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# Integrated Weed Management in *Kharif* Direct Seeded Rice (*Oryza sativa* L.) in Medium Black Soil of Konkan Region of Maharashtra

**A. A. Dademal, D. N. Jagtap, V. G. More, P. S. Bodake, N. V. Mhaskar, S. S. Pinjari and A. V. Dahiphale**

Dept. of Agronomy, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra (415 712), India

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**Corresponding** mauli296@gmail.com

0000-0002-0794-6507

## ABSTRACT

A field experiment was conducted at ARS, Repoli, Maharashtra, India during *kharif* (June to October) seasons of 2019, 2020 and 2021 to study integrated weed management in direct seeded rice (*Oryza sativa* L.). The experiment was replicated in randomized block design with seven treatments viz., $T_1$: Oxadiargyl 80% WP (PE) @ 100 g ha$^{-1}$, $T_2$: Oxadiargyl 80% WP (PE) @ 100 g ha$^{-1}$ *fb* HW at 30 DAS, $T_3$: Oxadiargyl 80% WP (PE) *fb* Bispyribac-Na @ 25 g ha$^{-1}$ at 25 DAS, $T_4$: Oxadiargyl 80% WP (PE) *fb* Metasulfuron-methyl+chlorimuron-ethyl @ 4 g ha$^{-1}$ at 25 DAS, $T_5$: Oxadiargyl 80% WP (PE) *fb* carpentrozone ethyl 40% @ 25 g ha$^{-1}$ at 25 DAS, $T_6$: Weed free check (2HW at 20 and 40 DAS) and $T_7$: Unweeded check (control). Based on pooled analysis, Significantly least number of weeds and dry weight of grasses, sedges and broad leaves weeds and higher yield attributes and yield were recorded in weed free check (2HW at 20 and 40 DAS) followed by Oxadiargyl 80% WP as Pre-emergence (PE) @ 100 g ha$^{-1}$ fb HW at 30 DAS and Oxadiargyl 80% WP (PE) *fb* Metasulfuron-methyl+chlorimuron-ethyl @ 4 g ha$^{-1}$ at 25 DAS treatments. The highest weed control efficiency, net returns with benefit-cost ratio was also obtained in the weed free check followed by by Oxadiargyl 80% WP as Pre-emergence (PE) @ 100 g ha$^{-1}$ fb HW at 30 DAS and Oxadiargyl 80% WP (PE) *fb* Metasulfuron-methyl+chlorimuron-ethyl @ 4 g ha$^{-1}$ at 25 DAS treatments. Among sequential herbicide treatments, application of Oxadiargyl 80% WP (PE) *fb* Metasulfuron-methyl+chlorimuron-ethyl @ 4 g ha$^{-1}$ at 25 DAS ($T_4$) recorded least number of weeds m$^2$ (5.82, 6.12 and 9.04) and dry weight m$^2$ (2.08, 2.50 and 4.08 g m$^{-2}$) as compared to other sequential herbicide treatments. Similarly highest weed control efficiency that is 72.97, 80.37 and 70.46% at 40, 60 DAS and at harvest stage, respectively recorded in treatment $T_4$. Similarly the yield attributing characters and grain and straw yield (4859 and 4816 kg ha$^{-1}$) was recorded highest in treatment $T_4$.

**KEYWORDS:** DSR, direct seeded rice, herbicides, IWM

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***Data Availability Statement:*** Legal restrictions are imposed on the public sharing of raw data. However, authors have full right to transfer or share the data in raw form upon request subject to either meeting the conditions of the original consents and the original research study. Further, access of data needs to meet whether the user complies with the ethical and legal obligations as data controllers to allow for secondary use of the data outside of the original study.

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## 1. INTRODUCTION

Rice production systems are undergoing several changes and one of such changes is shift from transplanted rice to direct seeding. Direct seeded rice establishment is spreading rapidly in Asia. As the farmers seeking to high productivity and profitability to offset increasing costs and scarcity of farm labour (Pandey and Valesco, 2002). Direct seeded rice serves several advantages i.e. saves labour, faster and easier planting helps in timely sowing, less drudgery, early crop maturity by 7–10 days, less water requirement, high tolerance to water deficit, often high yield, low production cost and more profit, better soil physical condition for following crops and less methane emission (Balasubramanian and Hill, 2002). Emerging DSR seedlings are less competitive with weeds and the initial flushes of weeds is not controlled by flooding (Gyawaly et al., 2021). Despite several advantages, various production obstacles are also encountered and heavy weed infestation is major one. Weeds cause heavy damage to direct seeded crop which can be to the tune of 5–100% (Rao et al., 2007, Mishra et al., 2011, Mahajan et al., 2013 Sen et al., 2018, Shekhawat et al., 2020 and Pradhan et al., 2023). The labour scarcity and increasing labour costs, weeding in rice under moist conditions is the last choice of agricultural labourers which has given momentum to the use of herbicides for weed management in rice (Pinjari et al., 2016, Mahadkar et al., 2015 and Dahiphale et al., 2015). Though many pre-emergence herbicides are available for controlling weeds, the need for post-emergence herbicide is often realized to combat the weeds emerged during later stages of crop growth. Moreover, due to increasing problem of labour availability for rice cultivation, use of pre and post-emergence herbicide has greater potential for effective weed management and higher rice yield. It is supposed to have residual effect up to 50 days Success of DSR is mainly depends on effective weed control with all the possible means. The yield loss in DSR is as high as 50–60% due to simultaneous germination of both crop and weeds seeds (Pinjari et al., 2016). Though the hand weeding has been found effective, but it is very expensive. Moreover, heavy demand of labour during peak period and its scarcity necessitates the use of alternate weed control measures. Chemical weed control by using preemergence herbicides being cost effective and less labour dependent is recommended to overcome this constraint under DSR. Broad spectrum of weed flora may not be controlled by spraying pre-emergence herbicides alone, as flushes of weeds come up at different growth stages. Hence, use of sequential application of pre- fb post-emergence herbicides or pre-emergence herbicides fb manual weeding could be more convenient in containing the weed menace (Yognanda et al., 2017). In view of this, the present investigation was undertaken to keep Direct seeded rice weed free for more period. objectives of this study are viz., to study the effect of different herbicide combination on growth and yield of direct seeded rice, weed flora, weed density, weed control efficiency in direct seeded rice and economics of different herbicide treatments.

