Indian Journal of Weed Science **50**(3): 257–261, 2018

Print ISSN 0253-8040 Online ISSN 0974-8164

Pretilachlor + pyrazosulfuron-ethyl (ready-mix) against complex weed flora in transplanted rice and its residual effects

Dharam Bir Yadav*, Ashok Yadav, S.S. Punia, Narender Singh and Anil Duhan

CCS Haryana Agricultural University, Hisar, Haryana, 125 004

**Email: dbyadav@gmail.com*

Article information

DOI: 10.5958/0974-8164.2018.00055.2

Type of article: Research article

Received : 02 August 2018
Revised : 18 September 2018
Accepted : 21 September 2018

Key words

Herbicides

Pretilachlor + pyrazosulfuron

Ready-mix

Residues

Transplanted rice

Weeds

ABSTRACT

A field experiment was conducted at CCS HAU, Regional Research Station, Karnal during *Kharif* 2010 to 2014 to evaluate the bio-efficacy of pretilachlor 6.0% + pyrazosulfuron-ethyl 0.15% GR (ready-mix) against complex weed flora in transplanted rice and also to study its residual effects. Results from on-station experiment (2010 and 2011) revealed that the optimum dose of pretilachlor + pyrazosulfuron-ethyl was 615 g/ha which provided effective control (91-96%) of complex weed flora in transplanted rice, with higher grain yield (5.98-6.05 t/ha) and B-C ratio (2.19-2.28). In general, it was comparable to its higher doses, bensulfuron-methyl + pretilachlor 660 g/ha, pretilachlor 1000 g/ha, butachlor 1500 g/ha, bispyribac-sodium 25 g/ha and weed free check in terms of weed control, grain yield of rice and benefit-cost ratio. In comparison to weedy check, there was 54-57% increase in grain yield of transplanted rice under pretilachlor + pyrazosulfuron-ethyl 615 g/ha. On an average of 19 adaptive/farmers-participatory trials, pretilachlor + pyrazosulfuron-ethyl 615 g/ha proved superior to commonly used herbicides butachlor 1500 g/ha in 2013 and pretilachlor 1000 g/ha in 2014 in terms of weed control and grain yield of rice. There was no phyto-toxicity of pretilachlor + pyrazosulfuron-ethyl on transplanted rice up to 1230 g/ha (2x dose) and it was also safe to the succeeding chickpea and wheat (2011-12, 2012-13 and 2012-13) crops in rotation.

INTRODUCTION

Rice is grown over an area of about 44 mha in India with the total production of 105 m tones, amounting to 40% of the total food grain in the country (Economic Survey 2015-16). Rice-wheat is the most important cropping system covering 10.5 mha area in India and supporting 600 million people. Infestation of weeds in transplanted rice is a major problem resulting into yield reductions of 27-68% (Singh *et al.* 2003, Yadav *et al.* 2009, Manhas *et al.* 2012, Duary *et al.* 2015). Pre-emergence herbicides like butachlor, pretilachlor, anilofos and oxadiargyl are most commonly used for the control of weeds in transplanted rice. Bispyribac-sodium is also being recently used for post-emergence control of weeds in transplanted rice (Yadav *et al.* 2009). But single application of one herbicide is not that effective against complex weed flora throughout the crop season. Moreover, some of the broad-leaf weeds and sedges are not effectively controlled by alone application of these herbicides. To achieve satisfactory control of complex weed flora, farmers resort to use 2,4-D, metsulfuron + chlorimuron or ethoxysulfuron as sequential post-emergence herbicides. However, this adds to the cost of weed management. Being easy to apply, farmers' preference otherwise also remains mostly in favour of pre-emergence herbicides to achieve effective weed management at an early stage. Under such situations, more suitable option would be single shot application of ready-mix or tank-mix combination of herbicides as pre-emergence. Keeping this in view, an investigation was conducted to evaluate the performance of pretilachlor + pyrazosulfuron (ready-mix) as pre-emergence against complex weed flora in transplanted rice and also its residual effects.

