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Short Research Article

Evaluation of Herbicide Combination Against Mixed Weed Flora in Direct Seeded Rice (*Oryza sativa* L.)

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Abstract

A field experiment was conducted to study the effect of pre and post emergence herbicide combination practices on complex weed flora in direct seeded rice (*Oryza sativa*) during *kharif* 2007 and 2008. The treatments consisted of Bispyribac-sodium (10 SC) @ 25 g ai ha^{-1} at 20 DAS, Pendimethlain (38.7 CS) @ 1000 g ai ha^{-1} as pre em fb Bispyribac, Oxadiargyl (80 WP) @ 100 g ai ha^{-1} as pre em fb Bispyribac-sodium, Pendimethlain (38.7 CS) as pre em fb Bispyribac fb manual weeding at 45 DAS, Pendimethlain (38.7 CS) as pre em fb manual weeding at 30 DAS, Bispyribac sodium (10 SC) @ 25 g ai ha^{-1}+Chlorimuron methyl+Metsulfuron methyl (20 WP) @ 4.0 g ai ha^{-1} at 20 DAS in comparison to passing cono weeder and hand weeding at 20 and 40 DAS and weedy check condition in RBD with three replications. The results indicated that the density and dry weight of weeds were significantly lower with two hand weeding, application with cono weeder and the among herbicide combinations Pendimethalin fb Bispyribac fb hand weeding treatments. Higher WCE and grain yields of direct seeded rice were significantly higher with application of above mentioned herbicide combinations and were at par with hand weeding and cono weeder treatments. The comparative economic study reveals that the herbicide combination treatments, Pendimethalin fb Bispyribac fb hand weeding recorded highest net return of ₹ 18,791/- with B:C ratio of 1.97 followed by Pendimethalin fb Bispyribac which recorded net return of ₹ 18,500/- with slightly higher B:C ratio of 2.03.

1. Introduction

In India rice is grown in both *kharif* and *Rabi* seasons under diverse ecological and climatic conditions apart from socio-economic diversities of the regions. In India 33% of total rice land has got irrigation facilities and rest is totally dependent upon rainfall. Rice, the most important staple food crop of India which is cultivated under various ecosystems, viz. direct dry seeded, direct wet seeded sown, puddle transplanted and puddle double transplanted situation. Direct Seeded Rice (DSR) has several advantages over puddle transplanted rice. Direct seeding is gaining momentum in the recent past as it saves time, energy; improves profitability; increases cropping intensity; and avoids arduous operations such as nursery preparation and transplanting (Subbaiah and Balasubramanian, 2000). Direct seeding also saves labour and 7–10 days earlier maturity of the direct seeded crop enables timely sowing of the succeeding crop and thus fits best in different cropping systems.

The change in crop establishment technique from transplanted to direct seeded rice culture, is subjected to greater weed competition than transplanted rice because both weed and crop seeds emerge at the same time resulting in severe yield reduction. Moreover, weed menace is a major concern in direct seeded rice. In direct seeded rice cultivation severe crop weed competition resulted in 60–80% reduction in rice yields (Mishra and Singh, 2007; Chauhan and Johnson, 2010). The share of weed management cost is higher than other operation in DSR. Management of heavy infestation of weeds is one of the major constraints for successful cultivation of direct seeded rice. Success of direct seeded rice depends largely on effective management of weeds. Various herbicides have been used for controlling weeds in direct seeded rice, but efficiency of pre emergence herbicides is unsatisfactory because of narrow range of weed control. Therefore, application of post-emergence herbicides in addition to pre-emergence herbicides can be more useful for season long weed control. Keeping in view,

the present field investigation was carried out at NDUAT, Faizabad to test the performance of various pre and post emergence herbicides and to find out the best herbicides or herbicide mixtures for control of weeds in direct-seeded rice.

