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EFFECT OF PRE AND POST EMERGENCE HERBICIDES ON WEED INFESTATION AND YIELD OF DIRECT SEEDED RICE

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ABSTRACT

Direct-seeded rice (DSR) is emerging as a profitable and sustainable rice production system to address the mounting scarcity of fresh water, labour and energy in agriculture sector. But, weeds are the number one biological constraint and major threat to the production and adoption of direct seeded rice systems and can cause rice yield losses up to 50-91%. Therefore,an experiment was laid out in randomized block design (RBD) with eight treatments *viz.,* T_1 - Weedy check, T_2 - Weed free check, T_3 - Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fbAzimsulfuron @ 35 g a.i. ha^{-1} at 25 DAS, T_4 - Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fbBispyribac sodium 10% SC @ 20 g a.i. ha^{-1} 20 DAS, T_5 - Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fb (Chlorimuron ethyl + Metsulfuron methyl) @ 4 g ha^{-1} at 25 DAS, T_6 - Oxadiargyl @ 100 g a.i. ha^{-1} fbAzimsulfuron @ 35 g a.i. ha^{-1} at 25 DAS, T_7 - Oxadiargyl @ 100 g a.i. ha^{-1} fbBispyribac sodium 20 g a.i. ha^{-1} at 20 DAS, T_8 - Oxadiargyl @ 100 g a.i. ha^{-1} fb (Chlorimuron ethyl + Metsulfuron methyl) @ 4 g a.i. ha^{-1} at 25 DAS with four replications at Agronomy Farm, College of Agriculture, Nagpur in *kharif* season of 2022-2023. Results revealed that, the weed infestation throughout the growth period of crop was significantly controlled with weed free treatment (T_2). Maximum weed control efficiency and lowest weed index was observed under weed free check (T_2). Amongst the herbicidal weed management practices, application of Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fbAzimsulfuron @ 35 g a.i. ha^{-1} at 25 DAS (T_3) was found to be the most effective treatment in controlling weed population across the crop growth period which resulted in maximum weed control efficiency and lowest weed index followed by application of Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fb Bispyribac sodium 10% SC @ 20 g a.i. ha^{-1} 20 DAS (T_4). Amongst the herbicidal weed management practices, application of Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fbAzimsulfuron @ 35 g a.i. ha^{-1} at 25 DAS (T_3) recorded significantly highest yield attributes *viz.,* number of effective tillers m^{-2}, number of grain panicle^{-1} and test weight (g), grain yield, straw yield and harvest index followed by application of Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1}fbBispyribac sodium 10% SC @ 20 g a.i. ha^{-1} 20 DAS (T_4). Hence, these two treatments can be effective in controlling the weeds.

(Key words: Rice, herbicide, weed, WCE, WI, yield)

INTRODUCTION

Rice (*Oryza sativa*) belongs to the family Poaceae. It is the most important and widely cultivated cereal crop in the world and staple food for more than one third of the world's population (Chaitanya *et al*., 2019). Asia is the favourite place for the rice production and also for the consumption. In the world after the China as regards production and consumption India is at 2nd number. But India is 1st in term of area. In case of the productivity USA is at the top, Japan at 2nd and China is at 3rd position.

Rice is mostly grown by transplanting of seedlings into puddled soil which creates a hard pan below the plough layer and reduces soil permeability and deteriorates soil structure and soil quality for the subsequent upland crops. Direct seeding of rice refers to the process of establishing a rice crop from seeds sown in the field rather than by transplanting seedlings from the nursery (Tangle *et al*., 2022). It is emerging as a profitable and sustainable rice production system to address the mounting scarcity of fresh water, labour and energy in agriculture sector. Direct seeding of rice avoids need for ponding water, thus requires 36% less water and 60% less labour compared to traditionally grown puddled transplanted rice (TPR), depending on season and types of direct-seeded rice. But, weeds are the number one biological constraint and major threat to the production and adoption of direct seeded rice systems and can cause rice yield losses of up to 50-91%.

