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Management of weeds in direct-seeded rice by bispyribac-sodium

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ABSTRACT

A field experiment was conducted during the *Kharif* season of 2011 and 2012 at G.B.Pant University of Agricultureand Technology, Pantnagar to find out the efficacy of bispyribac-sodium in managing weeds in direct-seeded rice. Among the treatments, bispyribac-sodium 20 and 25 g/ha applied at 1-3 leaf stage or at 4-6 leaf stage of the weeds was found the most efficient having lowest weed density and biomass during both the years. Rice grain yield and yield attributing characters (tillers/m^2 and grains/panicle) were influenced by the effectiveness of the treatments. The highest grain yield of rice was recorded with weed free (4.03 t/ha) which was at par with bispyribac-sodium 20 and 25 g/ha.

Keywords: Bispyribac-sodium, Direct-seeded rice, Herbicide, Management, Weeds, Yield

Transplanting of rice seedlings is an age old practice but in the recent years, non-availability of labour for timely transplanting is resulting in the reduced yield of rice (Budhar and Tamilselven 2002). Direct-seeded rice (DSR) has several advantages over puddled transplanted rice like easier planting, timely sowing, less drudgery, early crop maturity by 7-10 days, less water requirement, better soil physical condition for next crop and low production cost and more profit (Kumar and Ladha 2011). However, weeds are the main biological constraints to the production of DSR (Rao *et al.* 2007, Chauhan and Johnson 2010), which may cause 60-80% reduction in grain yield of rice. Hence, present study was carried out to evaluate the efficacy of bispyribac-sodium in managing weeds of direct-seeded rice.

MATERIALS AND METHODS

A field experiment was carried out during *Kharif* 2011 and 2012 at Crop Research Center of GBPUA & T, Pantnagar. The soil was loamy, medium in organic matter (0.67%), available phosphorous (17.5 kg/ha) and potassium (181.2 kg/ha) with pH 7.5. The experiment consisted of nine treatments with three doses of bispyribac-sodium 15, 20 and 25 g/ha as test product at two stages of its application *i.e.* 1-3 leaf stage and 4-6 leaf stage along with bispyribac-sodium (standard check) 20 g/ha, weed free and weedy check. The experiment was laid out in randomized block design with three replications. The rice variety '*Pant Dhan 12*'was sown on June 30, 2011 and June 16, 2012. The crop was raised with recommended package of practices. The data on weed density/m^2 and total weeds biomass were taken at 45 days after sowing. Effective tillers/m^2 area, 1000 grain weight (g) and grain yield (kg/ha) of rice were recorded at the time of rice harvest. The data on density and biomass of weeds were subjected to log transformation by adding 1.0 to original values before statistical analysis. The herbicides were applied by using a Maruti Foot Sprayer fitted with flat fan nozzle with 375 liter/ha water volume.

In addition of bio-efficacy, a separate experiment was also carried out to see the phytotoxicity effect (yellowing, necrosis, scorching, epinasty and hyponasty) of bispyribac-sodium on direct-seeded rice crop and to see the residual effect of bispyribac-sodium on succeeding crop lentil and mustard. Bispyribac-sodium 20 g and 40 g/ha were applied at 3-4 leaf stage of weeds using 375 liter/ha volume of water. Phytotoxicity symptoms were recorded at 5, 10, 15 and 30 days after spraying using rating scale of 0-10, where, 0 = no effect on plant and 10 = complete death of the plant.

Lentil and mustard crops were planted after nine days of harvesting of rice crop in the plots treated with bispyribac-sodium at 20 and 40 g/ha and in weedy check to see the residual effect on succeeding lentil and mustard crops. Untreated check was maintained for comparison. Visual observations on crop phytotoxicity on succeeding lentil and mustard crops were recorded at 15 and 30 days after sowing (DAS) at 0-10 scale.