2. Materials and Methods

A field experiment was conducted for two seasons during *kharif* 2007 and 2008 to know the bio-efficiency of combination of herbicides against complex weed flora and their effect on growth and yield of direct seeded rice, apart from knowing the phytotoxicity effect, if any at the KVK Instructional Farm, Crop Research Station, Masodha, Faizabad of Narandra Dev University of Agriculture and Technology, Kumarganj, Faizabad, Uttar Pradesh (India). The soil type was silty clay loam with low in available N, P and K having pH 7.5 to 8. Rice variety NDR 359 was sown using stale seed bed technique through zero till machine with 60 kg seed ha^{-1} in the third week of June in both the years of experiment. Recommended dose of Fertilizers was uniformly applied to all the treatments. Recommended dose of 120:60:50 kg NPK ha^{-1}, respectively was uniformly applied to all the treatments. Full dose of P and K besides half dose of N were applied at the time of sowing where as rest of the N was given in 2 equal splits by top dressing at tillering and flowering stage. Other agronomic practices were used as recommendation^{-1} of the crop. The treatment combinations tested in a RBD design replicated thrice were Bispyribac-sodium (10 SC) @ 25 g ai ha^{-1} at 20 DAS, Pendimethlain (38.7 CS) @ 1000 g ai ha^{-1} as pre em fb Bispyribac (10 SC) @ 25 g ai ha^{-1} at 25 DAS, Oxadiargyl (80 WP) @ 100 g ai ha^{-1} as pre em fb Bispyribac-sodium (10 SC) @ 25 g ai ha^{-1} at 25 DAS, Pendimethlain (38.7 CS) as pre em fb Bispyribac (10 SC) @ 25 g ai ha^{-1} at 25 DAS fb manual weeding at 45 DAS, Pendimethlain (38.7 CS) as pre em fb manual weeding at 30 DAS, Bispyribac sodium (10 SC) @ 25 g ai ha^{-1}+Chlorimuron ethyl+Metsulfuron methyl (20 WP) @ 4.0 g ai ha^{-1} at 20 DAS in comparison to passing cono weeder and hand weeding at 20 and 40 DAS and weedy check condition. All weed control treatments were applied as treatments^{-1} with the help of manually operated knapsack sprayer fitted with flat fan nozzle using 600 liters of water ha^{-1}. The observations on weeds and crop were taken as standard^{-1} procedure followed and being statistically analyzed to draw the reliable results and relevant data on weeds was subjected to square root transformation to normalize their distribution.

3. Results and Discussion

Major weed flora observed at experimental field were *Echinochloa colona*, *Echinochloa crusgalli*, *Eleusine indica*, *Cynodon dactylon* as grassy weeds *Celosia argentia*, *Eclipta alba*, *Ammania baccifera*, *Ludwigia parviflora, Marsilea quadrifolia* as broad leaved weed, and *Cyperus rotundus, Cyperus iria* and *Fimbristylis milliaceae* as sedges. Among the weed species, the densities of *Echinochloa colona*, *Echinochloa crusgalli*, *Celosia argentia, Cyperus rotundus* and *Cyperus iria* were more than other weed species, indicating their dominance during the crop cycle in both years.

All the weed management treatments reduced weed population and weed dry weight significantly (Table 1) during the pooled data of both the years. Among various herbicide combinations, Pendimethlain fb Bispyribac sodium, Pendimethlain fb Bispyribac fb hand weeding at 45 DAS were better in controlling the density of weed complex at 60 DAS and found at par with the application of cono weeder at 20 and 40 DAS. Similar findings were also found by Kumar and Kumar (2014); Nitave et al. (2014) with the pre and post emergence herbicide combinations. However, the two hands weeding at 20 and 40 DAS completely eradicate the weed population at 60 DAS; this was mainly due to smothering effect of rice tillers which inhibits the further germination of weeds. Similar trends were also with the weed dry weight at 60 DAS. Pendimethalin fb Bispyribac fb manual weeding reduced the maximum dry weight of weeds which was at par with cono weeder application and found superior to all weed control treatments. Similar trends were obtained by weed control efficiency. Maximum weed control efficiency (100%) were obtained with two hand weeding treatment followed by Pendimethalin fb Bispyribac fb manual weeding treatments (96.97%) followed by cono weeder treatment (96.18%). Reddy (2012) also observed in pigeon pea crop that application of herbicides in combination with cultural weed control methods were more effective in reducing weed biomass and getting higher weed control efficiency in different crops. Similarly, weed index were also superior in Pendimethalin fb Bispyribac fb manual weeding (3.32%), Pendimethalin fb Bispyribac (7.60%) and cono weeder application (5.20) treatments as compared to other weed control treatments (Table 1).

