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RESEARCH PAPER

Bio-efficacy of Different Post Emergence Herbicides for Broad Spectrum Weed Management in Transplanted Rice (*Oryza sativa* L.) in Indo-Gangetic Plain Zone of West Bengal

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ABSTRACT

A field experiment was conducted during two consecutive *kharif* seasons at AB block Farm, Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal, India during 2019-20 and 2020-21, to study the effect of different post emergence herbicides for broad spectrum weed management in transplanted rice. The experiment was laid out in a randomized block design with ten treatments and replicated thrice. Treatments comprises T_1 : Bispyribac sodium 38% + Chlorimuron ethyl 2.5 + Metsulfuron methy l 2.5% (43% WG) 34.4 g ai/ha at 20 DAT, T_2 : Bispyribac sodium 38% + Chlorimuron ethyl 2.5 + Metsulfuron methyl 2.5% (43% WG) 43 g ai/ha at 20 DAS, T_3 : Bispyribac sodium 38% + Chlorimuron ethyl 2.5 + Metsulfuron methyl 2.5% (43% WG) 51.6 g ai/ha at 20 DAS, T_4 : Penoxsulam 1.02% + Cyhalofop-butyl 5.1% OD 135 g ai/ha at 20 DAT, T_5 : Bispyribac Sodium 10 % SC 25 g ai/ha at 20 DAT, T_6 : Bispyribac Sodium 10 % SC 38 g ai/ha at 20 DAT, T_7 : Metsulfuron Methyl + Chlorimuron ethyl 10 % WP + Surfactant 4 g ai/ha at 21 DAT, T_8 : Metsulfuron Methyl + Chlorimuron ethyl 10 % WP + Surfactant 5 g ai/ha at 21 DAT, T_9 : Hand weeding (twice at 20 and 40 DAP), T_{10} : Weedy check. Among the different herbicidal treatments, T_2 and T_3 recorded highest weed control efficiency. Two times hand weeding at 20 and 40 days after showing was found highest grain yield and straw yield (4190.18 and 6707.04 kg/ha) and it was on par with chemical application of Bispyribac sodium 38%+ Chlorimuron ethyl 2.5 + Metsulfuron methyl 2.5% (43% WG) 43 g ai/ha WG @ 51.6 & 43 g a.i. ha^{-1} (4179.06 and 6785.78 kg/ha) and (4152.78 and 6631.88 kg/ha) followed by rest of the treatments excluding control (1523.43 and 3463.70 kg/ha).

HIGHLIGHTS

- Herbicidal treatments significantly reduced weed infestation compared with the weedy check and improved crop productivity.
- Bispyribac sodium + Chlorimuron ethyl + Metsulfuron methyl (43% WG) at 43 and 51.6 g a.i. ha^{-1} recorded the highest weed control efficiency among herbicidal treatments.
- Grain and straw yields under these herbicidal treatments were statistically comparable with two hand weedings at 20 and 40 days after transplanting.
- Effective chemical weed management markedly enhanced rice yield compared with the weedy check treatment.

Keywords: Bio-efficacy, post emergence, weed species, WCE, seed yield

Rice (*Oryza sativa* L.) is one of the most cereal food crops and occupies a significant position in Indian. Rice is the most important cereal food; India occupies second rank in the world. Rice is contributing 45 % to the total food grain production in India and is grown in an area of 44.1 million

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ha with a production of 106.64 million tones and productivity of 2.42 t/ha (Bhatt *et al.* 2017). The crop weed competition is more prevalent in early stage of crop growth. It is very much crucial for weed management upto 50 days of crop. It has been estimated that without weed control, the yield loss can be as high as 90% (Ferrero and Tinarelli 2007). Out of the total 44 M ha area under rice cultivation, transplanting occupies 56 per cent (Anonymous, 2011). Besides mechanical means of weed management with conoweeder / rotary weeder post emergence herbicide is also efficient and cost effective. Keeping this in view, attention was paid to compile advanced weed management options that are apply in transplanted rice crop, to reduce the crop weed competition of weeds to achieve higher grain yield. Weeds remove a large amount of plants nutrients from soil. It is estimated that weeds can deprive the crops by 47% N, 42% P, 50% K, 39% Ca and 24% Mg of their nutrient uptake as well as reduce the yield potential by competition for space and light. Hence successful weed control is essential for obtaining higher yield of rice (Kumar *et al.* 2007). Transplanted rice is the most common practice throughout the world. Normally puddling is followed to reduce percolation losses, to control weeds and to make transplanting operation easier. Puddling and land submergence in transplanted rice gives better plant establishment where weed suppress by water logging and soil compaction through puddling. Thus, management of weeds is more effective through post emergence herbicide in transplanted rice cultivation.

