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Impact of integrated weed management on weed flora, growth attributes and yield of direct seeded rice (*Oryza sativa* L.)

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Abstract
A field investigation was conducted during the rainy (*Kharif*) season of 2014 and 2015 at Varanasi, Uttar Pradesh, to study the impact of integrated weed management on weeds, growth attributes and yield of direct seeded rice (*Oryza sativa* L.). At 30, 60, 90 DAS and at harvest, amongst the integrated weed management treatments, penoxsulam 35 g/ha at 10 DAS *fb* 1 hand weeding at 35 DAS reduced total weed density and their dry weight than penoxsulam 35 g/ha at 20 DAS *fb* 1 hand weeding at 35 DAS thus resulting in the lowest weed index. Penoxsulam 35 g/ha at 10 DAS *fb* 1 hand weeding at 35 DAS markedly improved growth attributes viz., plant height, dry matter accumulation, leaf area index and chlorophyll content at 90 DAS. Penoxsulam 35 g/ha at 10 DAS *fb* 1 hand weeding at 35 DAS statistically influenced the grain and straw yields. Bispyribac Na 25g/ha at 10 DAS *fb* 1 HW at 35 DAS had the highest harvest index over all other treatments in the year of 2014.

Keywords: azimsulfuron, bispyribac na, chlorimuron ethyl, metsulfuron methyl, penoxsulam, direct seeded rice, economics

Introduction
Aerobic edaphic conditions under non flooded conditions in DSR stimulate germination of diverse weed species. Weed infestation in direct seeded rice (DSR) fields remains the single largest constraint limiting their productivity. Weeds in DSR compete for moisture, nutrients, light and space and reduce the grain yield by 50 to 91 % (Rao *et al;* 2007) [7]. An effective early weed management tactic is imperative for any DSR production technology aiming at achieving higher productivity and profitability (Jaya Suria *et al*; 2011) [5]. Weed problem in direct seeded rice can be managed by implementing integrated weed management. Chemical control proved to be a viable strategy with higher economic returns (Khaliq *et al;* 2012) [6]. Ehsanullah *et al.* (2012) [2] observed that the post emergence application of bispyribac sodium was the most effective in reducing the total density and dry weight over weedy, followed by penoxsulam. However, weeds in direct seeded rice cannot be controlled by herbicide alone because of various flushes of weeds during life cycle of crop. Continuous use of selective herbicides puts heavy selection pressure on weeds and weed flora shifts towards lesser competitive weeds and resistant to those selective herbicides. Herbicides having relatively broad spectrum killing may require less man days and will have better economics in an integrated weed management system. Therefore, it is imperative to identify effective integrated chemical and manual practices with respect to weed control, yield and to work out their economics. Integrated weed management systems have the potential to reduce herbicide use and (associated costs) and to provide more robust weed management over the long term (Swanton and Weise, 1991) [2]. Therefore, keeping above facts in view, the present study was taken up, to assess the suitable integration of different herbicides along with manual weeding on weeds, growth attributes and yield in direct seeded rice.

Materials and Methods
A field experiment was conducted during the rainy (*Kharif*) season of 2014 and 2015 at Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh. The soil was sandy clay loam, with pH 7.40, low in available organic carbon (0.41%), available nitrogen (207.47 kg/ha), and medium in available phosphorous (23.85 kg/ha) and potassium (219.60 kg/ha). The experiment was laid out in a randomized block design, comprising 10 treatments replicated thrice, viz. bispyribac Na 25g/ha at 10 DAS *fb* 1 HW at 35 DAS, bispyribac Na 25g/ha at 20 DAS *fb* 1 HW at 35 DAS, bispyribac Na 12.5g/ha + azimsulfuron 15g/ha at 10 DAS *fb* 1 HW at 35 DAS, bispyribac Na 12.5g/ha +