## 2. MATERIALS AND METHODS

Experiment was conducted at Agricultural Research Station, Repoli to study integrated weed management in kharif (June to October) direct seeded rice (*Oryza sativa* L.) in medium black soil during *kharif,* 2019, *kharif,* 2020 and *kharif,* 2021. Experiment conducted in randomized block design with three replications and seven treatments viz., $T_1$: Oxadiargyl 80% WP (PE) @ 100 g $ha^{-1}$, $T_2$: Oxadiargyl 80% WP (PE) @ 100 g $ha^{-1}$ *fb* HW at 30 DAS, $T_3$: Oxadiargyl 80% WP (PE) *fb* Bispyribac- Na @ 25 g $ha^{-1}$ at 25 DAS, $T_4$: Oxadiargyl 80% WP (PE) *fb* Metasulfuron-methyl+chlorimuron-ethyl @ 4 g $ha^{-1}$ at 25 DAS, $T_5$: Oxadiargyl 80% WP (PE) *fb* carpentrozone ethyl 40% @ 25 g $ha^{-1}$ at 25 DAS, $T_6$: Weed free check ( 2HW at 20 and 40 DAS ), $T_7$: Unweeded check (control). Karjat -5 variety of rice was sown 20 cm apart on June 2019, 2020 and 2021. The crop was fertilized with 100:50:50 kg $ha^{-1}$ of N, $P_2O_5$ and $K_2O$, respectively. Half dose of N and full dose of $P_2O_5$ and $K_2O$ was applied at sowing and remaining dose of N was applied in two split doses. Herbicides were applied with manually operated knapsack sprayer delivering with flat fan nozzle. In hand weeding, weeds were removed manually. Data on weed density and dry weight of weed were recorded after 40, 60 and at harvest day of sowing in each plot in four quadrats each of 25×25 $cm^2$. Weeds were counted in three categories i.e. grasses, broad leaf weed and sedges and were removed for recording dry weight of weeds. Weed samples were sun dried before oven dried at 70 $^oC$ until constant weight was attained.

Pooled analysis was done for three-year data of observations. Data on weeds were subjected to square-root transformation ($\sqrt{X+0.5}$) before statistical analysis. All the data were analyzed by using ANOVA, and the least significant values at 5% level of significance were calculated and used to test significant difference treatment means.

## 3. RESULTS AND DISCUSSION

### *3.1. Effect of different herbicide on weed flora in direct seeded rice*

The major grassy weeds observed in the direct seeded rice experimental plot were *Echinochloa colona* (Pakhad ) and *Echinocloa crusgalli* (Kusalipakhad) and *Ischane globosa* (Dhur) while, *Cyperusiria* and *Cyperus difformis* were the dominant weeds among sedges and broad-leaved weeds viz., *Eclipta alba* (L.), *Commellina difusa*. Weed density under unweeded control (UWC) situation showed that monocot

weeds (grasses and sedges) were more pre-dominant that is grasses constituted 74.80%, BLWs 14.20% and particularly sedges which constituted 11% of total weed density at Harvest stage. Similar findings were also observed by Linganagouda et al. (2019) in the experimental plot were *Cynodon dactylon* (L.) Pers., *Echinochloa colona* (L.) Link, *Dinebra retroflexa* (Vahl) Panz. and *Chloris barbata* Sw. while *Cyperus rotundus* L., *Cyperus iria* L., *Cyperus difformis* L. and *Fimbristylis miliacea* (L.) Vahl were the dominant weeds among sedges and broad-leaved weeds viz., *Ammannia baccifera* L., *Caesulia axillaris Roxb*., *Commelina benghalensis* L., *Eclipta alba* (L.) , *Phyllanthus niruri* L. and *Amaranthus viridis* L. were found dominant. Singh et al. (2005) also reported *Caesulia axil/aris* (59.8%), *Echinochloa colona* (14.7%), *Panicum maximum* (11.7%), *Cyperus iria* (5.7%) and *Ischaemum rugosum* (2.0%). Singh et al. (2025) observed that the *Echinochloa colonum, Parthanium* sp., *Cynodon dactylon*, and *Panicum* sp. were the most prevalent grassy weeds, followed by *Cyperus rotundus* and *Cyperus esculentus* for sedges, and *Digera arvensis, Celasia argentia*, *Eclipta alba*, and *Euphorbia hirta Echinochloa* sp. and *Cynodon dactylon* as broad leaf weeds.