The critical crop weed competition from starts with 28-45 days after transplanting in transplanted rice was reported by various workers (Raju and Reddy, 1995; and Singh *et al.* 2003). However it was reported that crop and weed competition up to 60 days stage of transplanted rice resulted in 72% grain yield reduction (Singh *et al.* 2004). Cyperus species competition for the first 30 days caused more than 10 % of the total yield loss in transplanted rice while competition for 40 days resulted in more than half (43.5%) of the total yield loss due to the different weeds. Singh *et al*. (2005) observed that grassy weed constituted 14.1%, sedges 71.4% and broad-leaf weeds 14.5% of the total weed population in rice crop at 30 days stage of crops. Mukherjee *et al.* (2008) observed that 20-40 days after transplanting was the most critical period of crop weed competition.

MATERIALS AND METHODS

The experiment was conducted during the *kharif* season of 2019-20 and 2020-21 at the AB block farm of BCKV, Kalyani. The study site comes under the Indo-Gangetic Plains of West Bengal with average rainfall of 1650 mm and evaporation of 1502 mm. Soil properties of the study site had low organic carbon with clay loam texture having pH of 6.6 and bulk density of ~1.28 g/cm^2. The experiment was conducted in RBD design and replicated thrice. The rice (v. MTU 1010) crop was cultivated with the ten different post emergence herbicide treatments on weed management practices. The experiment was conducted in a plot having the dimensions of 3 × 4 m^2 area. The weed management practices involved the application of T_1: Bispyribac sodium 38% + Chlorimuron ethyl 2.5 + Metsulfuron methyl 2.5% (43% WG) 34.4 g ai/ha at 20 DAT, T_2: Bispyribac sodium 38% + Chlorimuron ethyl 2.5 + Metsulfuron methyl 2.5% (43% WG) 43 g ai/ha at 20 DAS, T_3: Bispyribac sodium 38% + Chlorimuron ethyl 2.5 + Metsulfuron methyl 2.5% (43% WG) 51.6 g ai/ha at 20 DAS, T_4: Penoxsulam 1.02% + Cyhalofop-butyl 5.1% OD 135 g ai/ha at 20 DAT, T_5: Bispyribac Sodium 10 % SC 25 g ai/ha at 20 DAT, T_6: Bispyribac Sodium 10 % SC 38 g ai/ha at 20 DAT, T_7: Metsulfuron Methyl + Chlorimuron ethyl 10 % WP + Surfactant 4 g ai/ha at 21 DAT, T_8: Metsulfuron Methyl + Chlorimuron ethyl 10 % WP + Surfactant 5 g ai/ha at 21 DAT, T_9: Hand weeding (twice at 20 and 40 DAP), T_{10}: Weedy check.

Weed Control Efficiency (WCE)

Weed control efficiency is expressed as the percentage of control of weeds over unweeded control at 40 DAA. It denotes the efficiency of the applied herbicide for comparison purpose. WCE of different treatments was computed on the basis of weed dry weight by using the following formula,

$$\text{Weed Control Efficiency (\%)} = \frac{X - Y}{X} \times 100$$

Where,

X = Weed dry weight in control (untreated or un-weeded) plot

Y = Weed dry weight of treated plot

Statistical analysis

The data generated from field was subjected to statistical analysis using the technique of analysis of variance for split plot where main plot consisted of two varieties and subplot consisted of three irrigation frequencies. The data interpretation of results was done as described by Gomez and Gomez (1984). The treatment differences were compared at 5 per cent level of significance (P = 0.05).