azimsulfuron 15g/ha at 20 DAS *fb* 1 HW at 35 DAS, bispyribac Na 12.5g/ha + (chlorimuron ethyl + metsulfuron methyl) 2g/ha at 10 DAS *fb* 1 HW at 35 DAS, bispyribac Na 12.5g/ha + (chlorimuron ethyl + metsulfuron methyl) 2g/ha at 20 DAS *fb* 1 HW at 35 DAS, penoxsulam 35g/ha at 10 DAS *fb* 1 HW at 35 DAS, penoxsulam 35g/ha at 20 DAS *fb* 1 HW at 35 DAS, hand weeding at 15 and 35 DAS and weedy during both the years. Rice variety MTU-7029 was sown by zero till drill during the last week of June in the both the years using the seed rate of 30 kg/ha and 20 cm row-row spacing. A recommended dose of fertilizer (150 kg N, 60 kg P_2O_5 and 60 kg K_2O) was applied through urea, single super phosphate and muriate of potash during both the years of experimentation. Application of alone and tank mixed post emergence herbicides was done according to the treatments using knap-sack sprayer fitted with even-fan nozzle. The spray volume of post emergence herbicides was 300 litres/ha. The crop was raised under irrigated condition under the recommended package of practices. Species-wise weed density and their dry weight were measured at 30, 60, 90 DAS and at harvest by placing a quadrate of 0.50 m × 0.50 m randomly at 2 places in each plot. Data on weed density and dry weight were subjected to square root transformation before analysis. At 30, 60, 90 DAS and at harvest, weed control efficiency (Tripathi and Mishra 1971) [10] and weed index (Gill and Kumar 1969) [3] was calculated using weed dry weight and grain yield, respectively. Biometric characters viz, growth attributes and yields (grain and straw) of crop were recorded. Duncan Multiple Range Test (DMRT) (Gomez and Gomez, 1984) [4] was used for comparing treatment means.

Results and Discussion

Effect on Weeds

Total weed density and their dry weight varied statistically at 30, 60, 90 DAS and at harvest irrespective of integrated weed management treatments (Table 1 & 2). Penoxsulam 35g/ha at 10 DAS *fb* 1 HW at 35 DAS recorded lower total weed density in comparison to penoxsulam 35g/ha at 20 DAS *fb* 1 HW at 35 DAS and both treatments were statistically at par to each other at 90 DAS during both the years. This could be attributed due to alone application of penoxsulam 35 g/ha had effective control of both narrow and broad leaved weeds at early crop stages later on one manual weeding controlled weeds comprehensively. This result is conformity with Dalamas *et al.* (2006). However, bispyribac Na 25g/ha at 10 DAS *fb* 1 HW at 35 DAS had lesser total weed density as compared to bispyribac Na 25g/ha at 20 DAS *fb* 1 HW at 35 DAS and both treatments were statistically similar to each other at 90 DAS during both the years (Table 1). Amongst the integrated weed management treatments, penoxsulam 35g/ha at 10 DAS *fb* 1 HW at 35 DAS recorded lower total weed dry weight in comparison to penoxsulam 35g/ha at 20 DAS *fb* 1 HW at 35 DAS and both treatments were statistically at par to each other at harvest during both the years. However, bispyribac Na 12.5g/ha + (chlorimuron ethyl + metsulfuron methyl) 2g/ha at 10 DAS *fb* 1 HW at 35 DAS had lesser total weed dry weight as compared to bispyribac Na 12.5g/ha + (chlorimuron ethyl + metsulfuron methyl) 2g/ha at 20 DAS *fb* 1 HW at 35 DAS and both treatments were statistically similar to each other at 90 DAS and at harvest during both the years (Table 2). These findings are in conformity with that of Khare *et al*. (2014) in direct seeded rice.

