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Bioefficacy of pre- and post-emergence herbicides in direct-seeded rice in Central Punjab

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ABSTRACT

Field experiments were conducted during *Kharif* season of 2007 and 2008 at Punjab Agricultural University, Ludhiana to evolve suitable combination of pre and post-emergence herbicides for effective weed management in direct-seeded rice under unpuddled conditions. Results indicated that during 2007, integration of post-emergence application (30 Days after sowing) of bispyribac (25 and 30 g/ha) or azimsulfuron (20 g/ha) with pre-emergence application of pendimethalin 0.75 kg/ha, pretilachlor 0.5 kg/ha and thiobencarb 1.25 kg/ha provided effective control of weeds and produced significantly higher grain yields than unweeded (control) treatment. During 2008 also, integration of pre-emergence application of pendimethalin 0.75 kg/ha or oxadiargyl 0.90 g/ha with post-emergence application of bispyribac 25 kg/ha, azimsulfuron 20 g/ha and 2,4-D 0.5 kg/ha resulted in significant reduction in dry matter of weeds and increased grain yield as compared to alone application of pendimethalin 0.75 kg/ha. Pre-emergence application of flufenacet 80 g/ha and early post-emergence application of penoxsulam 30 and 35/g ha were found ineffective for controlling weeds.

Key words: Direct-seeded rice, Dry matter accumulation, Herbicides, Seed yield, Weed control

Rice (*Oryza sativa* L.) is the most important staple food for more than half of the world's population, including regions of high population density and rapid growth. India has the largest area among rice growing countries and stands second in production. Rice is being cultivated by three principal methods *viz.*, transplanting, dry seeding and wet seeding. Transplanting is the traditional system of rice cultivation and it is in vogue in many rice growing areas. Expansion in the irrigated area, introduction of early maturing rice cultivars, availability of selective herbicides for weed management together with increasing transplanting cost and declining profitability of transplanted rice production system have encouraged rice farmers to shift from transplanting to direct seeding (Subbaiah *et al.* 1999). In order to check the declining water table, a new technique of direct-seeding is now fast replacing traditional transplanted rice in areas with good drainage and irrigation facilities (Balasubramanian and Hill 2000). Globally, actual rice yield losses due to pests have been estimated at 40%, of which weeds have the highest loss potential (32%). The worldwide estimated loss in rice yield from weeds is around 10% of the total production (Oerke and Dehne 2004). However, for cultivation of direct-seeded rice, weeds are a major hurdle as nearly all *Kharif* season weeds depending upon seed bank in the field infest this crop. Direct seeding of rice is possible, provided there is a good crop establishment as well as adequate weed control methods are available to keep the crop free from weeds (Rao *et al.* 2007, Rao and Nagamani 2007) , however in absence of proper weed control, rice yields are reduced by 35-100 per cent in DSR (Kumar *et al.* 2008). Weeds pose major problem in rice production due to the prevalence of congenial atmosphere during *Kharif* season and uncontrolled weeds compete with dry-seeded rice and reduce yield upto 30.2% (Singh *et al.* 2005). The risk of crop yield loss due to competition from weeds by all seeding methods is higher than for transplanted rice because of the absence of the size differential between the crop and the weeds and the suppressive effect of standing water on weed growth at crop establishment. The conversion from transplanted to direct seeded rice results in more aggressive weed flora and increases reliance on herbicides for weed control. The adoption of direct seeded rice has resulted in a change in the relative abundance of weed species in rice crops. In particular *Echinochloa* spp., *Ischaemum rugosum*, *Cyperus difformis* and *Fimbristylis miliacea* are widely adapted to conditions of DSR. Chemical weed control (pre-emergence and post-emergence application) provides best weed control and grain yield. So, present investigations were undertaken to find out appropriate combination of pre and post-emergence herbicides to keep direct-seeded rice free from weeds.

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MATERIALS AND METHODS

Field experiments were conducted during *Kharif* 2007 and 2008 at Punjab Agricultural University, Ludhiana (30^0 56’ N latitude with 75^0 52' E longitude, 247 m mean sea level) to find out appropriate combination of herbicides in direct seeded rice. Direct seeding of rice was done in unpuddled (dry) conditions during both the years. The experiment field was loamy sand in texture with 76.7% sand, 9.2% silt and 14.0% clay. It was low in available nitrogen (255 and 263 kg/ha), medium in available P (11.8 and 12.7 kg/ha) and K (138.5 and 146.5 kg/ha) during 2007 and 2008, respectively. During 2007 pre-emergence application of pendimethalin 750 g/ha, pretilachlor 400 g/ha, thiobencarb 1250 g/ha and oxadiargyl 60 g/ha were followed by post-emergence (25 DAS) application of bispyribac 25 and 30 g/ha and azimsulfuron 20 g/ha. Alone pre-emergence application of pretilachlor 500 g/ha, flufenacet 80 g/ha as well as post–emergence application of bispyribac 25, 30 and 35 g/ha and pinoxsulam 30 and 35 g/ha were also kept. Unweeded control was also kept as check.

