*Indian Journal of Agricultural Sciences* **87** (5): 589–92, May 2017/Article
https://doi.org/10.56093/ijas.v87i5.70104

# Weed dynamics of direct seeded *basmati* rice (*Oryza sativa*) influenced by different herbicides and their tank-mix applications

ROHITASH BAJIYA[1], DHARAM BIR[2], ASHOK YADAV[3] and S S PUNIA[4]

*Choudhary Charan Singh Haryana Agricultural University, Hisar, Haryana 125 004*

Received: 4 October 2016; Accepted: 24 October 2016

ABSTRACT

A farm trial was conducted during the *kharif* season of 2013 at Chaudhary Charan Singh Haryana Agricultural University, Regional Research Station, Karnal, India to evaluate the efficiency of tank-mix application of bispyribac sodium with pyrazosulfuron, azimsulfuron or ethoxysulfuron after pendimethalin for control of complex weed flora on direct seeded *basmati* rice (*Oryza sativa* L.) with twenty treatments laid out in randomized block design with three replications. Among herbicidal treatments application of Pendimethalin 1000 g/ha (PRE) *fb* tank-mix combination of bispyribac-sodium 25 g/ha with pyrazosulfuron 25 g/ha or azimsulfuron 20 g/ha or ethoxysulfuron 18.0-37.5 g/ha (WCE at 40 DAS: 95.0-96.6%) were realized to be the best herbicidal combinations for control of complex weed flora in direct seeded rice, with significant improvement in total number of tillers at 40 DAS; (53.0-55.7 No./ meter row length (m.r.l.), grain yield (4.01-4.10 t/ha), net returns (₹ 108856-113485/ha) and B-C ratio (2.45-2.53) as compared to weedy check (30.6 No/m.r.l., 1.52 t/ha, ₹ 1590/ ha and 1.02, respectively).

**Key words:** *Basmati,* Direct seeded rice, Economics, Herbicides, Grain yield, Weeds control efficiency

Puddling is a common practice for establishing rice (*Oryza sativa* L.) in the rice-wheat system followed by manual transplanting. Puddling benefits rice by reducing water percolation losses, controlling weeds, facilitating easy seedling establishment and creating anaerobic conditions to enhance nutrient availability but besides being costly, time consuming, and degradation of soil and other natural resources (Pathak *et al*. 2011). Under such situations, direct seeding of rice is the need of time to avoid puddling and transplanting. Aerobic systems are subject to much higher weed pressure than conventional puddle transplanting system (Rao *et al*.2007) due to the absence of a size differential between the crop and weeds and the suppressive effect of standing water on weed growth at crop establishment (Chauhan *et al.* 2011). Pendimethalin as pre-emergence in sequence with bispyribac-Na at 15-25 DAS or bispyribac-Na in combination with 2, 4-D, metsulfuron, ethoxysulfuron or premix of chlorimuron + metsulfuron have already been recommended against complex weed flora infesting DSR (Yadav *et al*. 2011b). But in spite of using all such herbicidal combinations, control failures, lot of escapes or regeneration in some of the weed species have recently been noticed at many locations in DSR(Yadav *et al*. 2011b). Since, there is long window of emergence of diverse type of weeds in *kharif* season, one time application of herbicide will not solve the purpose. Also, many herbicides used in rice are of narrow spectrum; hence application of several herbicides in combination or in sequence can be more useful in DSR.

[1]Ph D Student (e mail bajiyarohitash@gmail.com), [2,3,4]Professor, Department of Agronomy

## MATERIALS AND METHODS

Field experiment was conducted at the research farm of Chaudhary Charan Singh Haryana Agricultural University, Regional Research Station, Uchani, Karnal is situated at 245 m above mean sea level with longitude of $67^0$58' north and latitude $29^0$43' east in sub-tropical zone.Mean weekly maximum and minimum temperatures fluctuated between 29.3 and $36.5^0$C and between 11.4 and $26.9^0$C. The total rainfall was recorded to be 94 cm during crop season to evaluate the efficiency of different tank-mix herbicides against complex weed flora in direct seeded *basmati* rice. The soil of experiment field was clay loam in texture and slightly alkaline in reaction (*p*H 8.2) and with EC of 0.35 dS/m. The soil was low in organic carbon (0.38%), available N (142 kg/ha) and $P_2O_5$ (20.1 kg/ha) but medium in $K_2O$ (170.4 kg/ha).Twenty treatments ($T_1$: pendimethalin 1000 g/ha, $T_2$: bispyribac-Na 25 g/ha, $T_3$: bispyribac 25 g/ha + pyrazosulfuron 25 g/ha, $T_4$: bispyribac 25 g/ha + azimsulfuron 20 g/ha, $T_5$-$T_7$: bispyribac 25 g/ha + ethoxysulfuron 18.8, 28.0, 37.5 g/ha, $T_8$: bispyribac 25 g/ha + fenosxarop (with safener) 60 g/ha, $T_9$: penoxsulam + cyhalofop (ready-mix) 150 g/ha, $T_{10}$: $T_1$*fb* $T_2$, $T_{11}$: $T_1$*fb* $T_3$, $T_{12}$: $T_1$*fb* $T_4$, $T_{13}$-$T_{15}$: $T_1$*fb* $T_5$-$T_7$, $T_{16}$: $T_1$*fb* $T_8$,$T_{17}$: $T_1$*fb* azimsulfuron 20 g/ha *fb* $T_8$, $T_{18}$: $T_{10}$ *fb* one hand weeding, along with weed free ($T_{19}$) and weedy checks ($T_{20}$) laid out in randomized