MATERIALS AND METHODS

Bio-efficacy studies

A field experiment was conducted at CCS HAU Regional Research Station, Karnal during *Kharif* 2010 and 2011 to evaluate the bio-efficacy of pretilachlor 6.0% + pyrazosulfuron-ethyl 0.15% GR (Eros 6.15% GR) against complex weed flora in transplanted rice. The soil of the experimental field was low in organic carbon, medium in available phosphorus, and potassium with slightly alkaline in reaction (pH 8.2).

The treatments included pretilachlor + pyrazosulfuron-ethyl 461, 615, 769, 922 g/ha at 0-5 days after transplanting (DAT); bensulfuron-methyl + pretilachlor 660 g/ha at 0-5 DAT, pyrazosulfuron-ethyl 15 g/ha at 3-7 DAT, pretilachlor 600 g/ha at 0-5 DAT, pretilachlor 50%EC 1000 g/ha at 0-3 DAT, butachlor 1500 g/ha at 0-3 DAT, bispyribac sodium 25 g/ha, along with weed free and weedy checks. Pretilachlor + pyrazosulfuron-ethyl 1230 g/ha at 0-5 DAT was kept as an additional treatment for phyto-toxicity studies. The experiment was laid out in randomized complete block design with three replicates. HKR47 cultivar of rice was transplanted at a spacing of 20 × 15 cm on 4 July 2010 and 22 July 2011 with plot size of 5.7 × 2.4 m in 2010 and 4.7 × 2.4 m in 2011. Density and dry weight of weeds was recorded at 75 DAT. Phyto-toxicity of different herbicides on 0-10 scale was recorded at 3, 7, 15 and 30 days after application (DAA). Grain yield and yield attributes were recorded at maturity of the crop. Crop was harvested on 13 October 2010 and 27 October 2011. Benefit-cost ratio was computed as gross returns over variable cost.

Another field experiment was conducted for residual phyto-toxicity studies during 2010-11 to 2012-13, with three treatments, *viz*. pretilachlor + pyrazosulfuron-ethyl 615 g/ha, 1230 g/ha and untreated check laid out with three replications and plot size of 5.7 × 2.4 m. The herbicides were applied at 5 DAT in rice (Var. '*HKR 47*') transplanted on 4 July 2010, 22 July 2011 and 15 July 2012 with a spacing of 20 × 15 cm. After harvest of rice in October, chickpea (var. '*HC5*') and wheat ('*DPW 621-50'*) were sown on 19 November 2010, 19 November 2011, 20 November 2012 during succeeding *Rabi* seasons, using the seed rate of 40 kg/ha (row spacing 30 cm) and 100 kg/ha (row spacing 20 cm), respectively. Visual phyto-toxicity on chickpea and wheat was recorded on 0-10 scale at 15, 30, 45, 60 and 75 days after sowing (DAS).

Harvest residue studies

For harvest residue studies, three treatments, *viz*. pretilachlor + pyrazosulfuron-ethyl 615 g/ha, 1230 g/ha and untreated check were laid out with three replications with plot size of 17.5 × 12.5 m during *Kharif* 2014. Transplanting of rice cultivar '*HKR47*' was done at a spacing of 20 × 15 cm on 19 July 2014. Crop was raised as per the recommendations of the University and harvested on 3 November 2014. Soil, rice grain and straw samples were taken from the treated plots at crop harvest and were analyzed for residues in Residue Lab, Department of Agronomy, CCS HAU, Hisar.

Adaptive/farmers-participatory trials

The adaptive/farmers-participatory trials were conducted in different districts of Haryana at 19 locations each during *Kharif* 2013 and 2014. Under these adaptive trials, pretilachlor + pyrazosulfuron-ethyl 615 g/ha was compared with recommended herbicides butachlor 1500 g/ha in 2013 and pretilachlor 1000 g/ha in 2014.

Statistical analysis

Before statistical analysis, the data on density of weeds and per cent weed control were subjected to square root ($\sqrt{x+1}$) and angular transformation to improve the homogeneity of the variance. All the data were subjected to the analysis of variance (ANOVA) separately for each year. The significant treatment effect was judged with the help of 'F' test at the 5% level of significance. The 'OPSTAT' software of CCS Haryana Agricultural University, Hisar, India, was used for statistical analysis (Sheoran *et al*. 1998).

