^{-2}) and WDT = Weed dry weight in treated plot (g m^{-2})

The crop was harvested on 3rd June, 2021 and the yield attributes namely number of panicle/plants, panicle length and number of grains/panicles was recorded from randomly selected 10 hills/plot. Grain yield was recorded in kg/plot and converted to t/ha. The data so obtained were subjected to standard statistical analysis (Gomez and Gomez, 1984) prescribed for the experiment.

Results and Discussion

***Weed density and dry weight* :**

Weed flora in the experimental field were predominantly consisted of *Echinochloa crusgalli* (Grass), *Cyperus irria* (Sedges), *Ludwigia parviflora* (BLW), *Eclipta alba* (BLW) and *Monochoria vaginalis* (BLW).

Data presented in tables and figure 1 to 2 on weed density showed that application of herbicides clearly indicates that herbicidal treatment was better than untreated control in the reduction of the weed density.

It was quite obvious that weed free plot had the lowest density of weed flora and dry weight. Among herbicidal treatments, reduction of weed population was found highest under Imazosulfuron 1% + Pretilachlor 8% GR @ 100+800 g a.i./ha (T_1) which was followed by Pretilachlor 6% + Pyrazosulfuron Ethyl 0.15% GR @ 600 g a.i/ha (T_3). Single application of Pretilachlor 50% EC @ 750g a.i./ha (T_2) was found better as compared to Metsulfuron Methyl 20% WP @ 4 g a.i./ha (T_4) in lessening the weed density at 30 and 60 days after application. Untreated control plot (T_5) recorded the highest number of all categories of weed species.

The weed dry matter was also less in treatments having a lower density of weeds. However, all the herbicide treatments were superior to untreated control in reducing weed growth at all the stages of observation. Among the herbicidal treatments, Imazosulfuron 1% + Pretilachlor 8% GR @ 100+800 g a.i./ha (T_1) recorded highest weight reduction of weeds followed by Pretilachlor 6% + Pyrazosulfuron Ethyl 0.15% GR @ 600 g a.i/ha (T_3), Pretilachlor 50% EC @ 750g a.i./ha (T_2), and Metsulfuron Methyl 20% WP @ 4 g a.i./ha (T_4).

***Weed Control Efficiency (WCE)* :**

The results of mean weed control efficiency (WCE) of different weed species are presented in tables and figure 1 to 2 and it was revealed that all the herbicidal treatments give effective control of grassy, broad leaf and sedges as compared to weedy check. Twice hand weeded plot recorded significantly highest weed control efficiency of 94.33, 94.38, 88.81, 85.66 & 90.02% and 92.61, 92.84, 96.39, 93.90 & 86.24% respectively at 30 and 60 days after transplanting for *Echinochloa crusgalli*, *Cyperus irria*, *Ludwigia parviflora*, *Eclipta*

alba and *Monochoria vaginalis* due to through uprooting of all emerged weed and thereby minimized competition for growth factors. Among the herbicidal treatments Imazosulfuron 1% + Pretilachlor 8% GR @ 100 + 800 g ai/ha (T_3) showed the highest degree of weed control efficiency with disregard to the species followed by Pretilachlor 6% + Pyrazosulfuron Ethyl 0.15% GR @ 600 g a.i/ha (T_3), Pretilachlor 50% EC @ 750g a.i./ha (T_2) and Metsulfuron Methyl 20% WP @ 4 g a.i./ha (T_4).

In general, weed control efficiency was more at 30 days after application of herbicides irrespective of weed flora except *Eclipta alba,* where weed control efficiency was highest at 60 days after application.

***Yield attributes and yields of rice* :**

The highest grain yield of 4.58 t ha^{-1} was obtained in the plot receiving twice hand weeding (T_8) might be due to better weed control efficiency which helped in better yield attributes. Better control efficiency and yield of transplanted rice with twice hand weeding was noticed by Singh and Singh, 2012. Among the herbicides treatment, significant increase in grain yield was obtained with the application of Imazosulfuron 1% + Pretilachlor 8% GR @ 100 + 800 g ai/ha (T_1) followed by Pretilachlor 6% + Pyrazosulfuron Ethyl 0.15% GR @ 600 g a.i/ha (T_3) due to better yield attributes. Akbar *et al.* 2011 and Jayasuria *et al.* 2011 also found better management of weed through herbicides in transplanted rice. While among the herbicidal treatment, lowest yield of 3.30 t ha^{-1} was recorded with the application of Metsulfuron Methyl 20% WP @ 4 g a.i./ha (T_4). Untreated check produced significantly lowest grain yield of 2.70 t ha^{-1} (fig.4).

