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Combination of Bispyribac-Sodium with Azimsulfuron or Pyrazosulfuron for Control of Complex Weed Flora in Direct Seeded Rice

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Abstract

A field experiment was conducted during *kharif* of 2008 through 2009 to evaluate the combination of bispyribac sodium with azimsulfuron or pyrazosulfuron against complex weed flora in wet direct seeded *basmati* rice. Bispyribac-sodium 25 g/ha at 15 DAS was effective in controlling *Echinochloa* sp.Tank mix application of azimsulfuron 10-20 g/ha with bispyribac 25g/ha at 15 DAS improved the control of broadleaf weeds (BLW) along with excellent control of sedges. Tank mix application of azimsulfuron with bispyribac was realized useful only in the fields dominated by sedges particularly *Cyperus rotundus.* Tank-mix or sequential application of pyrazosulfuron 25 g/ha with bispyribac 25 g/ha also provided excellent control of all type of weed except aerobic grassy weeds (*Leptochloa* sp. and *Eragrostis* sp. *Eleusine* sp. and *Dactyloctenium aegyptium* L.). Pretilachlor (with or without safener) though provided good control of aerobic grassy weeds but it was lowest in terms of grain yield due to poor control of major weeds (*Echinochloa* sp., BLW and sedges).

Key words : Bispyribac-sodium, Azimsulfuron, Pyrazosulfuron, Weed, Seeded rice.

In north-west India, common practice of growing rice is by manual transplanting in puddle fields. There is a need of water efficient and less labor intensive systems of rice establishment such as direct seeding which is catching interest of growers in Haryana (1). But, weed infestation is one of the major constraints in direct seeded rice (2, 3). Earlier for weed control in direct seeded rice (DSR) elsewhere made through pre-emergence herbicides like pendimethalin and pretilachlor (with safener) indicated that these herbicides alone were not suitable due to comparatively less efficacy against broad spectrum of weed flora and /or phyto-toxicity particularly in wet DSR. This situation warrants for initiating research efforts to evaluate and identify suitable post-emergence herbicide (s) in DSR. In direct seeded rice, weed flora is expected to change with time (4). Bispyribac-sodium, has been found quite effective against *Echinochloa* sp. in direct seeded rice, but control of some broadleaf weeds (BLW) and sedges was marginal (5). Azimsulfuron and pyrazosulfuron provide excellent control of sedges including *Cyperus rotundus* along with BLW. Hence, the present study was undertaken to evaluate bispyribac-sodium in combination with azimsulfuron or pyrazosulfuron for effective control of broad spectrum of weeds in direct seeded rice.

Methods

A field experiment was conducted at CCS Haryana Agricultural University Regional Research Station, Karnal during *Kharif* of 2008 through 2009. In 2008, the field was low in organic carbon (0.35%), medium in phosphorus (11 kg/ha) and potassium (284 kg/ha) with slightly alkaline reaction (pH 8.2). During 2009, the field was medium in organic carbon (0.53%), low in phosphorus (8 kg/ha) and high in potassium (321 kg/ha) with alkaline in reaction (pH 8.6). During 2008, the treatments included bispyribac 25 g/ha at 15 DAS, azimsulfuron 40 g/ha at 15 DAS, tank mix application of bispyribac + azimsulfuron 20 + 10, 25 + 10, 20 + 15, 25 + 15, 20 + 20, 25 + 20 g/ha at 15 DAS, pretilachlor + safener 500 g/ha at 5 DAS, pretilachlor 1000 g/ha at 7 DAS along with weed free and weedy check. During 2009, pretilachlor was applied at 500 g/ha at 10 DAS instead of 1000 g/ha at 7 DAS. Two additional treatments of bispyribac + pyrazosulfuron 25 + 25 g/ha at 15 DAS and pyrazosulfuron 25 g/ha at 15 DAS *fb*

Table 1. Effect of bispyribac alone and in combination with azimsulfuron or pyrazosulfuron on density and dry weight of weeds in wet direct secded rice. *Orginal figures in parenthese were subjected to square root transformation before statistical analysis. **BPB, bispyribac ; AZS, azimsulfuron ; PCR, pretilachlor, PZS, pyrazosulfuron.