At 30, 60, 90 DAS and at harvest, Penoxsulam 35g/ha at 10 DAS *fb* 1 HW at 35 DAS resulted higher weed control efficiency as compared to penoxsulam 35g/ha at 20 DAS *fb* 1 HW at 35 DAS, bispyribac Na 12.5g/ha + (chlorimuron ethyl + metsulfuron methyl) 2g/ha at 10 DAS *fb* 1 HW at 35 DAS, bispyribac Na 12.5g/ha + (chlorimuron ethyl + metsulfuron methyl) 2g/ha at 20 DAS *fb* 1 HW at 35 DAS, bispyribac Na 12.5g/ha + azimsulfuron 15g/ha at 10 DAS *fb* 1 HW at 35 DAS, bispyribac Na 12.5g/ha + Azimsulfuron 15g/ha at 20 DAS *fb* 1 HW at 35 DAS, bispyribac Na 25g/ha at 10 DAS *fb* 1 HW at 35 DAS, bispyribac Na 25g/ha at 20 DAS *fb* 1 HW at 35 DAS and weedy. Penoxsulam 35g/ha at 10 DAS *fb* 1 HW at 35 DAS recorded the lowest weed index except hand weeding at 15 and 35 DAS (Table 3).

Effect on crop

At 90 DAS, Penoxsulam 35g/ha at 10 DAS *fb* 1 HW at 35 DAS resulted higher plant height, dry matter accumulation (g running/m), leaf area index and chlorophyll content in comparison to penoxsulam 35g/ha at 10 DAS *fb*1 HW at 35 DAS and both treatments were statistically similar to each other except leaf area index in the year of 2015. However, bispyribac Na 12.5g/ha + (chlorimuron ethyl + metsulfuron methyl) 2g/ha at 10 DAS *fb* 1 HW at 35 DAS had higher plant height, dry matter accumulation (g/running m), leaf area index and chlorophyll content as compared to bispyribac Na 12.5g/ha + (chlorimuron ethyl + metsulfuron methyl) 2g/ha at 20 DAS *fb* 1 HW at 35 DAS and bispyribac Na 12.5g/ha + azimsulfuron 15g/ha at 10 DAS *fb* 1 HW at 35 DAS and all these treatments were statistically similar to each other except leaf area index in the year of 2015 (Table 4). Penoxsulam 35g/ha at 10 DAS *fb*1 HW at 35 DAS had better performance of growth attributes due to marked reduction in competition for growth resources due to reduction in weed density and weed dry weight (Table 1 & 2).

Yield

Integrated weed management treatments had significant variation in grain and straw yields (Table 5). Amongst the integrated weed management treatments, Penoxsulam 35g/ha at 10 DAS *fb* 1 HW at 35 DAS had the highest grain yield over rest of the treatments except hand weeding at 15 and 35 DAS. This was due to better performance of yield attributing character and higher harvest index as compared to weedy and other integrated weed management treatments. Bispyribac Na 25g/ha at 10 DAS *fb* 1 HW at 35 DAS had the highest harvest index over rest of the treatments in the year of 2014.

Table 1: Effect of integrated weed management on total density of weeds (/m^2) at different stages of observation of direct seeded rice