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The extent of damage on crop growth and yield caused by weeds depend on weed species and their densities occurring in a crop community. Direct seeding results in change in the relative abundance of weed species. In particular, *Echinochloa spp*., *Ishaemum rugosum*, *Fimbristylis miliacea* and *Cyperus difformis* were widely adapted to the conditions of direct seeded rice.

The critical period of crop-weed competition for direct seeded rice is 15 to 45 DAS. All around season crop-weed competition cause yield loss up to 80% in direct seed rice. Yield loss in transplanting method was 15 to 20%, in low land DSR method was 30 to 35% and in the upland DSR method was more than 50%. Loss of yield because of weed is more in the direct seeded rice rather than in transplanted rice.

Weeds are major concern in direct-seeded rice, improper management of weeds in direct seeded rice lead severe loss in the yield and less economic returns. Effective weed management is therefore, key for sustainable rice production under direct seeded situation. Now a days with the availability of crop specific and time specific newer herbicide molecules weed management is very crucial and critical in different crops. Presently, herbicides are becoming the most important weed management tool as it offers timely, effective, economical and practical way of weed management.

Efficacy of herbicides obtained by sequential applications of pre and post emergence herbicides on weeds is higher compared to their sole applications. Pre emergence herbicides initially control germinating weeds and late-emerging weeds are controlled by selective post-emergence herbicides.

MATERIALS AND METHODS

An experiment entitled "Weed management in direct seeded rice with pre and post emergence herbicides" was conducted at Agronomy Section Farm, College of Agriculture, Nagpur in *kharif* season of 2022-2023. The experiment was laid out in randomized block design (RBD) with eight treatments *viz.,* T_1 - Weedy check, T_2 - Weed free check, T_3 - Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fbAzimsulfuron @ 35 g a.i. ha^{-1} at 25 DAS, T_4 - Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fbBispyribac sodium 10% SC @ 20 g a.i. ha^{-1} 20 DAS, T_5 - Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fb (Chlorimuron ethyl + Metsulfuron methyl) @ 4 g ha^{-1} at 25 DAS, T_6 - Oxadiargyl @ 100 g a.i. ha^{-1} fbAzimsulfuron @ 35 g a.i. ha^{-1} at 25 DAS, T_7 - Oxadiargyl @ 100 g a.i. ha^{-1} fbBispyribac sodium 20 g a.i. ha^{-1} at 20 DAS, T_8 - Oxadiargyl @ 100 g a.i. ha^{-1} fb (Chlorimuron ethyl + Metsulfuron methyl) @ 4 g a.i. ha^{-1} at 25 DAS with four replications. Further data on weed count (at 30, 60, 90 DAS and at harvest), weed dry matter (at harvest), weed control efficiency (%) (at harvest), number of effective tillers m^{-2} (50-60 DAS), number of grains $panicle^{-1}$, test weight, grain yield, straw yield and harvest index (%) were recorded and analysed statistically (Panse and Sukhatme, 1967). Weed index was calculated by formula given by Gill and Kumar (1969).

$$WI = \frac{X - Y}{X} \times 100$$

Where,

X = Grain yield (kg ha^{-1}) from weed free plot

Y = Grain yield (kg ha^{-1}) from treatment plot, for which WI is to be calculated

Harvest index was worked out using the following formula,

$$\text{Harvest index (\%)} = \frac{\text{Economical yield (kg ha}^{-1}\text{)}}{\text{Biological yield (kg ha}^{-1}\text{)}} \times 100$$

RESULTS AND DISCUSSION

Effect of pre and post emergence herbicides on weed infestation of direct seeded rice

Total weed count

The weed free check (T_2) recorded significantly lowest total weed count amongst all other treatments, whereas highest total weed count was observed under weedy check (T_1) at all periodical growth stages. At 30 DAS, 60 DAS, 90 DAS and at harvest, amongst the herbicidal weed management practices, application of Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fbAzimsulfuron @ 35 g a.i. ha^{-1} at 25 DAS (T_3) recorded significantly lowest total weed count (4.26, 4.81, 5.39 and 4.48 m^{-2} respectively) followed by Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fbBispyribac sodium 10% SC @ 20 g a.i. ha^{-1} 20 DAS (T_4) (4.73, 5.14, 5.73 and 4.77 m^{-2}) and Oxadiargyl @ 100 g a.i. ha^{-1} fbAzimsulfuron @ 35 g a.i. ha^{-1} at 25 DAS (4.90, 5.40, 6.05 and 5.04 m^{-2}) over all other herbicidal weed management practices and weedy check.