During 2008, pendimethalin at 750 g/ha and penoxsulam 30 g/ha were applied as pre-emergence. Integration of pre-emergence pendimethalin 750 g/ha with post-emergence application of azimsulfuron 20 g/ha, 2, 4-D 500g/ha, metsulfuron 15 g/ha, etoxysulfuron 20g/ha and bensulfuron 60 g/ha as well as pre-emergence application of oxadiargyl 90 g/ha followed by post-emergence application of bispyribac 25 g/ha, azimsulfuron 20 g/ha, ethoxysulfuron 20 g/ha were applied. Tank mix application of bispyribac + azimsulfuron (25 + 20 g/ha), bispyribac + etoxysulfuron (25 g + 20 g/ha), Bispyribac + 2,4-D (25 g + 500 g/ha) were also included along with post-emergence application of bispyribac 25 g/ha and unweeded control. All the post-emergence herbicides were applied 30 days after sowing with knapsack sprayer using 250 litre water/ha. Direct-seeding of rice variety PR 115 was done manually with hand drill keeping row to row spacing of 20 cm on 10th June, 2007 and 7th June, 2008 using seed rate of 50 kg/ha. Data on weed dry matter was recorded at 60 DAS with quadrate measuring 50×50 cm and expressed as t/ha. Data on plant height, effective tillers, panicle length and grain yield was recorded at the time of crop harvest. Data was subjected to analysis as detailed by Cheema and Singh (1991) in statistical package CPCS-1.

RESULTS AND DISCUSSION

The major weed flora of the experiment field consisted of sedges (*Cyperus rotundus*, *Cyperus iria* and *Cyperus compressus*), grasses (*Digitaria sanguinalis*, *Echinochloa* spp, *Eleusine aegyptiacum*, *Leptochloa chinesis* and *Eragrostis* spp.) and broadleaves (*Ammania baccifera* and *Caesulia axillaris*). In 2007, all the herbicidal treatments reduced the dry matter of weeds significantly as compared to the unweeded control except for post-emergence application of penoxsulam 30 and 35 g/ha. Lowest weed dry matter (80 kg/ha) was recorded with the pre-emergence application of pendimethalin 0.75 kg/ha followed by post-emergence application of bispyribac 30 g/ha, which was significantly more than unweeded control but statistically at par with pre-emergence application of pretilachlor or thiobencarb or oxadiargyl followed by post emergence application of bispyribac and alone post emergence application of bispyribac (Table 1). Alone application of pre-emergence herbicides i.e. pretilachlor/ flufenacet or post emergence herbicide i.e. penoxsulam did not provided effective control of weeds as compared to combination of pre and post-emergence herbicides. Porwal (1999) also reported similar findings that post-emergence application of pretilachlor with Safener at 0.375 kg/ha gave 13.4 percent higher yield over its pre-emergence application. Among the post-emergence herbicides, bispyribac 25 and 30 g/ha proved better than azimsulfuron 20 g/ha, when these were integrated with pre-emergence application of pendimethalin 0.75 kg/ha or thiobencarb 1.25 kg/ha. Above data concludes that it is difficult to get effective weed control in DSR with a single herbicide. A combination of pre and post emergence herbicides is required to effectively control weeds. Highest weed control efficiency (86.2 and 77.6%) was recorded with pre-emergence application of pendimethalin 0.75 kg/ha followed by post emergence application of bispyribac 30 g/ha during both years.

All the growth parameters i.e. plant height, effective tillers and panicle length during 2007 were significantly higher under herbicidal combinations as compared to the alone application of these herbicides except bispyribac (Table 1). Application of thiobencarb followed by post-emergence application of bispyribac at 30 g/ha recorded highest grain yield of 5.7 t/ha which was 375 per cent higher than that of unweeded control. It was closely followed by the treatments where post-emergence application of bispyribac 30 g/ha was made following the pre-emergence application of pendimethalin or pretilachlor, which recorded 5.4 and 5.2 t/ha grain yield, respectively. The performance of oxydiargyl 60 g/ha followed by bispyribac 25 and 30 g/ha and bispyribac alone at higher dose 35 g/ha was found better as compared to pretilachlor at 0.50 kg/ha, flufenacet 80 g/ha (applied 2-3 days after sowing) and penoxsulam 30 g/ha.