Treatment	30 DAS		60 DAS		90 DAS		At harvest	
	2014	2015	2014	2015	2014	2015	2014	2015
Bispyribac Na 25g/ha at 10 DAS *fb* 1 HW at 35 DAS	4.8^{d} (22.6)	4.5^{d} (19.5)	4.5^{d} (20.4)	4.2^{d} (17.3)	2.9^{bc} (7.9)	2.8^{bc} (7.4)	2.8^{b} (7.7)	2.8^{bc} (7.4)
Bispyribac Na 25g/ha at 20 DAS *fb* 1 HW at 35 DAS	4.9^{b} (24.1)	4.6^{b} (20.8)	4.7^{b} (20.1)	4.3^{b} (18.7)	2.9^{b} (8.2)	2.8^{b} (7.5)	2.7^{f} (6.9)	2.8^{b} (7.5)
Bispyribac Na 12.5g/ha + azimsulfuron 15g/ha at 10 DAS *fb* 1 HW at 35 DAS	4.6^{e} (20.7)	4.4^{e} (18.6)	4.4^{e} (18.8)	3.9^{f} (15.4)	2.8^{bcd} (7.8)	2.8^{bcd} (7.3)	2.8^{c} (7.6)	2.7^{bcd} (7.3)
Bispyribac Na 12.5g/ha + azimsulfuron 15g/ha at 20 DAS *fb* 1 HW at 35 DAS	4.8^{c} (23.0)	4.5^{c} (20.4)	4.6^{c} (21.2)	4.3^{c} (18.1)	2.9^{bcd} (7.9)	2.8^{bcd} (7.4)	2.8^{b} (7.7)	2.8^{bc} (7.4)
Bispyribac Na 12.5g/ha + (chlorimuron ethyl + metsulfuron methyl) 2g/ha at 10 DAS *fb* 1 HW at 35 DAS	4.5^{f} (19.7)	4.1^{f} (16.7)	4.3^{f} (18.0)	3.8^{f} (14.3)	2.8^{bcd} (7.8)	2.7^{bcd} (7.2)	2.8^{cd} (7.5)	2.7^{bcd} (7.2)
Bispyribac Na 12.5g/ha + (chlorimuron ethyl + metsulfuron methyl) 2g/ha at 20 DAS *fb* 1 HW at 35 DAS	4.7^{de} (21.7)	4.5^{de} (19.5)	4.5^{e} (20.5)	4.1^{e} (16.5)	2.9^{bcd} (7.9)	2.8^{bcd} (7.4)	2.8^{b} (7.7)	2.8^{bcd} (7.3)
Penoxsulam 35g/ha at 10 DAS *fb* 1 HW at 35 DAS	3.4^{h} (11.3)	3.1^{h} (9.3)	3.3^{h} (10.7)	3.0^{h} (8.5)	2.8^{d} (7.4)	2.7^{d} (6.9)	2.7^{e} (7.2)	2.7^{d} (6.8)
Penoxsulam 35g/ha at 20 DAS *fb* 1 HW at 35 DAS	3.7^{g} (13.4)	3.4^{g} (11.0)	3.5^{g} (12.4)	3.1^{g} (9.3)	2.8^{cd} (7.5)	2.7^{cd} (7.0)	2.7^{d} (7.3)	2.7^{cd} (6.9)
Hand weeding at 15 and 35 DAS	0.7^{i} (0.0)	0.7^{i} (0.0)	0.7^{i} (0.0)	0.7^{i} (0.0)	0.7^{e} (0.0)	0.7^{e} (0.0)	0.7^{g} (0.0)	0.7^{e} (0.0)
Weedy	8.4^{a} (70.2)	8.2^{a} (66.9)	10.6^{a} (112.5)	10.7^{a} (115.4)	10.2^{a} (103.2)	10.2^{a} (104.4)	9.2^{a} (83.8)	9.1^{a} (81.9)
CV (%)	4.3	3.5	3.0	2.3	1.4	1.5	1.5	1.5

Data were subjected to square root ($\sqrt{X+0.5}$) transformation; figures in parentheses are original values

Table 2: Effect of integrated weed management on total dry weight of weeds (g/m^2) at different stages of observation of direct seeded rice