*3.2. Effect of different herbicide on weed density in direct seeded rice*

All the weed-control treatments significantly reduced the weed density and dry matter compared to UWC (Tables 1 and 2). Highest density and dry matter accumulation by weeds were recorded in UWC attributable to uncontrolled weed growth. It was observed from the pooled analysis data the lowest total number of weeds per $m^2$ and dry weight per $m^2$ was recorded in Weed free check treatment ($T_6$). Application of Oxadiargyl 80% WP (PE) @ 100 g $ha^{-1}$ fb HW at 30 DAS ($T_2$) treatment recorded significantly lowest number of weeds $m^2$ (0.71, 4.01 and 9.27) and dry weight $m^2$ (0.71, 1.72 and 4.15 g $m^{-2}$). Among sequential herbicide treatments, application of Oxadiargyl 80% WP (PE) *fb* Metasulfuron- methyl+chlorimuron-ethyl @ 4 g $ha^{-1}$ at 25 DAS ($T_4$) recorded least number of weeds $m^2$ (5.82, 6.12 and 9.04) and dry weight $m^2$ (2.08, 2.50 and 4.08 g $m^{-2}$)as compared to other sequential herbicide treatments. Gopinath and Kundu (2008) observed that sequential application of butachlor 2 days after sowing and Metasulfuron- methyl+chlorimuron-ethyl 21 days after sowing recorded significantly lower density of grossy weeds compared with methyl+chlorimuron-ethyl alone.

Table 1: Effect of different herbicide on weed density in direct seeded rice (pooled data of 3 years)

| Treatments | No. of weeds $m^{-2}$ | | | | | | | | | Total no. of weeds $m^{-2}$ | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Grasses | | | BLW | | | Sedges | | | | | |
| | 40 DAS | 60 DAS | At harvest | 40 DAS | 60 DAS | At harvest | 40 DAS | 60 DAS | At harvest | 40 DAS | 60 DAS | At harvest |
| $T_1$ | 5.86 (34.00) | 6.86 (46.67) | 10.51 (110.0) | 3.59 (12.45) | 4.26 (17.78) | 5.44 (29.33) | 3.68 (13.33) | 4.05 (16.00) | 4.56 (20.45) | 7.57 (59.77) | 8.99 (80.45) | 12.66 (159.78) |
| $T_2$ | 0.71 (0.00) | 2.65 (6.67) | 7.84 (61.33) | 0.71 (0.00) | 2.30 (4.89) | 3.63 (12.89) | 0.71 (0.00) | 2.12 (4.00) | 3.47 (11.56) | 0.71 (0.00) | 4.01 (15.56) | 9.27 (85.78) |
| $T_3$ | 4.75 (22.22) | 4.93 (24.00) | 8.41 (70.67) | 2.97 (8.45) | 3.51 (12.00) | 4.60 (20.89) | 3.06 (8.89) | 3.33 (10.67) | 3.89 (14.67) | 6.31 (39.56) | 6.85 (46.66) | 10.32 (106.22) |
| $T_4$ | 4.44 (19.55) | 4.53 (20.44) | 7.38 (54.22) | 2.72 (7.11) | 3.03 (8.89) | 4.19 (17.33) | 2.72 (7.11) | 2.90 (8.00) | 3.26 (10.22) | 5.82 (33.77) | 6.12 (37.33) | 9.06 (81.78) |
| $T_5$ | 4.69 (21.78) | 4.90 (24.00) | 8.29 (68.69) | 2.88 (8.00) | 3.38 (11.11) | 4.50 (20.00) | 3.04 (8.89) | 3.32 (10.67) | 3.64 (12.89) | 6.22 (38.67) | 6.75 (45.78) | 10.08 (101.78) |
| $T_6$ | 0.71 (0.00) | 0.71 (0.00) | 3.92 (15.56) | 0.71 (0.00) | 0.71 (0.00) | 2.56 (6.22) | 0.71 (0.00) | 0.71 (0.00) | 2.30 (4.89) | 0.71 (0.00) | 0.71 (0.00) | 5.15 (26.67) |
| $T_7$ | 10.44 (108.89) | 11.32 (127.78) | 14.43 (208.44) | 5.50 (29.78) | 5.93 (34.67) | 6.32 (39.56) | 4.98 (24.44) | 5.41 (28.89) | 5.58 (30.67) | 12.79 (163.11) | 13.85 (191.33) | 16.70 (278.67) |
| SEm± | 0.22 | 0.27 | 0.33 | 2.09 | 0.12 | 0.19 | 0.14 | 0.12 | 0.10 | 0.24 | 0.26 | 0.29 |
| CD | 0.67 | 0.83 | 1.02 | 6.44 | 0.38 | 0.57 | 0.42 | 0.37 | 0.31 | 0.74 | 0.80 | 0.91 |

$T_1$: Oxadiargyl 80% WP (PE) @ 100 g $ha^{-1}$; $T_2$: Oxadiargyl 80% WP (PE) @ 100 g $ha^{-1}$ *fb* HW at 30 DAS; $T_3$: Oxadiargyl 80% WP (PE) *fb* Bispyribac-Na @ 25 g $ha^{-1}$ at 25 DAS; $T_4$: Oxadiargyl 80% WP (PE) *fb* Metasulfuron-methyl+chlorimuron-ethyl @ 4 g $ha^{-1}$ at 25 DAS; $T_5$: Oxadiargyl 80% WP (PE) fbcarpentrozone ethyl 40% @ 25 g $ha^{-1}$ at 25 DAS; $T_6$: Weed free check (2HW at 20 and 40 DAS); $T_7$: Unweeded check (control); (Figures in parentheses are original values, which were subjected to square root transformation ($\sqrt{X+0.5}$) before statistical analysis)