RESULTS AND DISCUSSION

Weed species: The weed flora during crop period consisted of grasses, broad leaf and sedges. In the experimental plots, the dominant grass was identified *Echinochloa sp*, broad leaf weed flora were *Cynodan dactylon*, *Cyperus rotundus*, *Ludwigia sp*, *Eclipta alba*, *Sphenochlea zeylanica*, *Marsilea minuta* while *Cyperus difformis*, *Fimbristylis miliacea*, *Scirpu ssp*. were the dominant sedges (Table 1).

Table 1: List of weed flora found in the experimental plot

Grass	Broadleaf	Sedge
Echinochloa sp	*Ludwigia sp,*	*Cyperus difformis*
Dactyloctenium aegyptium, Leptochloa chinensis	*Eclipta alba, Sphenochlea zeylanica*	*Fimbristylis miliacea, Scirpus sp.*
	Marsilea minuta	

Weed dry weight

Data on species wise weed dry weight at 40 DAA have been presented in Table 2. The data on weed dry weight indicated that the post emergence application of tested herbicide i.e. Bispyribac sodium 38% + Chlorimuron ethyl 2.5 + Metsulfuron methyl 2.5% (43% WG) 43 g ai/ha WG effectively controlled the weed flora in transplanted rice. The total weed dry weight due to Bispyribac sodium 38% + Chlorimuron ethyl 2.5 + Metsulfuron methyl

Table 2: Dry weight of dominant weeds (gm^{-2}) 40 DAA of herbicide mean over two years

Treatments	Dose (g a.i.ha^{-1})	*Echinochloa sp*	*Ludwigia sp*	*Eclipta alba*	*Sphenochlea zeylanica*	*Marsilea minuta*	*Cyperus difformis*	*Fimbristylis miliacea*	*Scirpus sp*	Total Dry weight
T_1	34.4	1.34 (1.36)	3.47 (1.99)	1.85 (1.53)	2.46 (1.72)	0.99 (1.22)	2.14 (1.62)	2.02 (1.59)	1.75 (1.50)	16.02 (4.06)
T_2	43.0	0.81 (1.14)	1.13 (1.28)	0.02 (0.72)	1.01 (1.23)	0.00 (0.71)	0.59 (1.04)	0.45 (0.97)	0.50 (1.00)	4.51 (2.24)
T_3	51.6	0.83 (1.15)	1.01 (1.23)	0.00 (0.71)	1.01 (1.23)	0.00 (0.71)	0.57 (1.03)	0.44 (0.97)	0.40 (0.95)	4.26 (2.18)
T_4	135	0.89 (1.18)	1.01 (1.23)	0.00 (0.71)	1.01 (1.23)	0.00 (0.71)	0.76 (1.12)	0.64 (1.07)	0.21 (0.84)	4.52 (2.24)
T_5	25	1.06 (1.25)	4.28 (2.19)	1.19 (1.30)	2.57 (1.75)	0.64 (1.07)	1.56 (1.44)	1.43 (1.39)	1.18 (1.30)	13.91 (3.80)
T_6	38	0.91 (1.19)	3.27 (1.94)	0.99 (1.22)	2.36 (1.69)	0.00 (0.71)	0.93 (1.20)	0.81 (1.14)	0.56 (1.03)	9.83 (3.21)
T_7	4	12.18 (3.56)	1.37 (1.37)	0.00 (0.71)	1.01 (1.23)	0.00 (0.71)	0.88 (1.17)	0.76 (1.12)	0.51 (1.00)	16.71 (4.15)
T_8	5	12.17 (3.56)	1.04 (1.24)	0.00 (0.71)	1.01 (1.23)	0.00 (0.71)	0.34 (0.92)	0.22 (0.85)	0.12 (0.79)	14.90 (3.92)
T_9	—	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)
T_{10}	—	12.21 (3.57)	12.50 (3.61)	3.45 (1.99)	5.38 (2.42)	6.54 (2.65)	10.34 (3.29)	7.87 (2.89)	7.78 (2.88)	66.07 (8.16)
CD at 5 %		0.30	0.11	0.20	0.06	0.06	0.10	0.12	0.11	1.70