During second year, pre-emergence application of pendimethalin 0.75 kg/ha followed by bispyribac 25 g/ha

Table 1. Effect of different combination of pre- and post-emergence herbicides on weed dry matter, yield and yield attributes of direct-seeded rice (2007)

Treatment	Dose g/ha	Dry matter of weeds (60 DAS) (kg/ha)	Plant height (cm)	Effective tillers/m^2	Panicle length (cm)	Seed yield (t/ha)	Weed control efficiency (%)
Pretilachlor, pre-emergence	400	300 (1010)	62.0	312.5	24.0	3.8	47.3
Pendimethalin *fb* bispyribac	750, 25	80 (130)	65.4	387.3	25.3	4.9	86.2
Pendimethalin *fb* bispyribac	750, 30	110 (20)	65.5	400.5	25.2	5.4	81.6
Pendimethalin *fb* azimsulfuron	750, 20	310 (930)	63.9	369.2	23.6	4.7	47.6
Pretilachlor *fb* bispyribac	500, 25	180 (220)	65.9	398.2	25.3	5.2	69.6
Pretilachlor *fb* bispyribac	500, 30	150 (160)	63.0	402.3	23.6	5.2	73.9
Pretilachlor *fb* azimsulfuron	500, 20	240 (550)	65.0	365.7	24.0	4.7	58.2
Thiobencarb *fb* bispyribac	1250, 25	140 (160)	66.2	395.4	24.5	5.1	72.9
Thiobencarb *fb* bispyribac	1250, 30	120 (140)	68.3	415.4	24.2	5.7	79.9
Thiobencarb *fb* azimsulfuron	1250, 20	230 (590)	64.5	359.5	24.3	4.6	60.1
Oxadiargyl *fb* bispyribac	60, 25	140 (150)	68.5	375.0	25.3	4.8	75.4
Oxadiargyl *fb* bispyribac	60, 30	130 (90)	68.3	384.5	24.0	4.9	77.1
Oxadiargyl *fb* azimsulfuron	60, 20	420 (1910)	62.1	310.2	24.0	3.8	27.8
Bispyribac, post-emergence	25	160 (150)	67.3	342.5	25.0	4.3	72.5
Bispyribac, post-emergence	30	160 (150)	65.9	372.5	24.8	4.8	72.9
Bispyribac, post-emergence	35	170 (230)	66.4	393.4	24.7	5.0	70.8
Penoxsulam, post-emergence	30	490 (2570)	59.7	147.5	22.9	1.6	16.0
Penoxsulam, post-emergence	35	470 (2670)	62.9	213.2	22.9	2.4	19.2
Flufenacet, pre-emergence	80	320 (1300)	60.1	233.8	23.1	2.5	45.5
Control (unweeded)		580 (3560)	55.7	121.2	20.5	1.2	
LSD (P=0.05)		120	5.6	11.5	2.5	0.8	

*Figures in parentheses are original values

Table 2. Influence of different combinations of pre- and post-emergence herbicides on dry matter of weeds, yield and yield attributes of rice (2008)

Treatment	Dose g/ha	Dry matter of weeds (kg/ha)	Plant height (cm)	Effective tillers/m^2	Panicle length (cm)	Seed yield (t/ha)	Weed control efficiency (%)
Pendimethalin, pre-em	750	300 (780)	66.3	284.5	22.5	3.5	76.0
Pendimethalin *fb* bispyribac	750, 25	280 (850)	65.0	405.0	23.2	5.3	77.6
Pendimethalin *fb* azimsulfuron	750, 20	460 (2240)	67.6	384.0	22.7	4.9	63.2
Pendimethalin *fb* 2,4-D	750, 500	470 (2140)	66.0	353.2	23.3	4.6	62.4
Pendimethalin *fb* metsulfuron	750, 15	340 (1380)	66.5	291.3	23.7	3.6	72.8
Pendimethalin *fb* ethoxysufuron	750, 20	350 (1600)	65.2	345.5	23.4	4.5	72.0
Pendimethalin *fb* bensulfuron methyl	750, 6s0	340 (1380)	65.5	352.3	23.0	4.1	72.8
Bispyribac + azimsulfuron	25 + 20	670 (4030)	54.6	243.2	21.5	2.8	46.4
Bispyribac + ethoxysulfuron	25 + 20	300 (780)	62.7	269.4	21.6	3.1	76.0
Bispyribac + 2,4-D	25 + 500	310 (900)	60.5	21.02	21.5	2.4	75.2
Bispyribac	25	320 (950)	60.0	276.3	22.8	3.2	74.4
Oxadiargyl *fb* aispyribac	90, 25	540 (3130)	65.0	378.2	23.6	5.1	56.8
Oxadiargyl *fb* azimsulfuron	90, 20	300 (610)	64.7	381.2	22.3	4.9	76.0
Oxadiargyl *fb* ethoxysulfuron	90, 20	710(4760)	57.3	358.2	23.0	4.2	43.2
Penoxulam	30	660 (3760)	62.1	284.6	21.7	3.3	47.2
Control (unweeded)	-	1250 (3530)	65.2	182.3	21.0	2.1	
LSD (P=0.05)	-	330	7.0	31.4	1.8	1.1	