RESULTS AND DISCUSSION

Bio-efficacy studies

Weed flora of the experimental field: The weed flora of the experimental field consisted of *Echinochloa crus-galli* (grassy), *Ammannia baccifera* broad-leaf weed (BLW), and *Cyperus difformis* and *Fimbristylis miliaceae* among sedges during *Kharif* 2010. During *Kharif* 2011, the weed flora of the experimental field consisted of *Echinochloa crus-galli, Leptochloa chinensis, Eragrostis tenella* among grasses, *Ammannia baccifera* BLW, and *Cyperus rotundus, Cyperus difformis* and *Fimbristylis miliaceae* among sedges.

Effect on weeds

Density of weeds: The density of grassy weed *Echinochloa crus-galli* at 75 DAT decreased with increase in dose of pretilachlor + pyrazosulfuron-ethyl (ready-mix) during both the years (**Table 1**). Density of *Echinochloa crus-galli* under pretilachlor + pyrazosulfuron-ethyl 615 g/ha was lower than its lower dose of 461 g/ha but at par with its higher doses, hence 615 g/ha was realized to be the optimum dose. Pretilachlor + pyrazosulfuron-ethyl 615 g/ha was superior to pyrazosulfuron-ethyl 15 g/ha, pretilachlor 600 g/ha during 2010 but at par with bensulfuron-methyl + pretilachlor (ready-mix) 660 g/ha, pretilachlor 1000 g/ha, butachlor 1500 g/ha, bispyribac-sodium 25 g/ha and weed free check in respect of density of *Echinochloa crus-galli* during both the years.

The density of BLW *Ammannia baccifera* decreased with increase in dose of pretilachlor + pyrazosulfuron-ethyl during both the years (**Table 1**). During 2010, density of *Ammannia baccifera* under pretilachlor + pyrazosulfuron-ethyl 615 g/ha was lower than its lower dose but at par with its higher doses, hence it was realized to be the optimum dose. Pretilachlor + pyrazosulfuron-ethyl 615 g/ha was superior to pretilachlor 600 g/ha, bispyribac-sodium 25 g/ha and weedy check but at par with bensulfuron-methyl + pretilachlor 660 g/ha, pretilachlor 100 g/ha, butachlor 1500 g/ha and weed free check in respect of density of *Ammannia baccifera*. During 2011, density of BLW at 75 DAT under pretilachlor + pyrazosulfuron-ethyl 615 g/ha was lower than its lower dose (461 g/ha), pretilachlor 600 g/ha and weedy check but at par with all other herbicidal treatments.

The density of sedges decreased with increase in dose of pretilachlor + pyrazosulfuron-ethyl. The density of sedges under pretilachlor + pyrazosulfuron-ethyl 615 g/ha was at par with all other herbicidal treatments and weed free check (**Table 1**). Pretilachlor 750 g/ha + pyrazosulfuron-ethyl 25 g/ha as tank-mix application at 3 DAT has already been reported very effective in reducing density of complex weed flora in transplanted rice elsewhere (Teja *et al*. 2016).

Dry weight of weeds: The dry weight of grassy weeds decreased with increase in dose of pretilachlor + pyrazosulfuron-ethyl during both the years (**Table 2**). All the doses of pretilachlor + pyrazosulfuron-ethyl were at par with each other. During 2010, pretilachlor + pyrazosulfuron-ethyl 615 g/ha was superior to pyrazosulfuron-ethyl 15 g/ha, pretilachlor 600 g/ha and weedy check but at par with bensulfuron-methyl + pretilachlor 660 g/ha, pretilachlor 1000 g/ha, butachlor 1500 g/ha, bispyribac sodium 25 g/ha and weed free check in respect of dry weight of grassy weeds. During 2011, dry weight of *E. crus-galli* under pretilachlor + pyrazosulfuron-ethyl 615 g/ha was at par with all other herbicidal treatments except being superior to pyrazosulfuron-ethyl 15 g/ha. Dry weight of other grassy weeds (*Leptochloa chinensis, Eragrostis tenella*) was similar under all the treatments during 2011.