Table 2: Effect of different herbicide on dry weight of weeds in Direct Seeded Rice (pooled data of 3 years)

| Treatments | Dry weight. of weeds (g $m^{-2}$) | | | | | | | | | Total dry weight. of weeds (g $m^{-2}$) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Grasses | | | BLW | | | Sedges | | | | | |
| | 40 DAS | 60 DAS | At harvest | 40 DAS | 60 DAS | At harvest | 40 DAS | 60 DAS | At harvest | 40 DAS | 60 DAS | At harvest |
| $T_1$ | 2.09 (3.90) | 2.73 (7.00) | 4.66 (21.23) | 1.39 (1.45) | 1.97 (3.40) | 2.66 (6.58) | 1.41 (1.49) | 1.63 (2.17) | 2.03 (3.67) | 2.71 (6.84) | 3.61 (12.57) | 5.65 (31.47) |
| $T_2$ | 0.71 (0.00) | 1.22 (1.00) | 3.50 (11.83) | 0.71 (0.00) | 1.19 (0.93) | 1.84 (2.92) | 0.71 (0.00) | 1.02 (0.54) | 1.60 (2.07) | 0.71 (0.00) | 1.72 (2.47) | 4.15 (16.81) |
| $T_3$ | 1.74 (2.55) | 2.01 (3.59) | 3.75 (13.65) | 1.21 (0.99) | 1.66 (2.29) | 2.28 (4.71) | 1.22 (1.00) | 1.39 (1.45) | 1.76 (2.62) | 2.24 (4.54) | 2.79 (7.33) | 4.63 (20.98) |
| $T_4$ | 1.64 (2.25) | 1.87 (3.05) | 3.31 (10.47) | 1.15 (0.82) | 1.47 (1.70) | 2.09 (3.89) | 1.13 (0.80) | 1.25 (1.08) | 1.52 (1.83) | 2.08 (3.87) | 2.50 (5.83) | 4.08 (16.19) |
| $T_5$ | 1.72 (2.51) | 2.01 (3.58) | 3.70 (13.31) | 1.19 (0.93) | 1.61 (2.13) | 2.23 (4.47) | 1.22 (0.99) | 1.39 (1.46) | 1.67 (2.33) | 2.21 (4.43) | 2.75 (7.17) | 4.53 (20.11) |
| $T_6$ | 0.71 (0.00) | 0.71 (0.00) | 1.84 (3.01) | 0.71 (0.00) | 0.71 (0.00) | 1.36 (1.38) | 0.71 (0.00) | 0.71 (0.00) | 1.16 (0.86) | 0.71 (0.00) | 0.71 (0.00) | 2.38 (5.25) |
| $T_7$ | 3.52 (11.91) | 4.43 (19.11) | 6.37 (40.27) | 1.98 (3.44) | 2.67 (6.65) | 3.08 (9.06) | 1.76 (2.61) | 2.10 (3.94) | 2.43 (5.47) | 4.30 (17.96) | 5.49 (29.70) | 7.43 (54.81) |
| SEm± | 0.06 | 0.10 | 0.14 | 0.03 | 0.05 | 0.09 | 0.03 | 0.05 | 0.05 | 0.06 | 0.10 | 0.12 |
| CD | 0.19 | 0.31 | 0.44 | 0.10 | 0.16 | 0.28 | 0.09 | 0.15 | 0.16 | 0.19 | 0.31 | 0.38 |

$T_1$: Oxadiargyl 80% WP (PE) @ 100 g $ha^{-1}$; $T_2$: Oxadiargyl 80% WP (PE) @ 100 g $ha^{-1}$ *fb*HW at 30 DAS; $T_3$: Oxadiargyl 80% WP (PE) *fb* Bispyribac-Na @ 25 g $ha^{-1}$ at 25 DAS; $T_4$: Oxadiargyl 80% WP (PE) *fb* Metasulfuron-methyl+chlorimuron–ethyl @ 4 g $ha^{-1}$ at 25 DAS; $T_5$: Oxadiargyl 80% WP (PE) fbcarpentrozone ethyl 40% @ 25 g $ha^{-1}$ at 25 DAS; $T_6$: Weed free check (2HW at 20 and 40 DAS); $T_7$: Unweeded check (control); (Figures in parentheses are original values, which were subjected to square root transformation ($\sqrt{X}$+0.5) before statistical analysis)

Hemlatha et al. (2017) reported that sequential application of Pendimethalin *fb* Metasulfuron-methyl+Chlorimuron ethyl registered the lowest total weeds biomass. This was due to the reason that sole application of pre-emergence herbicide kills the first flush of weed and the effect remain up to 10–15 days of application and after that application of post-emergence herbicide application kill the second flush of weed resulting in the lower density and dry weight in sequential application of herbicides as compared with sole application of herbicide. Sequential application of pre and post-emergence herbicides effectively controlled weeds by broadening the spectrum of weed control (Mahajan et al., 2009). Also Mondal et al. (2019), reported that among the combined application of herbicides, pyrazosulfuron ethyl + pretilachlor (1.50 kg $ha^{-1}$) and Almix (20 g $ha^{-1}$) resulted in significantly higher density and dry weight by weeds than the other treatments. These results are in conformity with Singh et al. (2018), who reported that single applications of pyrazosulfuron, pretilachlor, bispyribac-Na and penoxsulam is less effective in reducing the weed growth compared to combined application of herbicides (sequence). Shekhawat et al. (2020) observed that a ready mixture of chlorimuron-methyl and metsulfuron-methyl remains effective for both grassy and broad-leaved weeds in DDSR. Pradhan et al. (2023) found that application of metsulfuron methyl 10%+chlorimuron ethyl 10% @ 20 g $ha^{-1}$ on 25 DAS *fb* hand weeding on 45 DAS found lower weed population, dry matter and higher yield compared to unweeded check. Similar findings also observed by Sahu et al. (2023) application of combine formulation of Chlorimuron+Metsulfuron (Almix) 20% WP @ 0.004 kg ai $ha^{-1}$ as post-emergence at 25 DAT to obtained effective control of weeds such as Eclipta alba (Bhringraj) Monochoria vaginalis, Sagittaria pygmaea, Commelina benghalensis, Sphenoclea zeylanica, Cyperus iria and Cyperus difformis in paddy fields. Sreelakshmi (2016) reported that sequential application of Emergence herbicide pretilachlor and post-emergence application of metsulfuron-methyl+Chlorimuronethyl on 25 DAT. The effectiveness of herbicide over weed would be lost after 30 days of its application. The sequential application of pretilachlor *fb* metsulfuron-methyl+chlorimuron-ethyl 750/4 g $ha^{-1}$ with the weed count (5.25 $m^{-2}$), weed DMP (7.80 kg $ha^{-1}$).