*Figures in parentheses are original values proved highly effective in controlling the weed infestation as dry matter of weeds was the lowest in this treatment (Table 2). This was closely followed by pendimethalin 0.75 kg/ha followed by metsulfuron 15 g/ha, pendimethalin 0.75 kg/ha followed by bensulfuron 60 g/ha and pendimethalin 0.75 kg/ha followed by ethoxysulfuron 20 g/ha. Bispyribac alone and pendimethalin alone did not provide effective control of weeds. Also post-emergence tank mix application of bispyribac (25 g/ha) + 2,4-D (500 g/ha) and bispyribac (25 g/ha) + azimsulfuron (20 g/ha) did not provide effective control of weeds as grain yield obtained in these treatments was at par with unweeded control. Singh *et al* (2005) also reported similar findings.

The maximum grain yield (5.3 t/ha) was obtained with pre-emergence application of pendimethalin 0.75 kg/ha followed by bispyribac 25 g/ha which was closely followed by oxadiargyl (90 g/ha) followed by bispyribac (25 g/ha), oxadiargyl (90 g/ha) followed by azimulfurom (20 g/ha) and pendimethalin 0.75 kg/ha followed by azimsulfuron 20 g/ha. There was 152.4, 142.9, 133.3 and 133.3 per cent increase in grain yield over unweeded control with these treatments, respectively. Plant height, panicle length and number of effective tillers/m^2 were also higher in these treatments.

REFERENCES

Balasubramanian V and Hill J. 2000. Direct wet seeding of rice in Asia: Emerging issues and strategic rsearch needs for the 21st century. *Proceedings of Annual Workshop of the Directorate of Rice Research,* Hyderabad, Andhra pardesh.

Cheema HS and Singh B. 1991. *Software Statistical Package CPCS-1. Developed at Department of Statistics*, Punjab Agricultural University, Ludhiana, India.

Kumar V, Bellinder RR, Gupta RK, Malik RK and Brainard DC. 2008. Role of herbicide resistant rice in promoting resource conservation technologies in rice wheat cropping systems in India: A Review. *Crop Protection* **27**: 290-301.

Oerke EC and Dehne HW. 2004. Safeguarding production losses in major crops and the role of crop protection. *Crop Protection* **23**: 275-285

Porwal MK. 1999. Weed management through herbicides in direct drilled upland rice in rainfed stuations of southern Rajasthan. *Indian Journal of Weed Science* **31**: 196-198.

Rao AN and Nagamani A. 2007. Available technologies and future research challenges for managing weeds in dry-seeded rice in India. In: *Proceedings of the 21st Asian Pacific Weed Science Society Conference.* 2 to 6th October 2007, Colombo, Sri Lanka.

Singh VP, Singh Govindra, Singh RK, Singh SP, Kumar Abnish, Dhyani VC, Kumar M and Sharma G. 2005. Effect of Herbicides alone and in combination on direct seeded rice. *Indian Journal of Weed Science* **37**(3&4): 197-201

Subbaiah SV, Singh SP, Kumar RM and Padmaja K. 1999. Drum seeding technology as a substitute for transplanting in India. In: *2nd IRRE-CREMNET Workshop Cum Group Meeting*, 24-27 August, 1999, Soil and water management research Institute, Thanjavur, Tamil Nadu, India.

Yadav A, Bir D, Malik RK, Gill G, Kamboj BR, Dahiya SS, Lathwal OP and Garg RB. 2009. Scope of direct seeded rice in Haryana. pp. 26-37. In: *Proceedings of National Workshop on Scope and Problems of Direct Seeded Rice*, PAU, Ludhiana.