The dry weight of BLW decreased with increase in dose of pretilachlor + pyrazosulfuron-ethyl during both the years (**Table 2**). During 2010, dry weight of BLW under pretilachlor + pyrazosulfuron-ethyl 615 g/ha was lower than its lower dose (461 g/ha), but at par with its higher doses, hence it was realized to be the optimum dose (**Table 2**). Pretilachlor + pyrazosulfuron-ethyl 615 g/ha was superior to pretilachlor 600 g/ha and weedy check but at par with bensulfuron-methyl + pretilachlor 660 g/ha, pretilachlor 1000 g/ha, butachlor 1500 g/ha, bispyribac-sodium 25 g/ha and weed free check in respect of dry weight of BLW. However, during 2011, dry weight of BLW under pretilachlor + pyrazosulfuron-ethyl 615 g/ha was at par with all herbicidal treatments except being lower than pretilachlor 600 g/ha and bispyribac-sodium 25 g/ha, and also weedy check.

The dry weight of sedges decreased with increase in dose of pretilachlor + pyrazosulfuron-ethyl during both the years (**Table 2**). Pretilachlor + pyrazosulfuron-ethyl 615 g/ha was at par with all other treatments except being superior to pretilachlor 600 g/ha and weedy check.

Based on two years data, the optimum dose of pretilachlor + pyrazosulfuron-ethyl was realized to be

Table 1. Effect of pretilachlor + pyrazosulfuron-ethyl on density of weeds (no./m^2) in transplanted rice (2010 and 2011)

Treatment	Dose (g/ha)	*Echinochloa crus-galli*		Other grass weeds	Broad-leaf weeds		Total sedges	
		2010	2011	2011	2010	2011	2010	2011
Pretilachlor + pyrazosulfuron-ethyl	461	2.63(6.0)	2.58(6.0)	1.41(1.3)	8.36 (70.0)	6.37(40.0)	1.00 (0.0)	3.83(15.3)
Pretilachlor + pyrazosulfuron-ethyl	615	1.41(1.3)	1.66(2.0)	1.00(0.0)	5.73 (32.7)	4.79(22.0)	1.00 (0.0)	2.19(6.7)
Pretilachlor + pyrazosulfuron-ethyl	769	1.00(0.0)	1.41(1.3)	1.00(0.0)	5.35 (30.0)	4.65(20.7)	1.00 (0.0)	2.27(7.3)
Pretilachlor + pyrazosulfuron-ethyl	922	1.00(0.0)	1.00(0.0)	1.00(0.0)	4.73 (22.0)	4.59(21.3)	1.00 (0.0)	1.00(0.0)
Bensulfuron-methyl + pretilachlor	660	1.90(2.7)	1.82(2.7)	1.41(1.3)	6.19 (37.3)	4.79(22.0)	1.00 (0.0)	2.56(6.0)
Pyrazosulfuron-ethyl	15	3.93(14.7)	3.95(14.7)	1.24(0.7)	5.10 (26.7)	4.16(16.7)	1.00 (0.0)	1.00(0.0)
Pretilachlor	600	2.75(6.7)	2.07(3.3)	1.00(0.0)	8.06 (64.0)	6.68(44.0)	1.67 (2.7)	3.88(14.7)
Pretilachlor	1000	1.41(1.3)	1.82(2.7)	1.00(0.0)	6.79 (46.0)	4.65(20.7)	1.00 (0.0)	2.18(4.7)
Butachlor	1500	1.49(1.3)	1.49(1.3)	1.00(0.0)	7.20 (51.3)	4.91(23.3)	1.00 (0.0)	1.00(0.0)
Bispyribac-sodium	25	1.00(0.0)	1.41(1.3)	3.28(10.0)	6.51 (42.0)	6.18(37.3)	1.00 (0.0)	1.00(0.0)
Weed free	-	1.00(0.0)	1.00(0.0)	1.00(0.0)	1.00 (0.0)	1.00(0.0)	1.00 (0.0)	1.00(0.0)
Weedy check	-	5.39(28.0)	5.31(28.7)	3.50(11.3)	12.31 (151.3)	10.31(105.3)	3.65 (13.3)	4.51(19.3)
LSD (p=0.05)		0.68	1.17	0.64	1.92	1.04	0.78	1.78