The weed management practices adopted in direct seeded rice significantly improved the yield of rice by reducing the weed competition (Table 2). Weed free treatment recorded the significantly higher grain yield (41.56 q ha^{-1}) over all the weed control treatments except Pendimethalin fb Bispyribac fb hand weeding (40.18 q ha^{-1}), Pendimethalin fb Bispyribac (38.40 q ha^{-1}) and cono weeder application treatment (39.40 q ha^{-1}). All the herbicidal treatment recorded significantly higher grain yield compared to weedy check (16.47 q ha^{-1}). Among the herbicidal treatments, Pendimethalin fb Bispyribac fb hand weeding resulted in higher grain yield comparable to hand weeding at 20 and 40 DAS and cono weeder application and were significantly superior to other pre and post-emergence herbicides and their combination. The higher grain yield was

Table 1: Effect of various weed management treatments on density and dry weight of weeds, weed control efficiency and weed index in direct seeded rice (pooled data of two years)

Treatment	Weed density at 60 DAS (Number m^{-2})	Weed dry weight at 60 DAS (g m^{-2})	Weed control efficiency	Weed index
Bispyribac sodium 10% SC	5.01 (149)	4.81 (122.1)	19.57	37.80
Pendimethalin fb bispyribac	3.22 (24)	3.06 (20.4)	86.56	7.60
Oxadiargyl fb bispyribac	4.40 (81)	4.36 (77.5)	48.95	23.36
Pendimethalin fb bispyribac fb manual weeding	2.30 (09)	1.72 (4.6)	96.97	3.32
Pendimethalin fb manual weeding	4.55 (94)	4.45 (84.6)	44.27	29.33
Bispyribac+(Chlorimuron+Metsulfuron)	4.73 (112)	4.63 (101.7)	33.00	36.84
Two mechanical weeding (cono weeder)	2.64 (13)	1.92 (5.8)	96.18	5.20
Weed free (HW at 20 and 40 DAS)	0.0 (0)	0.00 (0.0)	100.00	-
Weedy check	5.24 (187)	5.03 (151.8)	-	60.37
CD (p=0.05)	0.73	0.58	-	-

Original value is given in parenthesis

attributed to better control of weeds during early stage of crop growth which resulted in better availability of nutrients, moisture, space and light resulting in better superior yield components as reflected in number of panicles m^{-2}. These results are in conformity with the findings of Sanjay et al. (2012). However, unweeded check lowered the grain yield by 60% due to severe weed competition from initial stages (Table 2).

The comparative economics of the treatments revealed that highest net returns of ₹ 21,782 ha^{-1} and B:C ratio of 2.23 was found with the two hand weeding treatment followed by cono weeder application treatment (₹ 20,430/- and 2.20) which was superior over rest of all other treatments under study (Table 2). Among the herbicide combination treatments, Pendimethalin fb Bispyribac fb hand weeding recorded highest net return of ₹ 18,791/-with B:C ratio of 1.97 followed by Pendimethalin fb Bispyribac which recorded net return of ₹ 18,500/-with slightly higher B:C ratio of 2.03.

Table 2: Effect of various weed management treatments on density and dry weight of weeds, weed control efficiency and weed index in direct seeded rice (pooled data of two years)

Treatment	No. of panicles m^{-2}	Grain yield (q ha^{-1})	Net return (₹ ha^{-1})	B:C ratio
Bispyribac sodium 10% SC	224	25.85	8778.00	1.56
Pendimethalin fb bispyribac	252	38.40	18500.00	2.03
Oxadiargyl fb bispyribac	238	31.85	13008.00	1.75
Pendimethalin fb bispyribac fb manual weeding	269	40.18	18791.00	1.97
Pendimethalin fb manual weeding	230	29.37	10802.00	1.63
Bispyribac+(Chlorimuron+Metsulfuron)	219	26.25	8208.00	1.49
Two mechanical weeding (cono weeder)	267	39.40	20430.00	2.20
Weed free (HW at 20 and 40 DAS)	274	41.56	21782.00	2.23
Weedy check	181	16.47	2147.00	1.16
CD (p=0.05)	16.2	8.46	-	-

4. Conclusion

Two hand weeding and cono weeder application and among herbicide combinations Pendimethalin fb Bispyribac fb hand weeding and Pendimethalin fb Bispyribac may be the best for the effective control of grasses, broad leaved weeds, and sedges of direct seeded rice and improving the grain yield.

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