block design with three replications.Seeds of rice cultivar Pusa Basmati 1121 were drilled in lines 20 cm apart on 11 June, using zero-till seed-cum-fertilizer drill fitted with inclined plate seed metering system using the seed rate of 30 kg/ha, which was followed by thinning and gap filling at 15 DAS to maintain proper plant population. Herbicides were applied as spray in an aqueous medium at the rate of 500 litre water/ha for pre-emergence herbicides and 300 litres water/ha for post–emergence herbicides, using a knapsack sprayer with flat-fan nozzle. Data on weed count and weed biomass from an area enclosed in a quadrate of 0.25 $m^2$ at 2 places under different treatments were recorded at 40 days after sowing (DAS). Data on individual weed and total weed density and weed dry weight were subjected to square root transformation ($\sqrt{X+1}$). Weed control efficiency was calculated on dry matter basis and yield recorded in kg per plot was standardized to 14% moisture and then weight was converted into kg/ha. In order to calculate the net returns for each treatment, total cost of cultivation was subtracted from the gross returns. Total cost of cultivation and gross returns were estimated as per the prices prevailing at the time of conduct of experiment and benefit-cost ratio was calculated from gross return to cost of cultivation.

## RESULTS AND DISCUSSION

Experimental field was dominated with grassy weeds like *Echinochloa crus-galli, Eragrostis tenella,*

Table 1 Effect of weed control treatments on the population of the different weeds at 40 DAS in direct seeded *basmati* rice