Treat-ment**	Dose (g/ha)	Time (DAS)	Weed density *(No/m^2) *Echinochloa* sp. 2008	*Echinochloa* sp. 2009	Other grassy weeds 2009	BLW 2008	BLW 2009	Sedges 2008	Sedges 2009
BPB	25	15	2.5 (5.3)	1.77 (3.3)	7.66 (59.3)	6.7 (50.0)	11.23 (126.0)	5.3 (27.3)	3.73 (13.3)
AZS	40	15	4.2 (16.7)	4.35 (18.0)	6.27 (41.3)	4.6 (20.7)	5.01 (26.0)	1.0 (0.0)	1.00 (0.0)
BPB + AZS	20 + 10	15	2.2 (4.0)	1.24 (0.7)	6.89 (46.7)	7.1 (54.0)	8.16 (66.7)	1.0 (0.0)	1.67 (2.7)
BPB + AZS	25 + 10	15	1.2 (0.7)	1.24 (0.7)	6.00 (35.3)	12.1(148.0)	7.67 (58.7)	1.0 (0.0)	1.96 (3.3)
BPB + AZS	20 + 15	15	2.8 (11.3)	1.41 (1.3)	5.95 (34.7)	6.2 (39.3)	8.39 (70.0)	1.0 (0.0)	1.55 (2.0)
BPB + AZS	25 + 15	15	1.5 (1.3)	1.00 (0.0)	6.70 (45.3)	9.1 (84.7)	7.83 (60.7)	1.0 (0.0)	1.96 (3.3)
BPB + AZS	20 + 20	15	1.7 (2.0)	1.49 (1.3)	6.67 (44.7)	7.9 (65.3)	8.99 (80.0)	1.0 (0.0)	1.41(1.3)
BPB + AZS	25 + 20	15	2.1 (3.3)	1.00 (0.0)	7.19 (51.3)	11.5 (131.3)	7.44 (54.7)	1.0 (0.0)	1.82 (2.7)
BPB + PZS	25 + 25	15	-	1.24 (0.7)	7.57 (56.7)	-	6.00 (35.3)	-	1.00 (0.0)
PZS *fb* BPB	25/25	25/25	-	2.10 (4.0)	8.42 (70.0)	-	4.27 (19.3)	-	1.00 (0.0)
PCR + safener	500	5	4.4 (18.7)	4.03 (15.3)	2.28 (5.3)	7.8 (60.7)	8.42 (70.0)	4.9 (22.7)	2.99 (8.0)
PCR	1000	7	6.0 (34.7)	-	-	14.8 (218.0)	-	2.4 (6.0)	-
PCR	500	10	-	3.51 (11.3)	1.55 (2.0)	-	10.00 (100.0)	-	3.97 (15.3)
Weed free	-	-	1.0 (0.0)	1.00 (0.0)	1.00 (0.0)	1.0 (0.0)	1.00 (0.0)	1.0 (0.0)	1.00 (0.0)
Weedy check	-	-	7.8 (60.7)	4.99 (24.0)	6.82 (46.0)	14.6 (211.3)	10.75 (114.7)	9.8 (96.0)	5.85 (33.3)
CD 5%	-	-	1.4	0.90	1.76	2.9	1.72	1.0	1.15

Table 1. Continued.

Treatment**	Dose (g/ha)	Time (DAS)	Weed dry weight (g/m^2) *Echinochloa* sp. 2008	*Echinochloa* sp. 2009	Other grassy 2009	BLW 2008	BLW 2009	Sedges 2008	Sedges 2009
BPB	25	15	20.1	4.2	103.7	10.4	32.8	11.1	6.8
AZS	40	15	81.0	105.7	71.6	0.8	5.9	0.0	0.0
BPB + AZS	20 + 10	15	40.5	4.9	105.3	8.9	14.7	0.0	1.7
BPB + AZS	25 + 10	15	4.3	1.3	94.0	18.6	15.5	0.0	2.0
BPB + AZS	20 + 15	15	11.2	0.9	106.0	4.1	13.5	0.0	2.3
BPB + AZS	25 + 15	15	3.5	0.0	91.8	8.7	10.9	0.0	2.2
BPB + AZS	20 + 20	15	10.0	1.8	115.5	8.5	12.9	0.0	1.4
BPB + PZS	25 + 20	15	11.5	0.0	89.4	15.9	13.4	0.0	2.4
BPB + PZS	25 + 25	15	-	0.9	110.6	-	4.3	-	0.0
PZS *fb* BPB	25/25	15/25	-	8.0	119.3	-	2.5	-	0.0
PCR + safener	500	5	129.9	172.9	10.4	9.9	16.6	18.9	24.6
PCR	1000	7	290.0	-	-	20.0	-	2.5	-
PCR	500	10	-	132.2	33.3	-	46.6	-	23.7
Weed free	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Weedy check	-	-	323.1	178.5	95.1	27.9	38.0	52.7	29.1
CD 5%	-	-	43.1	20.4	30.4	11.4	7.2	24.1	4.0