Lowest weed count was observed in weed free check (T_2) followed by application of Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fbAzimsulfuron @ 35 g a.i. ha^{-1} at 25 DAS (T_3) might be due to keeping the weed free environment and application of post emergence herbicides that have continued effect on controlling both monocot and dicot weed population. At all stages of crop, total weed population were reduced significantly due to various weed management practices which were effective in timely reducing total weed population. These results support to findings by Satapathy et al. (2017) and Saha and Rao (2012). They reported that azimsulfuron at 30 g a.i. ha^{-1} was found significantly superior in reducing the population of all the predominant weeds.

Dry matter accumulation of weeds

The weed free check (T_2) recorded significantly lowest dry matter accumulation of weeds amongst all other treatments, whereas highest dry matter accumulation of weeds was observed under weedy check (T_1) at all periodical

growth stages. At 30 DAS, 60 DAS, 90 DAS and at harvest amongst the herbicidal weed management practices, application of Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1}fbAzimsulfuron @ 35 g a.i. ha^{-1} at 25 DAS recorded significantly lowest dry matter accumulation of weeds (1.68 g m^{-2}, 1.86 g m^{-2}, 2.15 g $m^{-2}$and 1.70 g m^{-2}respectively) and was followed by Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fbBispyribac sodium 10% SC @ 20 g a.i. ha^{-1} 20 DAS (1.90, 2.21, 2.49 and 2.01 g m^{-2} respectively) and Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fb (Chlorimuron ethyl + Metsulfuron methyl) @ 4 g ha^{-1} at 25 DAS (1.97, 2.37, 2.66 and 2.32 g m^{-2}) however the latter two was at par with each other over all other herbicidal weed management practices and weedy check.

The lowest dry matter accumulation of weeds was observed in weed free check over weedy check treatment might be due to keeping the weed free environment. Amongst the herbicidal weed management practices, application of Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1}fbAzimsulfuron @ 35 g a.i. ha^{-1} at 25 DAS suppressed the weed growth by having the broad-spectrum weed control which reduces the number of weeds and it turn dry matter accumulation of weed. These results are in agreements with findings by Ugalechumi *et al.* (2017) and Saha and Rao (2012). They reported that drastic reduction in dry weight of weeds was recorded with the application of azimsulfuron at 30 and 35 g a.i. ha^{-1} in rice. This might be due to effective control of weeds.

Weed control efficiency

The weed free check (T_2) recorded highest weed control efficiency amongst all other treatments, whereas lowest weed control efficiency was observed under weedy check (T_1) at all periodical growth stages. At 30 DAS, 60 DAS, 90 DAS and at havest, amongst the herbicidal weed management practices, application of Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fbAzimsulfuron @ 35 g a.i. ha^{-1} at 25 DAS recorded higher weed control efficiency (80.36%, 83.07%, 79.62% and 85.90% respectively) followed by application of Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1}fbBispyribac sodium 10% SC @ 20 g a.i. ha^{-1} 20 DAS (76.45%, 75.96%, 73.99% and 79.08% respectively) and Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fb (Chlorimuron ethyl + Metsulfuron methyl) @ 4 g ha^{-1} at 25 DAS (72.37%, 70.89%, 67.62% and 71.39% respectively).

The weed free check recorded highest weed control efficiency because of keeping weed free environment due to lesser number of weeds that produced less weed biomass and found superior over all other treatments. Amongst the herbicidal weed management practices, application of Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1}fbAzimsulfuron @ 35 g a.i. ha^{-1} at 25 DAS recorded higher weed control efficiency due to reduction in weed population and weed biomass. Alone application of herbicides results in poor WCE as compared to sequential application due to control of only one group of weed flora, mainly grassy whereas sequential application of herbicides managed all groups of weed flora. Higher weed control efficiency with sequential application of herbicides is the result of better weed control resulting in lesser number of weeds indicating efficient role of herbicides. These results are in similar with findings by Kumar *et al.* (2022), who reported that application of azimsulfuron with surfactant 35 g ha^{-1} recorded 100% weed control efficiency, which was followed by the same herbicide with lower doses of 17.5 and 26.25 and 35 g ha^{-1} without surfactant in rice.