RESULTS AND DISCUSSION

Weed flora consisted of *Echinochloa colona*, *Eleusine indica* and *Leptochloa chinensis* among grasses; *Celosia argentia*, a broad-leaved weed and *Cyperus*

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rotundus and *Fimbristylis milliaceae* among sedges. However, very low density of other weeds, *viz. Echinochloa crusgalli, Commelina benghalensis, Phyllanthus niruri* and *Eclipta alba* were also found. Bispyribac-sodium caused significant reduction in the total density and biomass of weeds when compared with weedy check. Post-emergence application of bispyribac-sodium 20 as well as 25 g/ha applied both at 1-3 leaf stage or at 4-6 leaf stage was found effective for the control of *E. colona, E. indica, C. argentia, C. rotundus* and *F. milliaceae*. However, bispyribac-sodium at these rates and stages of application was found less effective for the control of *L. chinenis*. The total density of weeds decreased with increase in dose of bispyribac-sodium at 45 DAS. Among the herbicides, application of bispyribac-sodium (1-3 leaf stage) at higher dose applied 25 g /ha significantly reduced the total weed density as compared to other herbicidal treatments followed by its lower dose at 20 g/ha which was statistically at par with application of bispyribac-sodium 25 g/ha at (4-6 leaf stage) (Table 1). The highest density was observed in unweeded control plots. These results were also in conformity with the findings of Kumaran *et al*. (2012) who registered lower weed density under bispyribac-sodium than other weed management treatments in direct-seeded rice.

Weed biomass

Weed free plots recorded the lowest weed biomass followed by application of bispyribac-sodium (1-3 leaf stage) at higher dose applied at 25 g/ha during both the years (Table 2). The highest weed biomass was recorded in weedy check. The significant reduction of weed biomass by bispyribac-sodium at 30 g/ha than pre-emergence herbicide application in dry-seeded rice was also observed by Walia *et al*. (2008).

Weed control efficiency

The weed control efficiency (WCE) was highest in the weed free plot (Table 2). Among the herbicidal treatments, the highest WCE was recorded with the application of bispyribac-sodium at 25 g/ha applied at 1-3 leaf stage followed by its lower dose *i.e.* 20 g/ha which was at par with application of bispyribac sodium at 25 g/ha applied at 4-6 leaf stage.

Effect on crop

The highest number of tillers/m^2 was obtained with weed free conditions which was at par with the application of bispyribac-sodium 25 g/ha at 1-3 or 4-6 leaf stage and bispyribac-sodium 20 g/ha at 1-3 leaf stage. The highest grain yield of rice was recorded from the weed free plot (4.03 t/ha) which was at par with bispyribac-sodium 20 and 25 g/ha applied at 1-3 and 4-6 leaf stage of weeds. Chemical weed control by the application of selective herbicides often proved very effective in suppressing weeds with sizeable boost in the productivity of variety of arable crops including DSR (Mahajan *et al*. 2009).

Phytotoxicity

There was no phytotoxic effect of bispyribac-sodium at any of the doses on rice crop.

Residual effect on succeeding crops

Data (Table 3) revealed that plant height at 30 days of lentil and mustard, which were grown as succeeding crop after rice harvesting from the plots treated with bispyribac-sodium at 20 and 40 g/ha and untreated check were non-significant. Further bispyribac-sodium at 20 and 40 g/ha did not show any phytotoxic symptoms,*viz.* yellowing, wilting, stunting and deformities on mustard and lentil when observed at 15 and 30 days after sowing.

Table 1. Effect of bispyribac-sodium on weed density at 45 days after sowing (mean data of 2011 and 2012)

Treatment	Dose (g/ha)	Application stage	Weed density (no/m^2)						Total weed density (no/m^2)
			Echinochloa colona	*Leptochloa chinensis*	*Celosia argentia*	*Cyperus rotundus*	*Fimbristylis miliaceae*	Other weeds	
Bispyribac-sodium (TP)	15	1-3 leaf	3.5(36)	2.3(9)	2.7(16)	2.6(15)	1.2(4)	2.1(8)	4.54(93)
Bispyribac-sodium (TP)	20	1-3 leaf	3.0(20)	1.9(7)	2.2(9)	1.7(9)	0.0(0)	1.2(4)	3.97(52)
Bispyribac-sodium (TP)	25	1-3 leaf	2.3(13)	2.2(9)	1.8(5)	1.9(7)	0.0(0)	1.0(3)	3.64(37)
Bispyribac-sodium (TP)	15	4-6 leaf	3.7(44)	2.4(11)	2.8(17)	3.0(20)	1.5(7)	2.7(15)	4.82(123)
Bispyribac-sodium (TP)	20	4-6 leaf	3.2(27)	2.2(9)	2.6(13)	2.6(13)	1.0(3)	2.2(11)	4.41(89)
Bispyribac-sodium (TP)	25	4-6 leaf	2.9(19)	2.1(8)	2.1(8)	2.2(9)	0.5(1)	1.8(5)	3.99(53)
Bispyribac-sodium (SC)	20	4-6 leaf	3.4(31)	2.2(9)	2.6(13)	2.4(12)	1.8(5)	2.4(12)	4.47(86)
Weed free	-	-	0.0(0)	0.0(0)	0.0(0)	0.0(0)	0.0(0)	0.0(0)	0.0(0)
Weedy	-	-	5.3(221)	2.6(15)	3.8(48)	4.2(70)	2.6(15)	3.3(28)	6.01(410)
LSD (P=0.05)	-	-	0.6	0.8	0.6	1.1	1.1	1.1	0.45