T_1: Bispyribac sodium 38% + Chlorimuron ethyl 2.5 + Metsulfuron methyl 2.5% (43% WG) 34.4 g ai/ha at 20 DAT, T_2: Bispyribac sodium 38% + Chlorimuron ethyl 2.5 + Metsulfuron methyl 2.5% (43% WG) 43 g ai/ha at 20 DAS, T_3: Bispyribac sodium 38% + Chlorimuron ethyl 2.5 + Metsulfuron methyl 2.5% (43% WG) 51.6 g ai/ha at 20 DAS, T_4: Penoxsulam 1.02% + Cyhalofop-butyl 5.1% OD 135 g ai/ha at 20 DAT, T_5: Bispyribac Sodium 10 % SC 25 g ai/ha at 20 DAT, T_6: Bispyribac Sodium 10 % SC 38 g ai/ha at 20 DAT, T_7: Metsulfuron Methyl + Chlorimuron ethyl 10 % WP + Surfactant 4 g ai/ha at 21 DAT, T_8: Metsulfuron Methyl + Chlorimuron ethyl 10 % WP + Surfactant 5 g ai/ha at 21 DAT, T_9: Hand weeding (twice at 20 and 40 DAP), T_{10}: Weedy check. Data in parentheses are Square root transformed value of (X + 0.5) and used for statistical analysis.

2.5% (43% WG) 43 g ai/ha WG @ 51.6 g a.i ha^{-1} (2.18 g/m^2) were lowest and followed by T_2 and T_4 at 40 DAA mean over two years, and statistically superior then rest of the treatments excluding control.

Weed control efficiency (WCE)

The weed dry weight at 40 DAA mean over two years have been presented in Table 3. The data on weed dry weight indicated that the post emergence application of tested herbicide i.e. T_4, T_2 and T_3 effectively controlled the weed flora in transplanted rice. The maximum (93.16%) weed control efficiency recoded in T_4- Penoxsulam 1.02% + Cyhalofop-butyl 5.1% OD 135 g ai/ha at 20 DAT which is at per with the T_2 - Bispyribac sodium 38% + Chlorimuron ethyl 2.5 + Metsulfuron methyl 2.5% (43% WG) treatment. The weed control efficiency for transplanted rice weed flora due to the herbicidal treatments ranged from 74.71-100%.

Weed density

The species-wise weed population was recorded 40 days after application and presented in table 4. However lower density of grasses, sedge and broad leaf weeds was noticed 40 days after application with T_2 and T_3 treatments. Further among category of weeds, sedges and broad leaf weed population was relatively higher in all the treatments followed by grass.

The maximum control of *Cyperus difformis* (0.16 nos./m^2) weeds was observed in Bispyribac sodium 38%+ Chlorimuron ethyl 2.5 + Metsulfuron methyl 2.5% (43% WG) 43 g a.i. ha^{-1} (Table 4) and significantly superior in control of sedge population over untreated control and hand weeding. Similarly, the significant control of grasses i.e. *Fimbristylis miliacea* was with post emergence application of T_3 at 40 DAA over two years followed by rest of the weed control treatments, Again, effective lowering of broad leaf weed was with post emergence application of Bispyribac sodium 38% + Chlorimuron ethyl 2.5 + Metsulfuron methyl 2.5% (43% WG) @ 51.6 g a.i. ha^{-1} and statistically at par with Bispyribac sodium 38% + Chlorimuron ethyl 2.5 + Metsulfuron methyl 2.5% (43% WG) @ 34.4 g a.i. ha^{-1}, Penoxsulam 1.02% + Cyhalofop-butyl 5.1% OD @ 135 g a.i. ha^{-1} and Metsulfuron methyl + Chlorimuron ethyl 10% WP @ 4 to 5 g a.i. ha^{-1} respectively (Table 4). Patra *et al.* (2011) observed that application of chlorimuron-ethyl + metsulfuron-methyl 0.004 kg/ha mixed with butachlor 0.938 kg/ha at 3 days after transplanting (DAT) was at par with hand weeding twice at 20 and 40 DAT in controlling weeds and higher grain yield. At 40 days after application, significant