Treatment	30 DAS		60 DAS		90 DAS		At harvest	
	2014	2015	2014	2015	2014	2015	2014	2015
Bispyribac Na 25g/ha at 10 DAS *fb* 1 HW at 35 DAS	3.7^{c} (13.4)	3.5^{c} (11.8)	3.5^{d} (12.1)	3.3^{d} (10.3)	2.2^{c} (4.7)	2.2^{bc} (4.5)	2.1^{b} (4.2)	2.1^{b} (3.8)
Bispyribac Na 25g/ha at 20 DAS *fb* 1 HW at 35 DAS	3.8^{b} (14.3)	3.5^{b} (12.4)	3.7^{b} (13.2)	3.4^{b} (11.1)	2.3^{b} (4.9)	2.2^{bc} (4.4)	2.2^{b} (4.3)	2.1^{b} (3.9)
Bispyribac Na 12.5g/ha + azimsulfuron 15g/ha at 10 DAS *fb* 1 HW at 35 DAS	3.5^{de} (12.2)	3.4^{e} (11.1)	3.4^{e} (11.2)	3.1^{e} (9.1)	2.3^{bc} (4.8)	2.2^{bc} (4.3)	2.2^{b} (4.3)	2.1^{b} (3.8)
Bispyribac Na 12.5g/ha + azimsulfuron 15g/ha at 20 DAS *fb* 1 HW at 35 DAS	3.7^{d} (13.6)	3.6^{b} (12.5)	3.6^{c} (12.6)	3.3^{c} (10.7)	2.3^{bc} (4.9)	2.2^{bc} (4.4)	2.2^{b} (4.4)	2.1^{b} (4.0)
Bispyribac Na 12.5g/ha + (chlorimuron ethyl + metsulfuron methyl) 2g/ha at 10 DAS *fb* 1 HW at 35 DAS	3.5^{f} (11.5)	3.2^{f} (9.9)	3.3^{f} (10.6)	2.9^{f} (8.4)	2.3^{bc} (4.8)	2.2 (4.3)	2.1^{b} (4.3)	2.1^{b} (3.9)
Bispyribac Na 12.5g/ha + (chlorimuron ethyl + metsulfuron methyl) 2g/ha at 20 DAS *fb* 1 HW at 35 DAS	3.6^{e} (12.7)	3.5^{d} (11.5)	3.5^{de} (11.9)	3.2^{de} (9.5)	2.3^{bc} (4.9)	2.2^{b} (4.5)	2.2^{b} (4.5)	2.1^{b} (4.1)
Penoxsulam 35g/ha at 10 DAS *fb* 1 HW at 35 DAS	2.7^{h} (6.8)	2.5^{h} (5.9)	2.5^{h} (6.2)	2.4^{h} (5.2)	2.2^{e} (4.3)	2.1^{e} (3.9)	2.1^{b} (3.9)	2.0^{b} (3.5)
Penoxsulam 35g/ha at 20 DAS *fb* 1 HW at 35 DAS	2.9^{g} (8.2)	2.7^{g} (6.9)	2.7^{g} (7.3)	2.4^{g} (5.5)	2.2^{d} (4.7)	2.1^{d} (3.9)	2.1^{b} (3.9)	2.0^{b} (3.6)
Hand weeding at 15 and 35 DAS	0.7^{i} (0.0)	0.7^{i} (0.0)	0.7^{i} (0.0)	0.7^{i} (0.0)	0.7^{f} (0.0)	0.7^{f} (0.0)	0.7^{c} (0.0)	0.7^{c} (0.0)
Weedy	6.5^{a} (41.4)	6.7^{a} (45.5)	8.6^{a} (74.9)	8.8^{a} (78.5)	7.8^{a} (60.5)	7.8^{a} (60.9)	6.7^{a} (45.5)	6.5^{a} (42.2)
CV (%)	4.5	3.3	2.8	2.7	1.5	1.4	1.7	1.5

Data were subjected to square root ($\sqrt{X+0.5}$) transformation; figures in parentheses are original values

Table 3: Effect of integrated weed management on weed control efficiency (%) at different stages of observation of direct seeded rice