### *3.3. Effect of different herbicide on weed control efficiency*

Data presented in Table 3 revealed that the highest

Table 3: Effect of different herbicide on growth, yield attributes yield and weed control efficiency (%) in direct seeded rice (pooled data of 3 years)

| Treatments | Growth and yield attributing characters and yield | | | | | Weed control efficiency (%) | | | Weed Index (%) |
|---|---|---|---|---|---|---|---|---|---|
| | Plant height (cm) | Number of tillers $m^{-2}$ | Number of panicles $m^{-2}$ | Grain yield (kg $ha^{-1}$) | Straw yield (kg $ha^{-1}$) | 40 DAS | 60 DAS | At harvest | |
| $T_1$ | 86.56 | 368.33 | 209.44 | 2843 | 3399 | 57.59 | 57.68 | 42.58 | 34.25 |
| $T_2$ | 92.79 | 463.33 | 259.89 | 4024 | 4879 | 100.0 | 91.70 | 69.30 | 6.98 |
| $T_3$ | 89.11 | 433.33 | 240.22 | 3557 | 4224 | 70.58 | 75.32 | 61.72 | 17.74 |
| $T_4$ | 94.44 | 481.06 | 269.22 | 4020 | 4816 | 72.97 | 80.37 | 70.46 | 7.03 |
| $T_5$ | 89.71 | 447.22 | 248.67 | 3657 | 4353 | 68.95 | 75.86 | 63.31 | 15.43 |
| $T_6$ | 95.31 | 493.89 | 275.67 | 4324 | 5187 | 100.0 | 100.0 | 90.4 | 0.00 |
| $T_7$ | 80.57 | 270.56 | 146.78 | 2047 | 2450 | 0 | 0 | 0 | 52.66 |
| SEm± | 0.95 | 3.72 | 2.81 | 67 | 88 | - | - | - | - |
| CD | 2.92 | 11.45 | 8.67 | 205 | 269 | - | - | - | - |

$T_1$: Oxadiargyl 80% WP (PE) @ 100 g $ha^{-1}$; $T_2$: Oxadiargyl 80% WP (PE) @ 100 g $ha^{-1}$ *fb* HW at 30 DAS; $T_3$: Oxadiargyl 80% WP (PE) *fb* Bispyribac-Na @ 25 g $ha^{-1}$ at 25 DAS; $T_4$: Oxadiargyl 80% WP (PE) *fb* Metasulfuron-methyl+chlorimuron-ethyl @ 4 g $ha^{-1}$ at 25 DAS; $T_5$: Oxadiargyl 80% WP (PE) fbcarpentrozone ethyl 40% @ 25 g $ha^{-1}$ at 25DAS; $T_6$: Weed free check (2HW at 20 and 40 DAS); $T_7$: Unweeded check (control)

weed control efficiency was observed in Weed free check treatment ($T_6$) during all the years and pooled analysis. Among herbicidal treatment at 40 and 60 DAS treatment $T_2$ (Oxadiargyl 80% WP (PE) @ 100 g $ha^{-1}$ fb HW at 30 DAS) was recorded the maximum weed control efficiency (100, and 91.70%, respectively). Among sequential herbicide treatments, application of Oxadiargyl 80% WP (PE) @ 100 g $ha^{-1}$ *fb* Metasulfuron-methyl+chlorimuron-ethyl @ 4 g $ha^{-1}$ at 25 DAS ($T_4$) recorded highest weed control efficiency that is 72.97, 80.37 and 70.46% at 40, 60 DAS and at harvest stage, respectively. Hemlatha et al. (2017) reported that Pre-emergence application of Pendimethalin fb PoE application of Metasulfuron-methyl+Chlorimuron ethyl registered the highest weed control efficiency (89.7%) which was comparable with weed free check (90.6%). This might be due to succesive application of two herbicides at an interval of 20 days resulting in reduction in total weed biomass. Higher weed control efficiency with lower weed index due to effective weed control more evident from lower weed density and biomass than other treatments as reported by Dahiphale et al. (2015). Sreelakshmi (2016) reported that the sequential application of pretilachlor *fb* metsulfuron-methyl+chlorimuron-ethyl 750/4 g $ha^{-1}$ with the weed count (5.25 $m^{-2}$), weed DMP (7.80 kg $ha^{-1}$) and increase the WCE (91%) on 60 DAT. Singh et al. (2025) found that the treatment (2 hand weeding) resulted in significantly higher weed control efficiency (WCE) up to 94.85% as compared to (Bispyrac sodium+(Metsulfuron+ Chlorimuron) treatment. The second best treatment was (Bispyrac sodium+(Metsulfuron+Chlorimuron) where the WCE was 78.62%.