Table 3: Weed control efficiency (%) at 40 DAA of herbicide mean over two years

Treatments	Dose (g a.i.ha^{-1})	*Echinochloa sp*	*Ludwigia sp*	*Eclipta alba*	*Sphenochlea zeylanica*	*Marsilea minuta*	*Cyperus difformis*	*Fimbristylis miliacea*	*Scirpus sp*	Total %WCE
T_1	34.4	89.03	72.24	46.38	54.28	84.86	79.30	74.33	77.51	75.75
T_2	43.0	93.37	90.96	99.42	81.23	100.00	94.30	94.28	93.57	93.18
T_3	51.6	93.20	91.92	100.00	81.23	100.00	94.49	94.41	94.86	93.55
T_4	135	92.71	91.92	100.00	81.23	100.00	92.65	91.87	97.30	93.16
T_5	25	91.32	65.76	65.51	52.23	90.21	84.91	81.83	84.83	78.95
T_6	38	92.55	73.84	71.30	56.13	100.00	91.01	89.71	92.80	85.12
T_7	4	0.25	89.04	100.00	81.23	100.00	91.49	90.34	93.44	74.71
T_8	5	0.33	91.68	100.00	81.23	100.00	96.71	97.20	98.46	77.45
T_9	—	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
T_{10}	—	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

T_1: Bispyribac sodium 38% + Chlorimuron ethyl 2.5 + Metsulfuron methyl 2.5% (43% WG) 34.4 g ai/ha at 20 DAT, T_2: Bispyribac sodium 38% + Chlorimuron ethyl 2.5 + Metsulfuron methyl 2.5% (43% WG) 43 g ai/ha at 20 DAS, T_3: Bispyribac sodium 38% + Chlorimuron ethyl 2.5 + Metsulfuron methyl 2.5% (43% WG) 51.6 g ai/ha at 20 DAS, T_4: Penoxsulam 1.02% + Cyhalofop-butyl 5.1% OD 135 g ai/ha at 20 DAT, T_5: Bispyribac Sodium 10 % SC 25 g ai/ha at 20 DAT, T_6: Bispyribac Sodium 10 % SC 38 g ai/ha at 20 DAT, T_7: Metsulfuron Methyl + Chlorimuron ethyl 10 % WP + Surfactant 4 g ai/ha at 21 DAT, T_8: Metsulfuron Methyl + Chlorimuron ethyl 10 % WP + Surfactant 5 g ai/ha at 21 DAT, T_9: Hand weeding (twice at 20 and 40 DAP), T_{10}: Weedy check. Data in parentheses are Square root transformed value of (X + 0.5) and used for statistical analysis.

Table 4: Weeds density (number m^{-2}) 40 days after application of herbicide mean over two years

Treatments	Dose (g a.i.ha^{-1})	*Echinochloa sp*	*Ludwigia sp*	*Eclipta alba*	*Sphenochlea zeylanica*	*Marsilea minuta*	*Cyperus difformis*	*Fimbristylis miliacea*	*Scirpus sp*
T_1	34.4	2.10 (1.61)	2.90 (1.84)	1.18 (1.30)	1.22 (1.31)	0.53 (1.02)	2.10 (1.61)	1.22 (1.31)	2.17 (1.63)
T_2	43.0	1.10 (1.26)	1.12 (1.27)	0.45 (0.97)	1.02 (1.23)	0.34 (0.91)	1.21 (1.31)	0.68 (1.08)	1.40 (1.38)
T_3	51.6	1.01 (1.23)	1.11 (1.27)	0.20 (0.84)	0.71 (1.10)	0.20 (0.84)	0.16 (0.81)	0.47 (0.99)	0.97 (1.21)
T_4	135	1.02 (1.23)	1.11 (1.27)	0.21 (0.84)	0.66 (1.08)	0.20 (0.84)	1.18 (1.30)	0.80 (1.14)	0.86 (1.17)
T_5	25	3.19 (1.92)	3.49 (2.00)	1.20 (1.30)	1.22 (1.31)	0.20 (0.84)	2.54 (1.74)	1.19 (1.30)	1.10 (1.26)
T_6	38	1.10 (1.26)	3.16 (1.91)	1.11 (1.27)	1.24 (1.32)	0.30 (0.89)	2.12 (1.62)	0.98 (1.22)	1.04 (1.24)
T_7	4	25.49 (5.10)	2.25 (1.66)	0.49 (1.00)	0.99 (1.22)	0.10 (0.77)	1.32 (1.35)	0.68 (1.08)	0.73 (1.11)
T_8	5	25.26 (5.08)	2.15 (1.63)	0.20 (0.84)	0.91 (1.19)	0.10 (0.77)	1.20 (1.30)	0.37 (0.93)	0.57 (1.04)
T_9	—	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)
T_{10}	—	28.34 (5.37)	14.12 (3.82)	5.12 (2.37)	4.11 (2.15)	8.32 (2.97)	55.43 (7.48)	9.43 (3.15)	9.23 (3.12)
CD at 5 %		0.11	0.09	0.12	0.07	0.09	0.14	0.11	0.13