*Original figures in parentheses were subjected to square root ($\sqrt{x+1}$) transformation before statistical analysis

615 g/ha with weed control efficacy of 91-96%. In general, it was comparable to its higher doses, bensulfuron-methyl + pretilachlor 660 g/ha, pretilachlor 1000 g/ha, butachlor 1500 g/ha, bispyribac-sodium 25 g/ha and weed free check. Pretilachlor 750 g/ha + pyrazosulfuron-ethyl 25 g/ha as tank-mix application at 3 DAT has already been reported very effective in reducing biomass of complex weed flora in transplanted rice elsewhere (Teja *et al*. 2016). Pre-emergence application of herbicides in combination has been reported very effective against complex weed flora in transplanted rice earlier also (Manhas *et al.* 2012, Kumar *et al.* 2014, Duary *et al.* 2015, Teja *et al.* 2015).

Effect on crop

Number of effective tillers/mrl under pretilachlor + pyrazosulfuron-ethyl 615 g/ha was at par with all other treatments except being superior to pyrazosulfuron-ethyl 15 g/ha and weedy check during both the years (**Table 3**). Grain yield of rice under pretilachlor + pyrazosulfuron-ethyl 615 g/ha was higher than its lower dose (461 g/ha) but at par with its higher doses (769 and 922 g/ha), indicating it to be the optimum dose. Pretilachlor + pyrazosulfuron-ethyl 615 g/ha (5.97-6.05 t/ha) provided grain yield of rice at par with bensulfuron-methyl + pretilachlor 660 g/ha, pretilachlor 1000 g/ha, butachlor 1500 g/ha, bispyribac-sodium 25 g/ha and weed free check (5.87-6.27 t/ha). Pretilachlor + pyrazosulfuron-ethyl 615 g/ha resulted in grain yield of rice higher than pyrazosulfuron-ethyl 15 g/ha and weedy check during both the years and pretilachlor 600 g/ha during 2010.

In comparison to weedy check, there was 54-57% increase in grain yield of transplanted rice under pretilachlor + pyrazosulfuron-ethyl 615 g/ha, 53-54% at 769 g/ha and 52-57% at 922 g/ha, 54% under bensulfuron-methyl + pretilachlor 660 g/ha, 44-45% under pretilachlor 600 g/ha, 54-56% under pretilachlor 1000 g/ha, 54-55% under butachlor 1500 g/ha, 51-57% under bispyribac-sodium 25 g/ha,16-25% under pyrazosulfuron-ethyl 15 g/ha and 60-64% under weed free check during both the years. Teja *et al.* (2016) have also reported grain yield of transplanted rice in pretilachlor 750 g/ha + pyrazosulfuron 25 g/ha treated plots (3 DAT) similar to weed free/two hand weeding. Effective management of complex weeds consequently resulting into higher yields of transplanted rice due to combined application of herbicides has been realized earlier also (Kumar *et al.* 2014, Duary *et al.* 2015, Teja *et al.* 2015).

Economics: Pretilachlor + pyrazosulfuron-ethyl 615 g/ha provided B: C ratio (benefit:cost ratio) (2.19 in 2010 and 2.28 in 2011) better than its other doses of 461 g/ha and 922 g/ha, pyrazosulfuron-ethyl 15 g/ha, pretilachlor 600 g/ha, weed free and weedy checks (**Table 3**). Pretilachlor + pyrazosulfuron-ethyl 615 g/ha provided B:C ratio similar to its higher dose of 769 g/ha, pretilachlor 1000 g/ha, butachlor 1500 g/ha, bispyribac-sodium 25 g/ha and bensulfuron + pretilachlor 660 g/ha during both years.

Crop phyto-toxicity and residue

There was no phyto-toxicity at 3, 7, 15 and 30 days after application of pretilachlor + pyrazosulfuron-ethyl at any of its doses up to 1230 g/ha on transplanted rice crop during both the years (data not given). Similarly, there was no crop phyto-toxicity due to any of other herbicidal treatments.