Treatment	Weed control efficiency (%)								Weed index (%)	
	30 DAS		60 DAS		90 DAS		At harvest			
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Bispyribac Na 25g/ha at 10 DAS *fb* 1 HW at 35 DAS	67.5	73.9	83.8	86.9	92.2	93.0	90.8	90.8	12.9	12.8
Bispyribac Na 25g/ha at 20 DAS *fb* 1 HW at 35 DAS	65.5	72.8	82.4	85.8	91.7	92.8	90.5	90.5	13.5	13.4
Bispyribac Na 12.5g/ha + azimsulfuron 15g/ha at 10 DAS *fb* 1 HW at 35 DAS	70.5	75.5	85.0	88.4	92.0	92.8	90.6	90.7	11.2	10.6
Bispyribac Na 12.5g/ha + azimsulfuron 15g/ha at 20 DAS *fb* 1 HW at 35 DAS	67.0	72.5	83.2	89.3	91.9	92.7	90.3	90.4	12.1	11.6
Bispyribac Na 12.5g/ha + (chlorimuron ethyl + metsulfuron methyl) 2g/ha at 10 DAS *fb* 1 HW at 35 DAS	72.0	78.2	85.8	89.3	92.1	92.9	90.5	90.6	9.6	7.9
Bispyribac Na 12.5g/ha + (chlorimuron ethyl + metsulfuron methyl) 2g/ha at 20 DAS *fb* 1 HW at 35 DAS	69.1	74.6	84.1	87.8	91.8	92.6	90.2	90.3	10.7	8.9
Penoxsulam 35g/ha at 10 DAS *fb* 1 HW at 35 DAS	83.5	86.9	91.6	93.4	92.9	93.5	91.4	91.5	2.4	2.7
Penoxsulam 35g/ha at 20 DAS *fb* 1 HW at 35 DAS	80.1	84.8	90.2	92.9	92.7	93.4	91.3	91.4	8.4	6.7
Hand weeding at 15 and 35 DAS	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0	0.0
Weedy	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	56.5	52.8

Table 4: Effect of integrated weed management on plant height (cm), dry matter accumulation (g/running m), leaf area index and chlorophyll content at 90 DAS in direct seeded rice.

Treatment	90 DAS							
	Plant height (cm)		Dry matter accumulation (g/running m)		Leaf area index		Chlorophyll content	
	2014	2015	2014	2015	2014	2015	2014	2015
Bispyribac Na 25g/ha at 10 DAS *fb* 1 HW at 35 DAS	79.7^{a}	83.5^{a}	79.6^{b}	83.7^{b}	3.7^{a}	3.8^{g}	40.2^{e}	43.2^{f}
Bispyribac Na 25g/ha at 20 DAS *fb* 1 HW at 35 DAS	79.3^{a}	83.2^{a}	79.2^{b}	83.0^{b}	3.7^{a}	3.8^{h}	40.1^{e}	43.2^{f}
Bispyribac Na 12.5g/ha + azimsulfuron 15g/ha at 10 DAS *fb* 1 HW at 35 DAS	80.3^{a}	83.8^{a}	80.0^{b}	84.4^{b}	3.7^{a}	3.8^{f}	40.8^{de}	43.4^{de}
Bispyribac Na 12.5g/ha + azimsulfuron 15g/ha at 20 DAS *fb* 1 HW at 35 DAS	80.0^{a}	83.7^{a}	79.8^{b}	84.2^{b}	3.7^{a}	3.8^{f}	40.5^{e}	43.3^{ef}
Bispyribac Na 12.5g/ha + (chlorimuron ethyl + metsulfuron methyl) 2g/ha at 10 DAS *fb* 1 HW at 35 DAS	81.8^{a}	84.3^{a}	80.5^{b}	85.5^{b}	3.7^{a}	3.8^{d}	42.1^{bc}	43.5^{c}
Bispyribac Na 12.5g/ha + (chlorimuron ethyl + metsulfuron methyl) 2g/ha at 20 DAS *fb* 1 HW at 35 DAS	81.3^{a}	84.1^{a}	80.3^{b}	85.3^{b}	3.7^{a}	3.8^{e}	41.5^{cd}	43.4^{cde}
Penoxsulam 35g/ha at 10 DAS *fb* 1 HW at 35 DAS	83.1^{a}	84.8^{a}	82.9^{ab}	86.1^{b}	3.8^{a}	3.9^{b}	42.7^{b}	44.2^{b}
Penoxsulam 35g/ha at 20 DAS *fb* 1 HW at 35 DAS	82.9^{a}	84.6^{a}	81.5^{b}	85.8^{b}	3.7^{a}	3.9^{c}	42.2^{bc}	43.5^{cd}
Hand weeding at 15 and 35 DAS	84.5^{a}	85.0^{a}	88.4^{a}	92.4^{a}	3.9^{a}	4.1^{a}	43.8^{a}	45.13^{a}
Weedy	61.1^{b}	66.5^{b}	53.9^{c}	57.3^{c}	1.4^{b}	2.6^{i}	35.2^{f}	38.3^{g}
CV (%)	4.6	2.7	4.7	3.1	5.4	1.1	1.1	1.2