T_1: Bispyribac sodium 38% + Chlorimuron ethyl 2.5 + Metsulfuron methyl 2.5% (43% WG) 34.4 g ai/ha at 20 DAT, T_2: Bispyribac sodium 38% + Chlorimuron ethyl 2.5 + Metsulfuron methyl 2.5% (43% WG) 43 g ai/ha at 20 DAS, T_3: Bispyribac sodium 38% + Chlorimuron ethyl 2.5 + Metsulfuron methyl 2.5% (43% WG) 51.6 g ai/ha at 20 DAS, T_4: Penoxsulam 1.02% + Cyhalofop-butyl 5.1% OD 135 g ai/ha at 20 DAT, T_5: Bispyribac Sodium 10 % SC 25 g ai/ha at 20 DAT, T_6: Bispyribac Sodium 10 % SC 38 g ai/ha at 20 DAT, T_7: Metsulfuron Methyl + Chlorimuron ethyl 10 % WP + Surfactant 4 g ai/ha at 21 DAT, T_8: Metsulfuron Methyl + Chlorimuron ethyl 10 % WP + Surfactant 5 g ai/ha at 21 DAT, T_9: Hand weeding (twice at 20 and 40 DAP), T_{10}: Weedy check. Data in parentheses are Square root transformed value of (X + 0.5) and used for statistical analysis.

control of total weed population was noticed with post emergence application of T_3 treatment. In comparison to untreated control at 40 days after application, the density of total weeds appeared was lower in post emergence application of T_3 treatment @ 51.6 g a.i. ha^{-1} followed by all the treatments except hand weeding in two times (20 and 40 DAT).

Grain yield and Economics

The grain and straw yield of transplanted rice varied significantly due to post emergence herbicides presented in Table 5. Two times hand weeding at 20 and 40 days after showing was found highest grain yield and straw yield (4190.18 and 6707.04 kg/ha) and it was on par with chemical application of Bispyribac sodium 38% + Chlorimuron ethyl 2.5 + Metsulfuron methyl 2.5% (43% WG) @ 34.4 g a.i. ha^{-1} 51.6 & 43 g a.i. ha^{-1} (4179.06 and 6785.78 kg/ha) and (4152.78 and 6631.88 kg/ha) followed by rest of the treatments excluding control (1523.43 and 3463.70 kg/ha) (Table 5). The maximum gross return and BC ratio recorded from the T_3, treatment ₹ 99511/- and 2.18 respectively. Veeraputhiran and Balasubramanian (2012) recorded higher economic benefits like net income and benefit cost ratio with the post emergence application of bispyribac-Na at 25 g/ha than all the other weed management treatments under Madurai situations.

Grain yield and Weed control efficiency relationship

Correlation with grain yield and weed control efficiency presented in Fig. 1. Grain yield variations observed with the variation of weed control efficiency of post emergence herbicides. A positive Correlation observed in grain yield with weed control efficiency. Yield variations about 27.78% is only due to the efficacy of post emergence herbicides.