Conclusion

The result from the experimental trial revealed that the weed flora in rice was controlled effectively by applying the Imazosulfuron 1% + Pretilachlor 8% GR @ 100 + 800 g a.i./ha, which were superior to the other herbicides. Significant increase in yield attributes and grain yield was obtained with the weed free treatment followed by application of Imazosulfuron 1% + Pretilachlor 8% GR @ 100 + 800 g a.i./ha in comparison to other and untreated control.

It can be concluded from the study conducted during boro season, 2021 that Imazosulfuron 1% + Pretilachlor 8% GR @ 100 + 800 g a.i./ha has a high degree of weed control efficiency with disregard to species and enhanced productivity of summer rice. Hence, farmers can safely use Imazosulfuron 1% + Pretilachlor 8% GR in transplanted rice during summer season.

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Table 1 : Effect of new generation herbicides on population, dry weight and control efficiency of *Echinochloa crusgalli* (EC) *and Cyperus irria* (CI) during boro, 2021.

Treatments	Weed count (numbers m^{-2})				Dry weight of weeds (g m^{-2})				Weed Control Efficiency (%)			
	30 DAA		60 DAA		30 DAA		60 DAA		30 DAA		60 DAA	
	EC	CI	EC	CI	EC	CI	EC	CI	EC	CI	EC	CI
T_1	1.42 (1.69)	2.2 (1.98)	2.95 (2.22)	3.95 (2.49)	1.44 (1.70)	1.79 (1.84)	1.46 (1.71)	2.79 (2.17)	83.33	82.36	81.35	70.63
T_2	5.46 (2.84)	6.46 (3.04)	6.89 (3.12)	7.25 (3.19)	2.69 (2.14)	3.36 (2.33)	3.05 (2.25)	3.85 (2.46)	68.87	66.90	81.60	59.47
T_3	2.12 (1.96)	2.87 (2.19)	3.93 (2.48)	5.05 (2.75)	1.65 (1.78)	3.06 (2.25)	1.79 (1.84)	2.99 (2.23)	80.90	69.85	77.14	68.53
T_4	6 .92 (3.13)	7.2 (3.18)	7.25 (3.19)	8.12 (3.35)	3.21 (2.29)	3.82 (2.45)	3.49 (2.37)	4.35 (2.59)	62.85	62.36	55.43	54.21
T_5	24.43 (5.44)	23.46 (5.34)	22.75 (5.27)	21.45 (5.13)	8.64 (3.43)	10.15 (3.68)	7.83 (3.29)	9.50 (3.58)	-	-	-	-
T_6	0.68 (1.32)	1.26 (1.62)	1.00 (1.50)	1.45 (1.70)	0.49 (1.20)	0.75 (1.37)	0.44 (1.16)	0.68 (1.32)	94.33	92.61	94.38	92.84
SEm. (±)	0.74	0.65	0.63	0.81	0.41	0.55	0.44	0.41	-	-	-	-
CD (P=0.05)	2.12	1.84	1.82	2.42	1.19	1.65	1.25	1.23	-	-	-	-

Figure in parenthesis indicates square root transformation ($\sqrt{x}$ + 0.5), DAA- Days after application

T_1: Imazosulfuron 1% + Pretilachlor 8% GR @100 +800 g a.i/ha; T_2: Pretilachlor 50% EC @750 g a.i/ha; T_3: Pretilachlor 6% + Pyrazosulfuron Ethyl 0.15% GR @ 600 g a.i/ha; T_4: Metsulfuron Methyl 20% WP @ 4 g a.i/ha T_5: Untreated check and T_6: Weed free check (Two hand weeding).

Table 2 : Effect of new generation herbicides on population, dry weight and control efficiency of *Ludwigia parviflora* (LP) *and Eclipta alba* (EA) during boro season, 2021

Treatments	Weed count (numbers m^{-2})				Dry weight of weeds				Weed Control Efficiency (%)			
	30 DAA		60 DAA		30 DAA		60 DAA		30 DAA		60 DAA	
	LP	EA	LP	EA	LP	EA	LP	EA	LP	EA	LP	EA
T_1	2.49 (2.08)	1.41 (1.38)	2.99 (2.23)	1.85 (1.53)	1.35 (1.66)	1.14 (1.28)	1.71 (1.81)	1.35 (1.36)	83.58	86.73	78.10	81.71
T_2	7.21 (3.19)	5.17 (2.38)	7.36 (3.21)	6.13 (2.57)	2.99 (2.23)	2.18 (1.63)	3.87 (2.47)	2.61 (1.77)	63.63	74.62	50.45	64.63
T_3	3.26 (2.31)	2.10 (1.61)	4.46 (2.61)	3.86 (2.08)	2.16 (1.97)	1.87 (1.53)	2.65 (2.13)	1.71 (1.48)	73.72	78.23	66.07	76.83
T_4	7.29 (3.20)	6.01 (2.55)	8.26 (3.37)	6.43 (2.63)	3.02 (2.24)	2.28 (1.66)	3.89 (2.47)	3.50 (2.00)	63.26	73.46	50.19	52.57
T_5	21.86 (5.18)	21.33 (4.67)	19.26 (4.89)	18.68 (4.38)	8.22 (3.36)	8.59 (3.01)	7.81 (3.29)	7.38 (2.81)	-	-	-	-
T_6	1.35 (1.66)	0.80 (1.39)	2.46 (2.06)	1.01 (1.50)	0.95 (1.47)	0.31 (1.05)	1.12 (1.55)	0.45 (1.17)	88.81	96.39	85.66	93.90
SEm.(±)	0.73	0.79	0.68	0.67	0.54	0.49	0.49	0.42	-	-	-	-
CD (P=0.05)	2.19	2.41	2.11	1.98	1.65	1.46	1.48	1.25	-	-	-	-