| Treatment | Dose (g/ha) | Density* of different weeds (No./$m^2$ ) | | | | | | Total dry matter accumulation ($g/m^2$) |
|---|---|---|---|---|---|---|---|---|
| | | *Echinochloa crus-galli* | *Eragrostis tenella* | *Dactyloctenium aegyptium* | *Cyperus rotundus* | *Ammannia baccifera* | Total BLW | |
| Pendimethalin | 1000 | 5.7 (32.0) | 2.9 (7.3) | 1.2 (0.7) | 9.5 (89.3) | 3.8 (13.3) | 4.3 (18.0) | 69.5 |
| Bispyribac-Na | 25 | 1.2 (0.7) | 6.4 (40.0) | 2.4 (4.7) | 7.4 (53.3) | 4.1 (16.0) | 4.4 (18.7) | 38.6 |
| Bispyribac + pyrazosulfuron | 25+25 | 1.2 (0.7) | 6.2 (38.0) | 2.2 (4.0) | 2.7 (6.0) | 2.5 (5.3) | 2.7 (6.0) | 23.9 |
| Bispyribac + azimsulfuron | 25+20 | 3.8 (13.3) | 6.3 (38.7) | 2.1 (3.3) | 2.8 (6.7) | 2.4 (4.7) | 2.4 (4.7) | 37.6 |
| Bispyribac + ethoxysulfuron | 25+18.8 | 4.0 (14.7) | 6.5 (40.7) | 2.4 (4.7) | 3.1 (8.7) | 2.5 (5.3) | 2.6 (6.0) | 41.7 |
| Bispyribac + ethoxysulfuron | 25+28 | 3.6 (12.0) | 6.2 (37.3) | 2.1 (3.3) | 1.9 (2.7) | 2.4 (4.7) | 2.4 (4.7) | 42.9 |
| Bispyribac + ethoxysulfuron | 25+37.5 | 4.2 (16.7) | 6.1 (36.7) | 2.2 (4.0) | 2.1 (3.3) | 2.2 (4.0) | 2.3 (4.7) | 39.9 |
| Bispyribac + fenoxaprop with safener (S) | 25+60 | 8.3 (67.3) | 4.2 (16.7) | 1.9 (2.7) | 9.6 (90.7) | 4.2 (16.7) | 4.6 (20.0) | 143.4 |
| Penoxsulam + cyhalofop (ready-mix) | 150 | 2.6 (6.0) | 4.7 (20.7) | 1.7 (2.0) | 5.7 (32.0) | 3.6 (12.0) | 4.0 (14.7) | 31.4 |
| Pendimethalin fb bispyribac | 1000/ 25 | 1.5 (1.3) | 3.1 (8.7) | 1.5 (1.3) | 8.1 (65.3) | 3.4 (10.7) | 3.7 (12.7) | 22.1 |
| Pendimethalin fb bispyribac + pyrazosulfuron | 1000 /25+25 | 1.7 (2.0) | 3.1 (8.7) | 1.5 (1.3) | 2.3 (4.7) | 2.5 (5.3) | 2.7 (6.0) | 9.0 |
| Pendimethalin fb bispyribac + azimsulfuron | 1000 /25+20 | 2.1 (3.3) | 3.0 (8.0) | 1.2 (0.7) | 2.5 (5.3) | 2.4 (4.7) | 2.6 (6.0) | 8.5 |
| Pendimethalin fb bispyribac + ethoxysulfuron | 1000 /25+18.8 | 2.5 (5.3) | 3.0 (8.7) | 1.5 (1.3) | 3.3 (10.0) | 2.5 (5.3) | 2.5 (5.3) | 8.9 |
| Pendimethalin fb bispyribac + ethoxysulfuron | 1000/ 25+28 | 2.6 (6.0) | 3.4 (10.7) | 1.2 (0.7) | 2.9 (7.3) | 2.4 (4.7) | 2.6 (6.0) | 9.6 |
| Pendimethalin fb bispyribac + ethoxysulfuron | 1000/ 25+37.5 | 2.6 (6.0) | 3.3 (10.0) | 1.2 (0.7) | 2.5 (5.3) | 2.4 (4.7) | 2.5 (5.3) | 6.5 |
| Pendimethalin fb bispyribac + fenoxaprop (S) | 1000 /25+60 | 3.5 (11.3) | 1.9 (2.7) | 1.5 (1.3) | 9.7 (92.7) | 3.6 (12.0) | 3.8 (13.3) | 27.4 |
| Pendimethalin fb azimsulfuron fb bispyribac + fenoxaprop (S) | 1000/ 20/25+60 | 3.3(10.0) | 2.3 (4.7) | 1.5 (1.3) | 1.6 (2.0) | 2.6 (6.0) | 2.8 (6.7) | 13.7 |
| Pendimethalin fb bispyribac fb one hand weeding (HW) | 1000/25/ HW | 1.0 0 (0.0) | 1.0 0 (0.0) | 1.0 (0.0) | 1.0 (0.0) | 1.0 (0.0) | 1.0 (0.0) | 0.0 |
| Weed free | | 1.0 0 (0.0) | 1.0 0 (0.0) | 1.0 (0.0) | 1.0 (0.0) | 1.0 (0.0) | 1.0 (0.0) | 0.0 |
| Weedy check | | 8.7(74.0) | 6.56(42.0) | 2.5 (5.3) | 9.9 (96.7) | 5.9 (34.0) | 6.9 (47.3) | 192.8 |
| SEm± | | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 2.9 |
| CD (P = 0.05) | | 0.53 | 0.7 | 0.6 | 0.7 | 0.4 | 0.6 | 19.5 |

*Original figures in parenthesis were subjected to square root transformation (X+1) before statistical analysis

Table 2 Effect of different herbicides alone and in combination on yield attributes and grain yield in direct seeded *basmati* rice