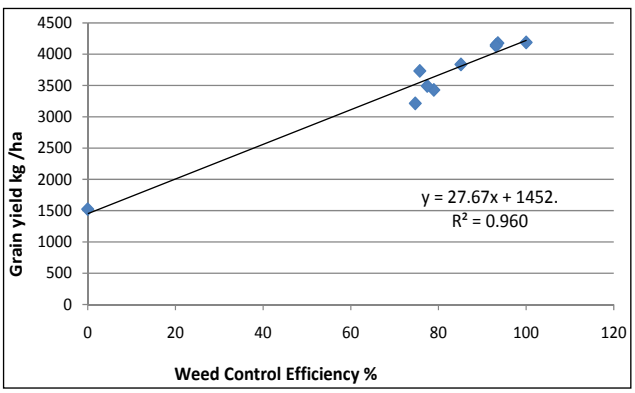

Fig. 1: Correlation with seed yield and weed control efficiency

Table 5: Effect of different post emergence herbicide on grain yield and economics at 40 days after application of herbicide mean over two years

Treatments	Grain Yield (kg/ha)	Straw yield (kg/ha)	Harvest Index (HI)	Gross Returns (₹/ha)	Net returns (₹/ha)	B:C
T_1	3734.26	5927.18	63.00	88852	43502	1.96
T_2	4152.78	6631.88	62.62	98830	53180	2.16
T_3	4179.06	6785.78	61.59	99511	53761	2.18
T_4	4133.57	6265.35	65.98	98205	52255	2.14
T_5	3429.98	5937.30	57.77	81858	36258	1.80
T_6	3838.39	6092.21	63.00	91329	46769	2.05
T_7	3214.66	5829.98	55.14	76852	31552	1.70
T_8	3493.67	6073.99	57.52	83391	37791	1.83
T_9	4190.18	6807.04	61.56	99778	53528	2.16
T_{10}	1523.43	3463.76	43.98	36771	2271	1.07
S.Em ±	**251.02**	**330.10**	—	—	—	—
CD @ 5%	**751**	**985**				

T_1: Bispyribac sodium 38% + Chlorimuron ethyl 2.5 + Metsulfuron methyl 2.5% (43% WG) 34.4 g ai/ha at 20 DAT, T_2: Bispyribac sodium 38% + Chlorimuron ethyl 2.5 + Metsulfuron methyl 2.5% (43% WG) 43 g ai/ha at 20 DAS, T_3: Bispyribac sodium 38% + Chlorimuron ethyl 2.5 + Metsulfuron methyl 2.5% (43% WG) 51.6 g ai/ha at 20 DAS, T_4: Penoxsulam 1.02% + Cyhalofop-butyl 5.1% OD 135 g ai/ha at 20 DAT, T_5: Bispyribac Sodium 10 % SC 25 g ai/ha at 20 DAT, T_6: Bispyribac Sodium 10 % SC 38 g ai/ha at 20 DAT, T_7: Metsulfuron Methyl + Chlorimuron ethyl 10 % WP + Surfactant 4 g ai/ha at 21 DAT, T_8: Metsulfuron Methyl + Chlorimuron ethyl 10 % WP + Surfactant 5 g ai/ha at 21 DAT, T_9: Hand weeding (twice at 20 and 40 DAP), T_{10}: Weedy check. Data in parentheses are Square root transformed value of (X + 0.5) and used for statistical analysis.

CONCLUSION

It is concluded that the post emergence application of herbicides in transplanted rice resulted in higher paddy grain yield, straw yield and economics, except hand weeding twice at 20 and 40 DAT. The higher weed control efficiency was recorded in Bispyribac sodium 38% + Chlorimuron ethyl 2.5 + Metsulfuron methyl 2.5% (43% WG) @ 34.4 g a.i. ha^{-1} 51.6 & 43 g a.i. ha^{-} and it was on per with hand weeding twice. The higher grain yield and weed control efficiency with the application of Bispyribac sodium 38% + Chlorimuron ethyl 2.5 + Metsulfuron methyl 2.5% (43% WG) @ 34.4 g a.i. ha^{-1} 51.6 & 43 g a.i. ha^{-} at 40 DAT was due to broad spectrum control of all categories of weeds viz., broad leaved, grasses and sedges in the beginning crop growth as indicated by their species wise lower density and dry weight.

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