Residual phyto-toxicity on succeeding crop and Harvest residues: There was no residual phyto-toxicity of pretilachlor + pyrazosulfuron-ethyl at 615 and 1230 g/ha at 15, 30, 45, 60 and 75 DAS on the succeeding chickpea and wheat crops (2010-11, 2011-12 and 2012-13) at any stage indicating its safety even at 2X dose to these crops in rotation (data not given). No harvest residues of pretilachlor and

Table 2. Effect of pretilachlor + pyrazosulfuron-ethyl on dry weight of weeds (g/m^2) in transplanted rice (2010 and 2011)

Treatment	Dose (g/ha)	*Echinochloa crus-galli*		Other grass weeds	BLW		Sedges	
		2010	2011	2011	2010	2011	2010	2011
Pretilachlor + pyrazosulfuron-ethyl	461	27.3	45.3	3.5	5.5	2.4	0.0	1.2
Pretilachlor + pyrazosulfuron-ethyl	615	15.2	30.5	0.0	2.8	1.3	0.0	0.5
Pretilachlor + pyrazosulfuron-ethyl	769	0.0	18.8	0.0	2.1	1.5	0.0	0.4
Pretilachlor + pyrazosulfuron-ethyl	922	0.0	0.0	0.0	2.2	0.7	0.0	0.0
Bensulfuron-methyl + pretilachlor	660	23.1	30.0	0.2	3.1	1.4	0.0	0.6
Pyrazosulfuron-ethyl	15	262.1	203.0	3.9	2.1	0.5	0.0	0.0
Pretilachlor	600	65.7	42.1	0.0	5.0	2.9	1.3	1.3
Pretilachlor	1000	14.1	15.8	0.0	3.6	0.9	0.0	0.5
Butachlor	1500	14.7	19.2	0.0	3.0	1.3	0.0	0.0
Bispyribac-sodium	25	0.0	0.9	3.4	3.3	2.9	0.0	0.0
Weed free	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Weedy check	-	392.5	337.9	5.3	8.9	5.7	4.4	3.6
LSD (p=0.05)		26.7	41.0	NS	0.9	1.5	1.2	0.8

Table 3. Effect of pretilachlor + pyrazosulfuron-ethyl on yield and yield attributes of transplanted rice (*Kharif* 2010 and 2011)

Treatment	Dose (g/ha)	Effective tillers/ mrl		Grain yield (t/ha)		B-C ratio	
		2010	2011	2010	2011	2010	2011
Pretilachlor + pyrazosulfuron-ethyl	461	53.5	52.0	5.43	5.30	2.01	1.98
Pretilachlor + pyrazosulfuron-ethyl	615	58.8	57.7	5.98	6.05	2.19	2.28
Pretilachlor + pyrazosulfuron-ethyl	769	59.2	56.8	5.99	6.06	2.18	2.27
Pretilachlor + pyrazosulfuron-ethyl	922	59.3	57.8	6.00	5.96	2.16	2.21
Bensulfuron-methyl + pretilachlor	660	58.8	57.8	5.87	5.99	2.15	2.26
Pyrazosulfuron-ethyl	15	43.8	44.7	4.43	4.87	1.66	1.87
Pretilachlor	600	53.0	53.2	5.49	5.67	2.05	2.17
Pretilachlor	1000	59.5	59.5	5.95	6.04	2.19	2.29
Butachlor	1500	58.0	59.7	5.91	6.03	2.20	2.31
Bispyribac-sodium	25	58.0	60.2	6.00	5.93	2.15	2.19
Weed free	-	63.2	61.3	6.25	6.27	1.91	1.89
Weedy check	-	39.3	37.8	3.81	3.92	1.46	1.53
LSD (p=0.05)		6.10	6.20	0.43	0.53		

Table 4. Performance of pretilachlor + pyrazosulfuron-ethyl against weeds in transplanted rice under adaptive/ farmer-participatory trials (average of 19 locations each in *Kharif* 2013 and 2014)

Treatment	Weed control (%)		Grain yield (t/ha)	
	2013	2014	2013	2014
Pretilachlor + pyrazosulfuron-ethyl 615 g/ha	78(94)	77(94)	6.51	5.37
Butachlor 1500 g/ha	68(85)	-	6.34	-
Pretilachlor 1000 g/ha	-	69(87)	-	5.05
LSD (p=0.05)	4.6	1.3	0.06	0.08

*Original figures in parenthesis were subjected to angular transformation before statistical analysis.