| Treatment | Dose (g/ha) | Weed control efficiency (%) | Tillers (No./ m.r.l.) 40 DAS | Plant height (cm) | 1000-grain weight (g) | Grain yield (t/ha) | Straw yield (t/ha) | Net returns (₹ × 103/ha) | B-C ratio |
|---|---|---|---|---|---|---|---|---|---|
| Pendimethalin | 1000 | 63.9 | 43.3 | 52.1 | 25.9 | 3.07 | 4.89 | 69.6 | 1.97 |
| Bispyribac-Na | 25 | 80.0 | 47.5 | 55.1 | 26.4 | 3.67 | 5.59 | 96.7 | 2.34 |
| Bispyribac + pyrazosulfuron | 25+25 | 87.6 | 49.9 | 53.5 | 26.0 | 3.78 | 5.67 | 100.1 | 2.38 |
| Bispyribac + azimsulfuron | 25+20 | 80.4 | 48.0 | 53.1 | 26.8 | 3.63 | 5.59 | 93.0 | 2.26 |
| Bispyribac + ethoxysulfuron | 25+18.8 | 78.4 | 46.3 | 52.7 | 25.5 | 3.55 | 5.52 | 90.3 | 2.24 |
| Bispyribac + ethoxysulfuron | 25+28 | 77.7 | 46.7 | 55.0 | 26.0 | 3.53 | 5.60 | 89.3 | 2.22 |
| Bispyribac + ethoxysulfuron | 25+37.5 | 79.3 | 47.1 | 54.4 | 26.1 | 3.54 | 5.47 | 89.3 | 2.22 |
| Bispyribac + fenoxaprop with safener (S) | 25+60 | 25.6 | 41.7 | 54.6 | 25.1 | 2.56 | 4.12 | 44.4 | 1.61 |
| Penoxsulam + cyhalofop (ready-mix) | 150 | 83.7 | 47.3 | 52.0 | 26.5 | 3.75 | 5.68 | 99.8 | 2.38 |
| Pendimethalin fb bispyribac | 1000/ 25 | 88.5 | 53.2 | 53.7 | 26.4 | 3.89 | 5.80 | 104.7 | 2.42 |
| Pendimethalin fb bispyribac + pyrazosulfuron | 1000 /25+25 | 95.4 | 54.7 | 53.2 | 26.9 | 4.10 | 5.83 | 113.4 | 2.53 |
| Pendimethalin fb bispyribac + azimsulfuron | 1000 /25+20 | 95.6 | 53.5 | 53.9 | 26.3 | 4.09 | 5.82 | 111.8 | 2.49 |
| Pendimethalin fb bispyribac + ethoxysulfuron | 1000 /25+18.8 | 95.3 | 53.0 | 51.2 | 26.1 | 4.04 | 5.74 | 110.8 | 2.49 |
| Pendimethalin fb bispyribac + ethoxysulfuron | 1000/ 25+28 | 95.0 | 54.3 | 53.8 | 26.2 | 4.05 | 5.82 | 111.1 | 2.49 |
| Pendimethalin fb bispyribac + ethoxysulfuron | 1000/ 25+37.5 | 96.6 | 55.7 | 52.2 | 26.0 | 4.01 | 5.74 | 108.8 | 2.45 |
| Pendimethalin fb bispyribac + fenoxaprop (S) | 1000 /25+60 | 85.8 | 43.4 | 51.8 | 26.4 | 3.68 | 5.60 | 94.0 | 2.26 |
| Pendimethalin fb azimsulfuron fb bispyribac + fenoxaprop (S) | 1000/ 20/25+60 | 92.9 | 47.6 | 52.3 | 26.1 | 3.70 | 5.73 | 93.4 | 2.22 |
| Pendimethalin fb bispyribac fb one hand weeding (HW) | 1000/25/HW | 100.0 | 56.3 | 52.3 | 27.3 | 4.20 | 5.89 | 112.6 | 2.42 |
| Weed free | | 100.0 | 57.6 | 57.5 | 27.1 | 4.36 | 6.05 | 112.2 | 2.28 |
| Weedy check | | 0.0 | 30.6 | 54.3 | 25.0 | 1.52 | 2.64 | 15.9 | 1.02 |
| SEm± | | | 1.8 | 2.5 | 1.0 | 0.11 | 0.23 | | |
| CD (P = 0.05) | | | 5.3 | NS | NS | 0.33 | 0.67 | | |