### *3.4. Effect of different herbicide on growth, yield attributes and yield of crop*

It is revealed from the data presented in Table 3 that All weed control treatments showed significantly higher values of growth and yield attributes compared to Unweeded control mainly due to effective suppression of weeds that resulted in improved uptake of inputs like nutrients, light, moisture and other resources by crop. The weed free check treatment ($T_6$) recorded significantly superior growth and yield attributes as compared to other treatments including weedy check. Among herbicidal and sequential treatments, significantly higher plant height (94.44 cm), number of tillers (481.06 $m^2$), number of effective tillers (269.22 $m^2$) was recorded with application of Oxadiargyl 80% WP (PE) @ 100 g $ha^{-1}$ *fb* Metasulfuron-methyl+chlorimuron-ethyl @ 4 g $ha^{-1}$ at 25 DAS ($T_4$) as compared with other treatment which is at par with treatment $T_2$ where Oxadiargyl 80% WP (PE) @ 100 g $ha^{-1}$ *fb* HW at 30 DAS was applied. This might be attributed to initial vigorous crop growth restricted the growth of weeds that has indirectly boosted the plants to record higher growth parameters and also better utilization of nutrients during plant growth which has contributed for an increased growth of crop. Thus, it clearly indicates that increased weed population adversely affect the yield parameters in direct seeded rice. Gopinath and Kundu (2008) reported that Metasulfuron-methyl+chlorimuron-ethyl @ 4 g $ha^{-1}$ applied 15 DAS recorded significantly

higher plant height than weedy check. Pinjari et al. (2016) observed that different weed control treatments significantly influenced the yield attributes, viz. plant height, number of tillers and weight of filled grains per panicle over weedy check. Weed free check (three hand weeding) recorded significantly higher plant height over all other treatments followed by pendimethalin 1000 g $ha^{-1}$ at 0 to 2 DAS *fb* manual weeding at 25 to 30 DAS while in respect of number of tillers, weed free check (HW at 20, 40, and 60 DAS) recorded significantly higher number of tillers except pendimethalin 1000 g $ha^{-1}$ at 0 to 2 DAS *fb* manual weeding at 25 to 30 DAS. Weed free check (HW at 20,40, and 60 DAS) also recorded significantly higher weight of filled grains per panicle as compared to bispyribac-Na at 25 g $ha^{-1}$ at 20 DAS, oxadiargyl at 100 g $ha^{-1}$ 0 to 2 DAS fb bispyribac-Na at 25 g $ha^{-1}$ 25 DAS, pendimethalin at 1000 g $ha^{-1}$ 0 to 3 DAS fb bispyribac-Na at 25 g $ha^{-1}$ at 25 DAS fb manual weeding at 45 DAS and weedy check. Mondal et al. (2018), who reported that effective and timely weed management under these treatments reduced the density and dry weight of weeds which facilitated the crop with sufficient space, light, nutrients and moisture, and hence improved yield attributes and yield of rice. Singh et al. (2025) observed that the treatment (bispyrac sodium+(metsulfuron+ chlorimuron) has recorded significantly higher tiller over the remaining treatments. Walia et al. (2012), and Lingangouda et al. (2019) observed that All the growth and yield attributes were significantly higher under sequential application of pre and post emergent herbicides.

Weed free check treatment ($T_6$) recorded significantly higher grain (4324 kg $ha^{-1}$) and straw yield (5187 kg $ha^{-1}$) of rice than rest of the weed-control treatments owing to better control of weeds. Among herbicidal and sequential herbicidal treatments, significantly higher grain yield (4024 kg $ha^{-1}$) and straw yield (4879 kg $ha^{-1}$) was recorded with application of Oxadiargyl 80% WP (PE) @ 100 g $ha^{-1}$ fb HW at 30 DAS ($T_2$) as compared with other treatment where as it was at par with Oxadiargyl 80% WP (PE)@ 100 g $ha^{-1}$ fb Metasulfuron-methyl+chlorimuron-ethyl @ 4 g a.i $ha^{-1}$ at 25 DAS ($T_2$) was applied. Significantly lower grain yield and straw yield was recorded with weedy check (2047 and 2450 kg $ha^{-1}$, respectively). The enhanced yield under these treatments was because of elimination of weeds which helped in enhancing the availability of nutrients resulting in better growth and development of crop plants. Similarly Among the herbicides treatments, lower weed index (6.98) was recorded in treatment $T_2$ where Oxadiargyl 80% WP (PE) @ 100 g $ha^{-1}$ fb HW at 30 DAS ($T_2$) fallowed by treatment $T_4$(weed index 7.03) was recorded in which Oxadiargyl 80% WP (PE) @ 100 g $ha^{-1}$ fb Metasulfuron-methyl+chlorimuron-ethyl @ 4 g $ha^{-1}$ at 25 DAS was applied. Gopinath and Kundu (2008) observed that sequential application of butachlor 2 days after sowing and Metasulfuron-methyl+chlorimuron-ethyl 21 days after sowing recorded significantly higher grian yield as compared with methyl+chlorimuron-ethyl alone. Rajkhoa et al. (2005) reported that grain yield of rice was significantly increased due to different treatments over unweeded check. Manishankar et al. (2024) found that metsulfuron methyl, 5 g a.i $ha^{-1}$ registered notably better grain yield (4590 kg $ha^{-1}$) and considerable straw yield (7047 kg $ha^{-1}$) than other treatments. Jyothi Basu et al. (2022) reported that Pre-emergence application of bensuluron methyle @ 60 g a.i $ha^{-1}$+pretichlore with safener @ 500 g a.i $ha^{-1}$ fb post emergence application of azimsulfuron @ 20 g a.i $ha^{-1}$ at 25 DAS fb post emergence application of Metasulfuron- methyl and chlorimuron-ethyl @ 4 g $ha^{-1}$ applied at 45 DAS realized the highest grain yield. The results of effective weed control along with higher grain yield by bispyribacsodium against mixed weed flora in transplanted rice are in confirmity with Dahiphale et al. (2015). Also these results are in conformity with Dahiphale et al. (2015), Mahadkar et al. (2015), Pinjari et al. (2016) Hemlatha et al. (2017) and Mondal et al. (2019)