Locations in 2013 (19): 2 (Gabipur and Barwala), 5 (Pirthala), 3(2-Dhani Lehranwali and Kala Grewal), 3 (2-Batta and Teek), 3 (2-Barhi and Sukhrahon), 1 (Chanarthal) and 2 (Khanpur and Sagga) in Hisar, Fatehabad, Sirsa, Jind, Kaithal, Ambala, Kurukshetra and Karnal districts of Haryana, respectively.

Locations in 2014 (19): 1 (Bithmada), 2 (Nangla), 3 (Dhani Kahan Singh and 2-Rania), 2 (Danoda), 4 (Kingan, Bhagal, Teek and Kheri Raiwali), 2 (Thana and Chanarthal), 2 (Danoura and Landa), 1 (Saidu Pur) and 2 (Majri Jattan) in Hisar, Fatehbad, Sirsa, Jind, Kaithal, Kurukshetra, Ambala, Yamuna Nagar and Punchkula districts of Haryana, respectively.

pyrazosulfuron-ethyl were detected in rice grain, straw and soil samples drawn from plots treated with pretilachlor + pyrazosulfuron-ethyl 615 and 1230 g/ha, indicating its safety up to 2X dose.

Adaptive trials

Based on average of 19 locations, pretilachlor + pyrazosulfuron-ethyl 615 g/ha provided better control of complex weed flora (93.9% in 2013 and 94.2% in 2014) and higher gain yield (6.50 t/ha in 2013 and 5.37 t/ha in 2014) in transplanted rice than the already recommended herbicides butachlor 1500 g/ha (85%, 6.34 t/ha in 2013) and pretilachlor 1000 g/ha (87%, 5.05 t/ha in 2014) (**Table 4**).

It may be concluded that pretilachlor + pyrazosulfuron (RM) 615 g/ha at 0-5 DAT could safely be used for control of complex weed flora in transplanted rice.

REFERENCES

Duary B, Teja KC, Roy Chowdhury S and Mallick RB. 2015. Weed growth and productivity of wet season transplanted rice as influenced by sole and sequential application of herbicides. *International Journal of Bio-Resource, Environment and Agricultural Sciences* **1**(4): 187–192.

Economic Survey. 2015-16. Ministry of Finance, Govt. of India. http://indiabudget.nic.in/budget2016-17/es2014-15/echapter-vol2.pdf (accessed 17.12.2017), Vol-II, pp. 100.

Kumar N, Nandal DP and Punia SS. 2014. Efficacy of post-emergence herbicides for weed control in transplanted rice. *Indian Journal of Weed Science* **46**(4): 380–382.

Manhas SS, Singh G, Singh D and Khajuria V. 2012. Effect of tank-mixed herbicides on weeds and transplanted rice (*Oryza sativa* L.). *Annals of Agricultural Research* New Series **33**(1&2): 25–31.

Sheoran OP, Tonk DS, Kaushik LS, Hasija RC and Pannu RS. 1998. Statistical Software Package for Agricultural Research Workers. pp 139–143. In: *Recent Advances in Information Theory, Statistics & Computer Applications* (Eds. DS Hooda & RC Hasija). CCS HAU, Hisar.

Singh G, Singh VP, Singh M and Singh SP. 2003. Effect of anilofos and triclopyr on grassy and non-grassy weeds in transplanted rice. *Indian Journal of Weed Science* **35**: 30–32.

Teja KC, Cuary B, Das S. 2016. Sole and combined application of herbicides on complex weed flora of transplanted rice. *Indian Journal of Weed Science* **48**(3): 254–258.

Teja KC, Duary B, Kumar M and Bhowmick MK. 2015. Effect of bensulfuron-methyl + pretilachlor and other herbicides on mixed weed flora of wet season transplanted rice. *International Journal of Agriculture, Environment and Biotechnology* **8**(2): 323–329.

Yadav DB, Yadav A and Punia SS. 2009. Evaluation of bispyribac-sodium for weed control in transplanted rice. *Indian Journal of Weed Science* **41**(1&2): 23–27.