Figure in parenthesis indicates square root transformation ($\sqrt{x}$ + 0.5), DAA- Days after application

T_1: Imazosulfuron 1% + Pretilachlor 8% GR@100 +800 g a.i/ha; T_2: Metsulfuron Methyl 20% WP @ 4 g a.i/ha; T_3: Pretilachlor 50% EC @750 g a.i/ha; T_4: Pretilachlor 6% + Pyrazosulfuron Ethyl 0.15% GR @ 600 g a.i/ha; T_5: Untreated check and T_6: Weed free check (Two hand weeding).

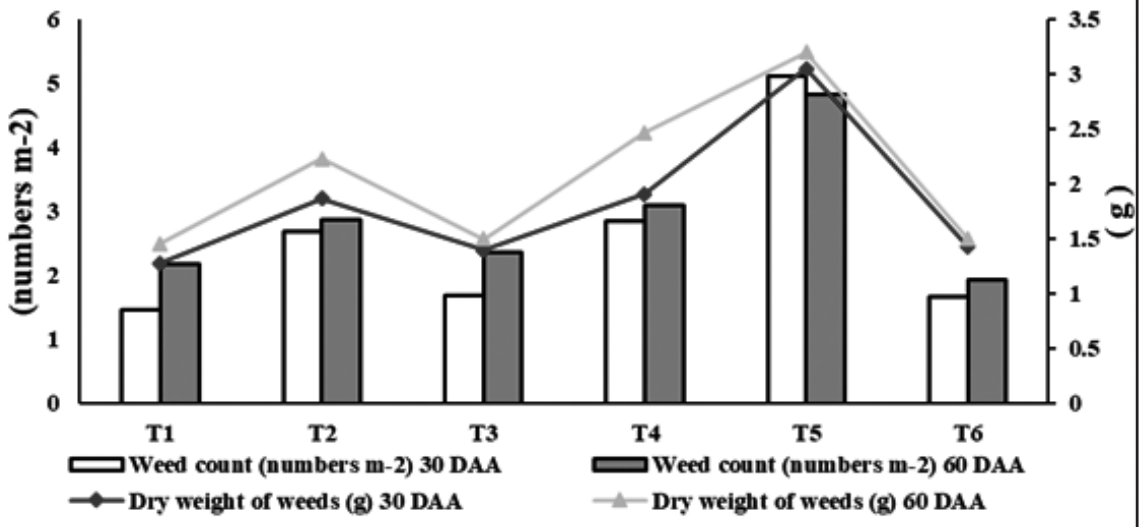