Weed index

At harvest, amongst the herbicidal weed management practices, application of Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fbAzimsulfuron @ 35 g a.i. ha^{-1} at 25 DAS showed the minimum weed index (9.69 %) followed by application of Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1}fbBispyribac sodium 10% SC @ 20 g a.i. ha^{-1} 20 DAS (14.74%) and Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fb (Chlorimuron ethyl + Metsulfuron methyl) @ 4 g ha^{-1} at 25 DAS (19.64%), whereas weedy check treatment recorded maximum weed index (59.29%) indicating the reduction in grain yield due to presence of weeds throughout crop growth period.

Weed index indicates reduction in yield. Lowest weed index in herbicidal treatments might be due to its effective control of complex weed flora of grasses, sedges and BLWs as compared to weedy check, which provides favourable condition for crop growth that increased the grain yield. These results support to findings by Singh *et al.* (2019), who reported that among weed control treatment, minimum WI was under bispyribac sodium + azimsulfuron (25 g + 35 g ha^{-1}) + 0.25% NIS at 15-20 DAS.

Effect of pre and post emergence herbicides on yield of direct seeded rice

Number of effective tillers m^{-2}

The weed free check (T_2) recorded significantly highest number of effective tillers (308 m^{-2}) amongst all other treatments, whereas lowest number of effective tillers (166 m^{-2}) was observed under weedy check (T_1).

At harvest, amongst the herbicidal weed management practices, application of Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1}fbAzimsulfuron @ 35 g a.i. ha^{-1} at 25 DAS (T_3) recorded significantly higher number of effective tillers (283 m^{-2}) and was found to be at par with application of Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fbBispyribac sodium 10% SC @ 20 g a.i. ha^{-1} 20 DAS (T_4) (268 m^{-2}).

The increase in number of effective tillers might be due to better crop growth and less crop-weed competition and providing favourable environment to the crop with controlling the weed which reduces the competition of crop with weed for space, air, sunlight, moisture and nutrients. These results are similar to finding by Singh *et al.* (2019), who reported that hand weeding at 20, 40 and 60 DAS

recorded significantly higher growth and yield components and higher weed control efficiency in rice.

Number of grains panicle^{-1}

The weed free check (T_2) recorded significantly higher number of grains panicle^{-1} (101) amongst all other treatments, whereas lowest number of grains panicle^{-1} (81) was observed under weedy check treatment (T_1).

At harvest, amongst the herbicidal weed management practices, application of Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fbAzimsulfuron @ 35 g a.i. ha^{-1} at 25 DAS (T_3) recorded significantly higher number of grains panicle^{-1} (96) and was found to be at par with application of Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fbBispyribac sodium 10% SC @ 20 g a.i. ha^{-1} 20 DAS (T_4) (94), but was at par with Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fb (Chlorimuron ethyl + Metsulfuron methyl) @ 4 g ha^{-1} at 25 DAS (92) (T_5) and Oxadiargyl @ 100 g a.i. ha^{-1} fbAzimsulfuron @ 35 g a.i. ha^{-1} at 25 DAS (T_6) (93).

The increase in number of grains panicle^{-1} was due to better crop growth, Dry matter accumulation by plants because of availability of plant growth resources to the plant on account of reduced crop weed competition by reduction in weed population and weed biomass. These results are similar with the findings by Singh *et al.* (2019) and Saha and Rao (2012) recorded higher number of panicles m^{-2} and number of grains panicle^{-1} at the application rate of 30.0 - 35.0 g a.i. ha^{-1} of azimsulfuron over pretilachlor in rice.