NS, Non significant

*Dactyloctinum aegyptium;* broad leaf weeds like *Ammannia baccifera* and sedges like *Cyperus rotundus*. Pendimethalin significantly controlled aerobic grassy weeds like *Eragrostis* and *Dactyloctenium* (Godara *et al*. 2012) but its efficacy was low against grass weeds like *Echinochloa crus-galli* and sedges like *Cyperus rotundus*, while pyrazosulfuron, azimsulfuron and ethoxysulfuron were effective against broadleaf weeds and sedges (Yadav *et al.* 2011a).Pendimethalin and bispyribac sodium alone and in sequential combination did not provide effective control of sedges. But, sequential applications of bispyribac 25 g/ ha tank-mix with pyrazosulfuron 25 g/ha, azimsulfuron 20 g/ha or ethoxysulfuron 18.8-37.5 g/ha after pendimethalin 1000 g/ha were superior to their individual applications in respect of density and dry weight of all type of grassy weeds (Yadav *et al*. 2011b). Fenoxaprop (with safener) had antagonistic effect on the efficacy of bispyribac sodium against all type of weeds, as visible from their density and dry weight at 40 days after sowing (DAS). Integration of one hand weeding with pendimethalin *fb* bispyribac also resulted in almost complete control of all type of weeds. Pendimethalin 1000 g/ha or oxadiargyl 100 g/ha as pre emergence application *fb* bispyribac-Na 25 g/ha at 25 DAS were realized as the best combinations to provide satisfactory control of all type of weeds with significant improvement in grain yield of direct seeded *basmati* rice (Godara *et al*. 2012).There was no significant effect of different treatments on plant height and test weight of direct seeded *basmati* rice (Yadav *et al*. 2011a). Sequential application of bispyribac 25 g/ha, bispyribac 25 g/ha + pyrazosulfuron 25 g/ha, bispyribac 25 g/ha + azimsulfuron 20 g/ha or bispyribac 25 g/ha + ethoxysulfuron 18.8-37.5 g/ha after pendimethalin 1000 g/ha resulted in higher number of tillers at 40 DAS (53.0-55.7 No./m.r.l.), grain yields (4.01-4.10 t/ha), straw yield (5.74-5.83 t/ha) Net returns (₹ 1 08 856-1 13 485/ha ) at par with weed free check. It was basically due to combination of lower cost of cultivation and higher yields (Azami *et al.* 2005). Kamboj *et al*. (2012) also speculated that DSR can be grown successfully provided weeds are controlled effectively.

It was concluded thatstudy clearly indicate that weeds can also be effectively controlled by suitable herbicidal

combinations as sequential applications of bispyribac sodium 25 g/ha + pyrazosufuron 25 g/ha or azimsulfuron 20 g/ha or ethoxysulfuron 18.8-37.5 g/ha after pendimethalin 1000 g/ha (PRE) were the best herbicidal combination at 40 DAS for effective control of weed complex in direct seeded rice with improved yields, net returns and B-C ratio. These were better than their respective counterpart treatments without pendimethalin and also the already recommended combination of pendimethalin 1000 g/ha *fb* bispyribac 25 g/ha. Integration of one hand weeding (40 DAS) with pendimethalin 1000 g/ha *fb* bispyribac 25 g/ha provided almost complete control of all type of weeds with highest grain yield.

## REFERENCES

Azmi M, Chin D V, Vongsaroj P, and Johnson D E. 2005. Emerging issues in weed management of direct-seeded rice in Malaysia, Vietnam, and Thailand. (*In*) *Rice Is Life: Scientific Perspectives for the 21st Century*, pp 196–8. K Toriyama, K L Heong, and B Hardy Eds). International Rice Research Institute, Los Ban ˜os, Philippines, and Japan International Research Center for Agricultural Sciences, Tsukuba, Japan.

Chauhan B S, Singh V P, Kumar A and Johnson D E. 2011. Relations of rice seeding rates to crop and weed growth in aerobic rice. *Field Crops Research* **21**: 105–15.

Godara S P, Yadav A and Yadav D B. 2012. Evaluation of herbicides as alone or in sequential application against weeds in direct seeded basmati rice. (*In*) *Proc. Extended Summaries of 3rd International Agronomy Congress,* New Delhi, India, 26-30 November 2012, Vol 2, pp 336–7.

Kamboj B R, Kumar A, Bishnoi D P, Singla K, Kumar V, Jat M L, Choudhary H S, Gosain D K, Khippal A, Garg R, Lathwal O P, Goyal N K, Yadav A, Malik D S, Mishra A and Bhatia R. 2012. Direct seeded rice technology in western indo-gangetic plains of India: CSISA Experiences. CSISA Technical Bulletin 2102/1, CSISA, IARI and CIMMYT, India, p 16.

PathakH, TewariA N, Sankhyan S, Dubey D S, Mina U, Singh V K, Jain N and Bhatia A. 2011. Direct-seeded rice: Potential, performance and problems – A review. *Current Advances in Agricultural Sciences* **3(2)**: 77–88.

Rao A N, Johnson D E, Sivaprasad B, Ladha J and Mortimer A M. 2007. Weed management in direct seeded rice. *Advances of Agronomy* **93**: 153–5.

Yadav D B, Yadav A, Malik R K And Gill G. 2011a. Combination of bispyribac-sodium with azimsulfuron or pyrazosulfuron for control of complex weed flora in direct seeded rice. *Environment and Ecology* **29(4)**: 1 840–44.

Yadav D B, YadavA, Malik R K And Gill G. 2011b. Evaluation of bispyribac in combination with other herbicides for post-emergence control of complex weed flora in direct seeded rice. *Environment and Ecology* **29(4)**: 1 832–36.