Table 5: Effect of integrated weed management on grain yield (kg/ha), straw yield (kg/ha) and harvest index (%)in direct seeded rice.

Treatment	Grain yield (kg/ha)		Straw yield (kg/ha)		Harvest index (%)	
	2014	2015	2014	2015	2014	2015
Bispyribac Na 25g/ha at 10 DAS *fb* 1 HW at 35 DAS	4500.3^{bc}	4541.3^{d}	6066.3^{a}	6066.3^{a}	46.0^{cd}	42.8^{cd}
Bispyribac Na 25g/ha at 20 DAS *fb* 1 HW at 35 DAS	4469.6^{c}	4512.1^{d}	6059.6^{a}	6059.6^{a}	42.4^{cd}	42.6^{d}
Bispyribac Na 12.5g/ha + azimsulfuron 15g/ha at 10 DAS *fb* 1 HW at 35 DAS	4585.9^{bc}	4655.7^{bcd}	6083.3^{a}	6083.3^{a}	42.9^{bcd}	43.3^{bcd}
Bispyribac Na 12.5g/ha + azimsulfuron 15g/ha at 20 DAS *fb* 1 HW at 35 DAS	4543.8^{bc}	4601.6^{cd}	6068.3^{a}	6068.3^{a}	42.8^{bcd}	43.1^{cd}
Bispyribac Na 12.5g/ha + (chlorimuron ethyl + metsulfuron methyl) 2g/ha at 10 DAS *fb* 1 HW at 35 DAS	4672.2^{bc}	4794.9^{bc}	5793.7^{a}	5945.7^{a}	44.6^{abc}	44.6^{abc}
Bispyribac Na 12.5g/ha + (chlorimuron ethyl + metsulfuron methyl) 2g/ha at 20 DAS *fb* 1 HW at 35 DAS	4609.8^{bc}	4740.4^{bcd}	6068.3^{a}	6068.3^{a}	43.2^{bcd}	43.8^{bcd}
Penoxsulam 35g/ha at 10 DAS *fb* 1 HW at 35 DAS	5041.6^{a}	5066.6^{a}	6173.0^{a}	6173.0^{a}	44.9^{ab}	45.1^{ab}
Penoxsulam 35g/ha at 20 DAS *fb* 1 HW at 35 DAS	4732.5^{bc}	4856.5^{b}	6199.6^{a}	6199.6^{a}	43.3^{bcd}	43.9^{bcd}
Hand weeding at 15 and 35 DAS	5166.6^{a}	5208.3^{a}	6085.0^{a}	6151.6^{a}	45.9^{a}	45.8^{a}
Weedy	2248.5^{d}	2456.1^{e}	3312.2^{b}	3420.5^{b}	41.1^{d}	42.2^{d}
CV (%)	3.5	2.6	6.2	5.6	2.8	2.3

Conclusion

Based on above findings it may be concluded that penoxsulam 35g/ha at 10 DAS *fb*1 HW at 35 DAS should be applied for effective control of weeds, to obtain higher yield in direct seeded rice.

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