Test weight (g)

There was no significant difference observed in test weight among all weed control treatments. However, weed free check (T_2) recorded higher test weight (17.73 g) amongst all other treatments, while lowest test weight (17.02 g) was observed under weedy check treatment (T_1).

This could be because of elimination of crop weed competition during early growth as well as later part of the crop growth and development in this treatments and consequently greater dry matter accumulation by plants causing improvement in yield attributes.

These results are in conformity with the findings of Singh *et al.* (2019), who observed that application of bispyribac sodium + azimsulfuron (25 g + 35 g ha^{-1}) + 0.25% NIS at 20 DAS was significantly superior in panicles m^{-1} row, length of panicle, number of grains panicle^{-1} and 1000 grain weight this might be due to low weed growth, minimum weed competition during critical growth period. As a result these conditions enabled crop to make maximum use of inputs for crop growth, and thereby for formation and development of yield attributes.

Grain yield (kg ha^{-1})

The weed free check (T_2) recorded significantly highest grain yield ha^{-1} (4126 kg ha^{-1}) amongst all other treatments, where as minimum grain yield ha^{-1} (1680 kg ha^{-1}) was observed under weedy check treatment (T_1). Amongst the herbicidal weed management practices, application of Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fbAzimsulfuron @ 35 g a.i. ha^{-1} at 25 DAS (T_3) recorded significantly higher grain yield ha^{-1} (3726 kg ha^{-1}) over all other herbicidal weed management practices and weedy check.

Different weed management practices significantly improved the crop yield as compared to weedy check might be due to efficiency and broad spectrum weed control of sedges and broad leaf weeds as well as better suppression of grassy weeds achieved with the herbicides. The favourable conditions created through the efficient weed management resulted in lesser weed competition between crop and weeds during the critical period of crop growth. This favoured the crop to produce more leaf area and plant dry matter production. These results are similar with findings by Ugalechumi *et al.* (2017) and Walia *et al.* (2012). They reported that higher grain yield (6286 kg ha^{-1}) was recorded with the PE oxadiargyl 180 g ha^{-1} fb POE azimsulfuron 35 g ha^{-1} which was at par with PE pretilachlor (S) 450 g ha^{-1}fb POE azimsulfuron 35 g ha^{-1}.

Straw yield (kg ha^{-1})

The weed free check (T_2) recorded significantly highest straw yield ha^{-1} (5570 kg ha^{-1}) amongst all other treatments, whereas minimum straw yield ha^{-1} (2770 kg ha^{-1}) was observed under weedy check treatment (T_1). Amongst the herbicidal weed management practices, application of Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1}fbAzimsulfuron @ 35 g a.i. ha^{-1} at 25 DAS (T_3) recorded significantly higher straw yield ha^{-1} (5067 kg ha^{-1}) and was found to be at par with application of Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fbBispyribac sodium 10% SC @ 20 g a.i. ha^{-1} 20 DAS (T_4) (4890 kg ha^{-1}).

Increased in straw yield might be due to luxurious crop growth, increase in dry matter accumulation in crop and decreased in dry matter accumulation in weeds, less crop-weed competition in weed free and herbicidal treated plots. These results are conformity with findings by Singh and Singh (2014), who reported that combination of azimsulfuron with pre-emergence herbicide produce significantly higher grain yield and straw yield. This is due to the fact that application of herbicides and manual weeding reduced the weed competition which enabled the direct seeded rice plant for better utilization of nutrient and growth factors which ultimately resulted in higher grain yield in rice.

Harvest index (%)

The mean harvest index recorded was 41.24%. The maximum harvest index (42.55%) was recorded in weed free check followed by application of Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1}fbAzimsulfuron @ 35 g a.i. ha^{-1} at 25 DAS (42.37%) whereas minimum harvest index (37.75%) was observed under weedy check. These results are closely agreements with the findings of Singh and Singh (2014), who reported that among weed management methods application of pendimetahlin azimsulfuron + one hand weeding had the maximum harvest index.