Figure 1 : Effect of new generation herbicides on *Monochoria vaginalis*

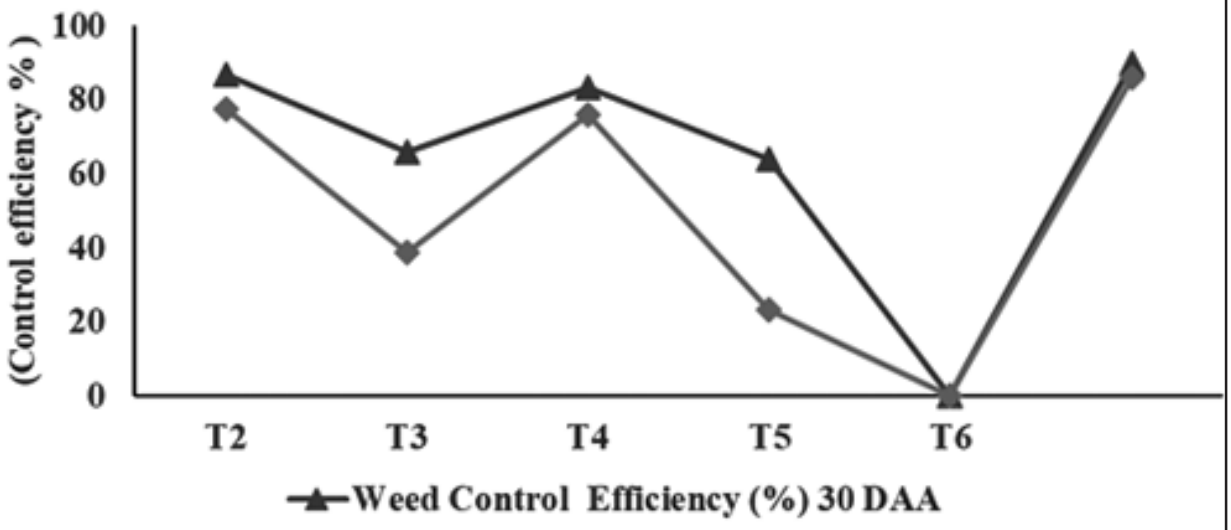

Figure 2 : Effect of new generation herbicides on control efficiency of *Monochoria vaginalis*

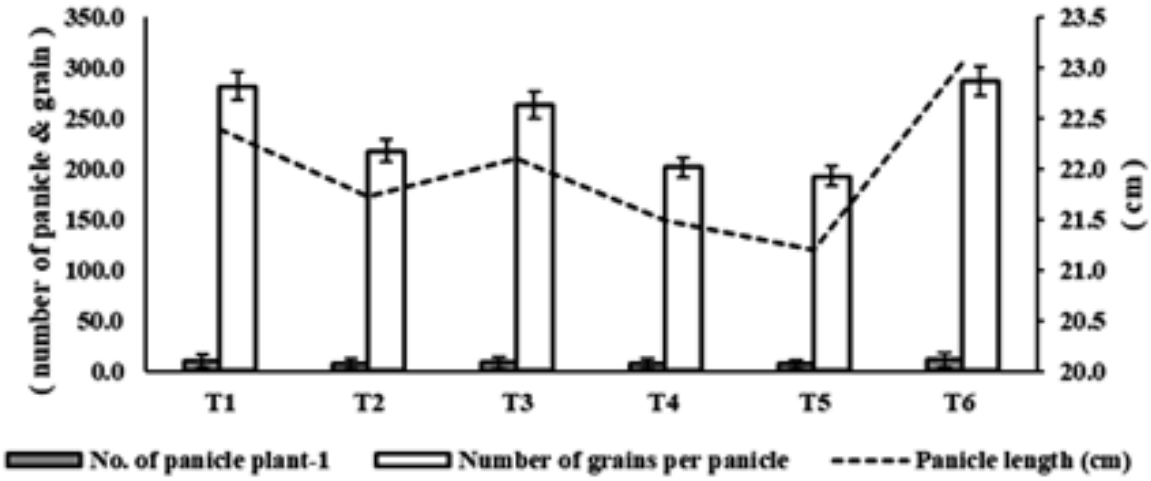

Figure 3 : Yield attributes of rice as influenced by new generation herbicides

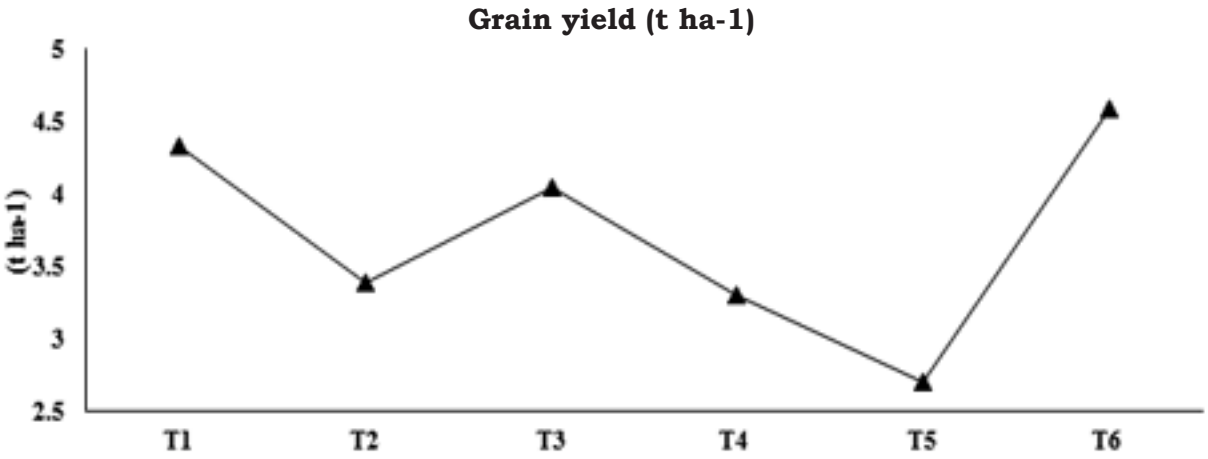

Figure 4 : Grain yield of rice as influenced by new generation herbicides