### *3.5. Economics of the different treatments*

The Pooled data regarding economics of the different treatments are presented in Table 4. The treatments $T_6$ i.e Weed free check recorded higher net profit on input cost (₹ 34215) and benefit-cost ratio (1.52) as compared to remaining treatments. Fallowed by Oxadiargyl80% WP (PE) @ 100 g $ha^{-1}$ *fb* HW at 30 DAS treatment ($T_2$) recorded net profit (₹ 29974) and benefit-cost ratio (1.48) and treatment $T_4$ that was Oxadiargyl 80% WP (PE) *fb* Metasulfuron-methyl+chlorimuron-ethyl @ 4 g $ha^{-1}$ at 25 DAS recorded net profit (29826) and benefit-cost ratio (1.48). Yognanda et al. (2017) observed that highest net returns and BC ratio recorded in preemergence application of Bensulfuron-methyl+Pretilachlor 660 g $ha^{-1}$ fb post emergence application of bispiribac-sodium 25 g $ha^{-1}$. They increased in benefits mainly attributed to higher grain yield and reduced labour cost. Lingangouda et al. (2019) revealed that higher gross returns, net returns and benefit-cost ratio was obtained with application of pendimethalin 38.7 CS @ 700 g a.i. $ha^{-1}$ (PE) *fb* (chlorimuron ethyl+metsulfuron methyl) 20 WP 4 g a.i. $ha^{-1}$ (POE). Gopinath and Kundu (2008) observed that sequential application of butachlor 2 days after sowing and Metasulfuron- methyl+chlorimuron-ethyl 21 days after sowing recorded highest net returns ₹ 10123 $ha^{-1}$ and B:C ratio 1.96. Pinjari et al. (2016) reported that application of pendimethalin 1000 g $ha^{-1}$ at 0 to 2 DAS *fb* manual weeding at 25 to 30 DAS was most effective and economical treatment (BC ratio 1.28) followed by weed free check (HW at 20, 40, and 60 DAS) (BC ratio 1.19). Pre-emergence application of bensuluron methyle @ 60 g

Table 4: Economics of different treatments

| Treatments | Input cost (₹) | Net return over input cost (₹) | Benefit-cost ratio on input cost |
|---|---|---|---|
| $T_1$ | 55678 | 9518 | 1.17 |
| $T_2$ | 62578 | 29974 | 1.48 |
| $T_3$ | 59053 | 22403 | 1.38 |
| $T_4$ | 62401 | 29826 | 1.48 |
| $T_5$ | 58117 | 25670 | 1.44 |
| $T_6$ | 65203 | 34215 | 1.52 |
| $T_7$ | 49582 | -2250 | 0.72 |

Rate of rice ₹ 18.15 $kg^{-1}$ and Straw ₹ 4.00 $kg^{-1}$; 1 US$=₹ 71.06; 73.56; 74.91 (Average October month value for 2019, 2020, 2021 respectively)

a.i $ha^{-1}$+pretichlore with safener @ 500 g a.i $ha^{-1}$ fb post emergence application of azimsulfuron @ 20 g a.i $ha^{-1}$ at 25 DAS fb post emergence application of Metasulfuron-methyl and chlorimuron-ethyl @ 4 g $ha^{-1}$ applied at 45 DAS realized the highest net return ₹ 47801/- and return per rupee investment 1.22 (Jyothi Basu et al., 2022).

## 4. CONCLUSION

The application of sequential herbicide Oxadiargyl 80% WP (PE)@ 100 g $ha^{-1}$ *fb* Metasulfuron-methyl+chlorimuron- ethyl @ 4 g a.i $ha^{-1}$ at 25 DAS or Oxadiargyl 80% WP (PE) @ 100 g $ha^{-1}$ *fb* HW at 30 DAS to control weeds effectively and obtaining higher yield and monetary returns from direct seeded rice during *Kharif* season.

## 5. REFERENCES


Balasubramanian, V., Hill, J.E., 2002. Direct seeding or rice in Asia: Emerging issues and strategic research needs for 21st century. In: Pandey, S., Mortimer, M., Wade, L., Tuong, T.P., Lopez, K., Hardy, B. (Eds.), Direct seeding: research strategies and opportunities. IRRI, Los Banos, 15–39.

Chauhan, B.S., 2012. Weed ecology and weed management strategies for dry-seeded rice in Asia. Weed Technology 26(1), 1–13.

Dahiphale, A.V., Bhagat, S.B., Gangawane, S.B., Shinde, P.S., Govekar, Y.R., Mahadkar, U.V., 2015. Effect of post-emergence herbicide on yield and yield contributing character of transplanted rice in north Konkan region. 25th Asian-Pacific Weed Science Society Conference on "Weed Science for Sustainable Agriculture, Environment and Biodiversity", Hyderabad, India during 13-16 October, 2015: PP 47.

Gyawaly, P., Sah, S.K., Bhattarai, R.K., Chaulagain, B., Pantha, P., 2021. Managing weeds in dry direct seeded rice: a profound challenge. Agronomy Journal of Nepal 5(01), 124–135.

Jyothi Basu, B., Prasad, P.V.N., Murthy, V.R.K., Ashoka Rani, Y., Prasad, P.R.K., 2022. Effect of pre and post emergence herbicides on yield and economics of direct sown rice. The Andhra Agricultural Journal 69(4), 459–464.

Mondal, D., Ghosh, A., Sen, S., Roy, D., Bera, S., Ghosh, R., Bandopadhyay, P., 2019. Effect of herbicides and their combinations on weeds and productivity of direct-seeded rice (*Oryza sativa*). Indian Journal of Agronomy 64(4), 464–470.