Table 1. Total weed count, weed dry matter, WCE and weed index as influenced by different weed management practices in direct seeded rice

Treatments		Total weed count (m^{-2})				Weed dry matter at harvest (g m^{-2})	WCE (%) at harvest	Weed index (%)
		30 DAS	60 DAS	90 DAS	At harvest			
T_1	Weedy check	6.60(43.07)	7.82(60.68)	8.67(74.64)	7.75(59.57)	4.19(17.02)	-	59.29
T_2	Weed free check	0.71(0.00)	0.71(0.00)	0.71(0.00)	0.71(0.00)	0.71(0.00)	100.00	-
T_3	Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fb Azimsulfuron @ 35 g a.i. ha^{-1} at 25 DAS	4.26(17.67)	4.81(22.64)	5.39(28.57)	4.48(19.61)	1.70(2.40)	85.90	9.69
T_4	Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fbBispyribac sodium 10% SC @ 20 g a.i. ha^{-1} 20 DAS	4.73(21.88)	5.14(25.93)	5.73(32.37)	4.77(22.30)	2.01(3.56)	79.08	14.74
T_5	Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fb (Chlorimuron ethyl + Metsulfuron methyl) @ 4 g ha^{-1} at 25 DAS	5.13(25.86)	5.49(29.59)	6.21(38.02)	5.37(28.36)	2.32(4.87)	71.39	19.64
T_6	Oxadiargyl @ 100 g a.i. ha^{-1} fbAzimsulfuron @ 35 g a.i. ha^{-1} at 25 DAS	4.90(23.47)	5.40(28.63)	6.05(36.09)	4.90(23.47)	2.41(5.31)	68.80	20.80
T_7	Oxadiargyl @ 100 g a.i. ha^{-1} fb Bispyribac sodium 20 g a.i. ha^{-1} at 20 DAS	5.26(27.12)	5.63(31.16)	6.42(40.68)	5.26(27.12)	2.87(7.71)	54.70	21.58
T_8	Oxadiargyl @ 100 g a.i. ha^{-1} fb (Chlorimuron ethyl + Metsulfuron methyl) @ 4 g a.i. ha^{-1} at 25 DAS	5.44(29.12)	6.13(37.08)	6.82(46.08)	5.44(29.12)	3.23(9.19)	46.00	27.71
	SE (m)±	0.01	0.02	0.03	0.01	0.05	-	-
	CD at 5%	0.03	0.06	0.09	0.03	0.15	-	-

Table 2. Number of effective tillers m^{-2}, number of grains $panicle^{-1}$, test weight, grain yield, straw yield and harvest index as influenced by different weed management practices in direct seeded rice

Treatments	Number of effective tiilers m^{-2} (50-60 DAS)	Number of grains $panicle^{-1}$	Test weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index (%)
T_1 Weedy check	166	81	17.02	1680	2770	37.75
T_2 Weed free check	308	101	17.73	4126	5570	42.55
T_3 Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fbAzimsulfuron @ 35 g a.i. ha^{-1} at 25 DAS	283	96	17.47	3726	5067	42.37
T_4 Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fbBispyribac sodium 10% SC @ 20 g a.i. ha^{-1} 20 DAS	268	94	17.36	3518	4890	41.84
T_5 Pretilachlor 30% + Pyrazosulfuron ethyl 0.75 WG @ 1.75 kg a.i. ha^{-1} fb (Chlorimuron ethyl + Metsulfuron methyl) @ 4 g ha^{-1} at 25 DAS	244	92	17.22	3316	4709	41.32
T_6 Oxadiargyl @ 100 g a.i. ha^{-1} fbAzimsulfuron @ 35 g a.i. ha^{-1} at 25 DAS	246	93	17.28	3268	4575	41.67
T_7 Oxadiargyl @ 100 g a.i. ha^{-1} fbBispyribac sodium 20 g a.i. ha^{-1} at 20 DAS	235	92	17.27	3236	4595	41.32
T_8 Oxadiargyl @ 100 g a.i. ha^{-1} fb (Chlorimuron ethyl + Metsulfuron methyl) @ 4 g a.i. ha^{-1} at 25 DAS	231	91	17.35	2983	4266	41.15
SE (m)±	9. 27	1.00	0.60	64	85	-
CD at 5%	27. 26	2.94	-	188	251	-

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