bispyribac 25 g/ha at 25 DAS were also included in 2009. The experiment was laid out in randomized block design with three replicates. Basmati rice cultivar CSR 30 was sown with drum seeder (18 cm row spacing) on 14 July in 2008 and 18 June in 2009 using pre-germinated seed (20 and 25 kg/ha during 2008 and 2009, respectively) under puddle conditions. Seed was also treated with 1 g carbendazim solution in 1 liter of water per kilogram of seed by soaking for 24 hours. The gross and net plot size was 4.8 m × 2.16

m × 1.86 m, respectively during 2008 and 5.5 m × 2.16 and 3.0 m × 1.44 m, respectively during 2009. Post-emergence herbicides were applied as spray with flat-fan nozzle using 300 liter/ha water, whereas pre-emergence herbicide (pretilachlor) as sand-mix in 150 kg sand/ha. Fertilizers were applied as in main crop according to recommended package of practices by the state university. Crop phyto-toxicity was recorded at 15 days after application. Data on weeds were recorded at 80 DAS in 2008 and 90 DAS in 2009 ; and yield and yield attributes were recorded at harvest. Crop was harvested on 10 November 2008 and 16 November 2009.

Results and Discussion

During 2008, *Echinochloa crus-galli* (L.) P. Beauv. was the predominant weed along with 1broadleaf weeds like *Ammannia baccifera* L. (Vahl), and sedges like *Cyperus rotundus* L., *C. difformis* L., *Fimbristylis miliacea* (L.) Vahl. During 2009 in addition, other grassy weeds like *Echinochloa colona* (L.) Link, *Leptochloa* sp. and *Eragrostis* sp., *Eleusine* sp. and *Dactyloctenium aegyptium* L. were also present.

Effect on Weeds

Reduction in density and dry weight of *Echinochloa* sp. was more due to bispyribac than azimsulfuron and it was at par with weed free check (Table 1). Efficacy of bispyribac against *Echinochloa* sp. in DSR has been reported excellent earlier as well (1, 6—8). Tank-mix application of azimsulfuron with bispyribac did not have much added effect on the control of *Echinochloa.* All the bispyribac and azimsulfuron treatments were superior to pretilachlor (with or without safener) and weedy check during both years. During 2009, bispyribac as tank-mix or sequential application with pyrazosulfuron was at par with weed free check in respect of density and dry weight of *Echinochloa,* except density under pyrazosulfuron *fb* bispyribac being inferior to weed free check. Azimsulfuron 40 g/ha alone did not provide effective control of *Echinochloa.*

Bispyribac alone or in combination with azimsulfuron or pyrazosulfuron did not provide any control of other aerobic grassy weeds (*Leptochloa* sp., *Eragrostis* sp., *Eleusine* sp. and *Dactyloctenium* aegyptium); however pretilachlor (with or without safener) provided excellent control of these weeds (Table 1).

During 2008, density and dry weight of broadleaf weeds particularly *Ammannia baccifera* were similar under azimsulfuron 40 g/ha and bispyribac 25 g/ha alone, while reduction was more under azimsulfuron during 2009 (Table 1). Tank-mix application of azimsulfuron with bispyribac further decreased the density and dry weight of BLW during 2008 but not so in 20009. Different doses of azimsulfuron (10—20 g/ha) as tank-mix application with bispyribac did not differ much in respect of density and dry weight of BLW. Tank-mix or sequential application of pyrazosulfuron 25 g/ha with bispyribac 25 g/ha also decreased the density and dry weight of BLW even up to the level of weed free check during 2009.

Addition of azimsulfuron even at low doses (10—20 g/ha) provided excellent control of sedges. Also, tank-mix or sequential application of pyrazosulfuron with bispyribac provided complete control of sedges (Table 1). Tank-mix application of pyrazosulfuron appeared better than its sequential application.

Phytotoxicity

There was no phytotoxicity of bispyribac and azimsulfuron alone and as tank-mix on the crop. Similarly tank-mix or sequential application of pyrazosulfuron with bispyribac had no phytotoxicity. Pretilachlor 1,000 g/ha at 7 DAS caused 70% phytotoxicity during 2008 but it was safe to crop when applied at 500 g/ha at 10 DAS or at 5 DAS with safener (data not given).