Hemalatha, K., Ramana, A.V., Ramana Murthy, K.V., Jagannadam, J., 2017. Nutrient uptake by rice and weeds as influenced by different weed management practices in dry-seeded rice. Indian Journal of Weed Science 49(3), 287–289.

Satyaraj, R.K., Dwivedi, S.K., Khajanji, S.N., Jha, S.K., 2020. Efficacy of herbicides in managing weeds in direct-seeded rice. Indian Journal of Weed Science 52(3), 222–226.

Shekhawat, K., Rathore, S.S., Chauhan, B.S., 2020. Weed management in dry direct-seeded rice: a review on challenges and opportunities for sustainable rice production. Agronomy 10(9), 1264. Link: https://www.mdpi.com/2073-4395/10/9/1264.

Singh, A.K., Tomar, S.K., Singh, D.P., 2018. Bio-efficacy of herbicides and their mixture on weeds and yield of rice (*Oryza sativa*) under rice–wheat cropping system. Indian Journal of Agronomy 63(2), 145–149.

Linganagouda, N.A., Mastanareddy, B.G., Ajayakumar, M.Y., Vishwanath, J., 2019. Bio-efficacy of sequential application of herbicides in direct seeded rice (*Oryza sativa* L.) Journal of Farm Science 32(4), 415–419.

Mahadkar, U.V., Dahiphale, A.V., Gangawane, S.B., Shinde, P.S., Kanade, V.M., 2015. Effect of method of sowing and weed control on the performance direct-seeded rice in Konkan region. 25th Asian-Pacific Weed Science Society Conference on "Weed Science for Sustainable Agriculture, Environment and Biodiversity", Hyderabad, India during 13-16 October, 2015: pp. 48.

Mahajan, G., Chauhan, B.S., Gill, M.S., 2013. Dry-seeded rice culture in Punjab State of India: Lessons learned from farmers. Field Crops Research 144, 89–99.

Mahajan, G., Chauhan, B.S., Johnson, D.E., 2009. Weed management in aerobic rice in Northwestern Indo-Gangetic plains. Journal of Crop Improvement 23(4), 366–382.

Mishra, J.S., Singh, V.P., 2011. Effect of tillage and weed control on weed dynamics, crop productivity and

energy-use efficiency in rice (*Oryza sativa*)-based cropping systems in vertisols. Indian Journal of Agriculture Sciences 81, 129–133.

Mishra, J.S., Singh,V.P., 2012, Effect of tillage and weed management on weed dynamics and productivity of dry seeded rice-wheat system. Indian Journal of Agronomy 57(1), 34–37.

Pandey, S., Valesco, L.E., 2002. Economics of direct seeding in Asia: Patterns of adoptions and research priorities. In: Pandey, S., et al. (Eds.), Direct seeding: Research strategies and opportunities. Proc. International Workshop on Direct Seeding in Asian Rice System, 25–28 January 2000, Bangkok, Thailand. International Rice Research Institute, Los Banos, Philippines. pp. 383.

Pinjari, S.S., Gangawane, S.B., Mhaskar, N.V., Chavan, S.A., Chavan, V.G., Jagtap, D.N., 2016. Integrated use of herbicides to enhance yield and economics of direct-seeded rice. Indian Journal of Weed Science 48(3), 279–283.

Pradhan, D., Rawal, S., Bali, A., Dhaka, A.K., Asif, M., Purohit, N.N., 2023. Impact of pre and post-emergence herbicide mixtures in direct seeded rice (*Oryza sativa* L.). International Journal of Environment and Climate Change 13(12), 1240–1252.

Rajkhowa, D.J., Barna, I.C., Deka, N.C., Borah, D., 2005. Bioefficacy of oxadiargyl in transplanted rice under rainfed conditions. Indian Journal of Weed Science 37(3 & 4), 258–259.

Rao, A.N., Johnson, D.E., Sivaprasad, B., Ladha, J.K., Mortimer, A.M., 2007. Weed management in direct-seeded rice. Advances in Agronomy 93, 153–255.

Sahu, S.K., Sharma, R.L., Yadav, R.M., 2013. Effects of chlorimuron ethyl 10%+metsulfuron methyl 10% wp (almix) herbicide uses on transplanted rice *(oryza sativa* L.) under plain resign of Chhattisgarh. Journal of Plant Development Sciences 5(4), 435–437.

Sen, S., Kaur, R., DAS, T.K., Shivay, Y.S., Sahoo, P.M., 2018. Bio-efficacy of sequentially applied herbicides on weed competition and crop performance in dry direct-seeded rice (*Oryza sativa*). Indian Journal of Agronomy 63(2), 230–233.

Sreelakshmi, K., Balasubramanian, R., Babu, R., Balakrishnan, K., 2016. Herbicide combinations for weed management in transplanted rice. Indian Journal of Weed Science 48(1), 60–63.

Singh, S., Maurya, D.K., Sahoo, M., Mourya, P.K., Singh, S., Singh, J.K., 2025. Weed management in direct seeded rice using different herbicide combinations and their effect on growth and yield parameters. Plant Archives 25(Supplement 1, 2025), 1009–1017

Singh, R.P., Singh, C.M., Singh, A.K., 2005. Effect of crop establishment methods, weed management and split nitrogen application on weeds and yield of rice. Indian Journal of Agricultural Sciences 75, 285–287.

Walia, U.S., Walia, S.S., Sidhu, A.S., Nayyar, S., 2012. Bioefficacy of pre and post-emergence herbicides in direct-seeded rice in Central Punjab. Indian Journal of Weed Science 44(1), 30–33.

Yogananda, S.B., Thimmegowda, P., Shruthi, G.K., 2017. Weed management effect on growth and yield of wet direct-seeded rice in Cauvery command area of Karnataka. Indian Journal of Weed Science 49(3), 219–222.