Figures in parentheses are original values, which are subjected to log transformation, TP = Test product, SC = Standard check

Table 2. Effect of bispyribac-sodium on weed biomass and weed control efficiency at 45 days after sowing in direct-seeded rice (mean data of 2011 and 2012)

Treatment	Dose (g/ha)	Application stage	Weed biomass (g/m^2)			Total weed biomass (g/m^2)	WCE (%)
			Grassy weeds	Broad-leaf weeds	Sedge		
Bispyribac-sodium (TP)	15	1-3 leaf	3.61(38.11)	1.90(6.71)	2.67(13.67)	4.09 (58.49)	85.32
Bispyribac-sodium (TP)	20	1-3 leaf	3.17(23.11)	1.63(4.43)	2.55(6.23)	3.55 (33.77)	91.54
Bispyribac-sodium (TP)	25	1-3 leaf	2.65(13.73)	1.39(3.11)	2.38(4.90)	3.12 (21.74)	94.54
Bispyribac-sodium (TP)	15	4-6 leaf	5.15(73.30)	2.19(8.99)	3.47(18.85)	4.63 (101.14)	74.62
Bispyribac-sodium (TP)	20	4-6 leaf	5.00(36.27)	1.92(5.87)	3.07(11.50)	4.00 (53.64)	86.54
Bispyribac-sodium (TP)	25	4-6 leaf	3.25(25.2)	1.81(4.22)	2.60(7.40)	3.63 (36.82)	90.76
Bispyribac-sodium (SC)	20	4-6 leaf	5.0(37.50)	1.97(6.07)	2.97(12.34)	4.04 (55.91)	85.97
Weed free	-	-	0.0(00.00)	0.0(00.00)	0.0(00.00)	0.0 (0.00)	100.00
Weedy	-	-	5.72(306.93)	2.51(21.38)	4.25(70.30)	5.99 (398.61)	-
LSD (P=0.05)	-	-	0.25	0.33	0.20	0.47	

TP = Test product, SC = Standard check

Table 3. Effect of bispyribac-sodium on yield attributes and yield of direct seeded rice (mean data of 2011 and 2012)

Treatment	Dose (g/ha)	Application stage	Effective tillers/m^2	Grains/panicle	1000 grains weight (g)	Yield (t/ha)
Bispyribac-sodium (TP)	15	1-3 leaf	222.0	102.0	22.5	3.00
Bispyribac-sodium (TP)	20	1-3 leaf	248.3	106.3	22.7	3.80
Bispyribac-sodium (TP)	25	1-3 leaf	255.0	107.3	22.9	3.88
Bispyribac-sodium (TP)	15	4-6 leaf	200.0	100.0	21.3	2.30
Bispyribac-sodium (TP)	20	4-6 leaf	233.0	104.0	21.8	3.56
Bispyribac-sodium (TP)	25	4-6 leaf	241.0	104.7	22.2	3.72
Bispyribac-sodium (SC)	20	4-6 leaf	226.0	103.5	21.5	3.38
Weed free	-	-	260.7	110.7	23.2	4.03
Weedy	-	-	65.0	77.0	20.9	0.33
LSD (P=0.05)	-	-	20.1	4.5	NS	0.49

TP = Test product, SC = Standard check

On the basis of this study, it can be concluded that bispyribac-sodium 20 g/ha is optimum dose in rice for effective control of weeds and to attain higher grain yield of rice without any phyto-toxicity to rice or on lentil and mustard, which were planted as succeeding crops after harvesting of rice crop.

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