Yield and Yield Attributes

During 2008, plant height and effective tillers were similar under bispyribac and azimsulfuron alone and tank-mix treatments, and were at par with weed free check and better than pretilachlor (with or without safener) (Table 2). Whereas during 2009, plant height under all the herbicidal treatments was similar to weed free check except azimsulfuron 40 g/ha and pretilachlor (with or without safener) being similar to weedy check. Effective tillers were similar under bispyribac alone and in combination with azimsulfuron or

Table 2. Effect of bispyribac alone and in combination with azimsulfuron or pyrazosulfuron on yield and yield attributes of wet direct seeded rice. *BPB, bispyribac ; AZS, azimsulfuron ; PCR, pretilachlor ; PZS, pyrazosulfuron.

Treatment*	Dose (g/ha)	Time (DAS)	Plant height (cm)		Effective tillers/mrl		Panicle length (cm)		Grain yield (kg/ha)	
			2008	2009	2008	2009	2008	2009	2008	2009
BPB	25	15	82.7	109.7	49.2	87.7	20.2	21.6	1452	1910
AZS	40	15	80.8	104.9	47.7	80.3	20.5	21.3	1204	1423
BPB + AZS	20 + 10	15	81.5	109.6	45.0	89.0	20.9	21.7	1217	1852
BPB + AZS	25 + 10	15	78.4	112.4	49.0	90.5	20.7	21.5	1407	2033
BPB + AZS	20 + 15	15	81.9	109.1	44.7	90.5	20.5	21.4	1312	1892
BPB + AZS	25 + 15	15	77.3	111.3	53.0	87.3	20.7	21.5	1489	2044
BPB + AZS	20 + 20	15	84.9	110.6	48.8	87.3	20.2	21.7	1414	1900
BPB + AZS	25 + 20	15	84.2	111.7	55.7	86.8	20.0	21.4	1684	2069
BPB + PZS	25 + 25	15	-	110.3	-	88.2	-	21.5	-	2157
PZS *fb* BPB	25/25	15/25	-	108.8	-	86.5	-	21.4	-	1805
PCR + safener	500	5	70.2	105.1	21.5	66.0	20.5	21.2	823	1196
PCR	1000	7	60.6	-	8.0	-	19.5	-	231	-
PCR	500	10	-	105.9	-	56.2	-	21.3	-	1258
Weed free	-	-	79.9	113.2	53.2	88.8	20.5	21.8	1655	2616
Weedy check	-	-	58.7	103.8	7.7	49.0	19.6	20.7	180	913

pyrazosulfuron which were at par with weed free check and better than pretilachlor (with or without safener) and azimsulfuron alone. Panicle length under all the treatments of bispyribac alone and in combination with azimsulfuron or pyrazosulfuron being similar to each other was at par with weed free check but better than pretilachlor (with or without safener), azimsulfuron alone and weedy check during both the years.

During 2008, bispyribac alone and its all tank mix application with azimsulfuron except 20 + 10 g/ha resulted into grain yield at par with weed free check (Table 2). However, none of the herbicidal treatments could achieve grain yields at par with weed free check during 2009, and bispyribac 25 g/ha alone and in combination with azimsulfuron (10—20 g/ha) or pyrazosulfuron 25 g/ha were at par with each other. Addition of azimsulfuron to bispyribac did not have any significant added effect on grain yield during both the years. However, the maximum grain yield was obtained under bispyribac + azimsulfuron 25 + 20 g/ha which was superior to azimsulfuron alone but at par with bispyribac alone during 2008. During 2009, more grain yields were obtained under bispyribac + pyrazosulfuron at 15 DAS and bispyribac + azimsulfuron 25 + 20 g/ha, which were superior to azimsulfuron 40 g/ha alone but at par with bispyribac 25 g/ha alone. The grain yields under all the bispyribac 25 g/ha alone or in combination with azimsulfuron 10—20 g/ha or pyrazosulfuron 25 g/ha were superior to pretilachlor (with or without safener). Yields under pretilachlor were lowest among different herbicidal treatments during both the years.

Conclusion

Bispyribac-sodium 25 g/ha at 15 DAS was effective in controlling *Echinochloa* sp. in direct seeded rice. Tank mix application of azimsulfuron 10—20 g/ha with bispyribac 25 g/ha at 15 DAS improved the control of BLW along with excellent control of sedges. Tank mix application of azimsulfuron with bispyribac can be useful only in the fields dominated by sedges particularly *Cyperus rotundus.* Tank-mix or sequential application of pyrazosulfuron with bispyribac also provided excellent control of all type of weeds except aerobic grassy weeds (*Leptochloa* sp. and *Eragrostis* sp. *Eleusine* sp. and *Dactyloctenium aegyptium* L.). Pretilachlor (with or without safener) though provided good control of aerobic grassy weeds but it was lowest in terms of grain yield due to very poor control of dominating weeds (*Echinochloa*, BLW and sedges).

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