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**Short Note**

# Effect of Weed Management Practices on Growth and Yield of Rice (*Oryza sativa* L.) under Transplanted Lowland

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**A field experiment was conducted during *kharif*, 2010, to study the effect of weed management practices on weed control, growth and yield of rice (*Oryza sativa* L) under lowland conditions. The treatments consisted of pre-emergence application of butachlor and metsulfuron methyl along with post-emergence application of 2, 4-D EE or conoweeding at 20 DAT, which was compared to two hand weedings at 20 and 40 DAT and control. Among the herbicidal treatments, pre – emergence application of metsulfuron methyl at l 6 g ha-1 + post emergence spray of 2, 4-D EE at 500 g ha-1 recorded the least weed density (81.32 m-2), weed biomass (30.68 m-2) and maximum weed control efficiency (76.68%) in rice. Among the growth parameters of rice, maximum plant height (88.07 cm), plant dry weight (63.40 g), number of tillers plant-1 (22.1) and crop growth rate (0.951 g m-2 day-1) were recorded under the aforesaid treatment. Better yield attributes, higher grain yield (5.01 t ha-1), harvest index (39.10 %), net return ( ₹ 36235 ha-1) and benefit: cost ratio (2.02) of rice were recorded under the same treatment.**

**Key words :** Rice (*Oryza sativa* L.), lowland transplanted rice, weed management, Butachlor, Metsulfuron methyl, 2, 4-D EE, Conoweeding, hand weedings.

Rice production in India had increased in the past three decades continuously beginning with the green revolution, but has stagnated since 1999. It is estimated that by 2020 at least 170 to 180 m t of rice (115-120 m t milled rice) is to be produced in India, with an average productivity of 4.03 t ha-1, to maintain the present level of self- sufficiency (Mishra *et al.*, 2006), which means that the productivity should go up by a tonne ha-1 from the current level. With many constraints, producing more rice from the same land to feed additional population is a great challenge. System of rice intensification (SRI) holds the key for increasing the productivity with least inputs, as it saves 80 % seeds and 40 to 50 % irrigation water but due to square planting, rice crop faces a heavy infestation of weeds *viz;* grasses, sedges and broad leaved weeds during initial stage of its growth, which cause a major threat to its production. The average loss in grain yield by unchecked growth of weeds in transplanted rice is reported to be 20 to 27 % (Singh *et al.*, 2007). In view of the above facts, the present investigation was undertaken to find out the most suitable method of weed management in rice grown under transplanted lowland conditions.

## Materials and Methods

A field experiment was conducted during *kharif* season of 2010 at the Crop Research Farm, Department of Agronomy, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad. The soil of the experimental field was sandy loam, having an organic carbon content of 0.6 per cent, pH of 7.9 and available N, P and K of 230 kg ha-1, 18.50 kg ha-1 and 228 kg ha-1, respectively. The experiment was laid out in Randomized Block Design (RBD) with ten treatments, replicated thrice. The treatments consisted of pre-emergence application of butachlor and metsulfuron methyl along with post-emergence application of 2, 4-D EE or conoweeding at 20 DAT, which was compared with two hand weedings at 20 and 40 DAT and weedy check control. Twelve days old seedlings of the variety 'Pro-Agro 6444' was transplanted at 25 x 25 cm spacing on 26 July 2010, after basal placement of half of the recommended dose of N (60 kg ha$^{-1}$) and full doses of $P_2O_5$ (60 kg ha-1) and $K_2O$ (40 kg ha-1) before transplanting and remaining N (60 kg ha-1) was top-dressed in two equal splits, half at active tillering and the rest half at panicle-initiation stage. All the other recommended agronomic and plant protection measures were adopted to raise the crop. The data on weed biomass was recorded at different growth stages of rice crop with the help of a quadrate (0.5 m × 0.5 m). Weed control efficiency (%) was computed using the dry weight of weeds (Saha and Rao, 2010). Grain yield of rice along with other yield-attributing characters like effective panicles $m^{-2}$ were recorded at harvest.

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## Results and Discussion

### *Effect on weeds*

The major weed flora observed in the experimental field was *Echinochloa crussgalli, Echinochloa colonum, Cyperus rotundus, Cyperus iria, Cynodon dactylon, Sorghum halepense* etc. All the treatments registered significantly lower number of weed biomass and weed index than control (Table 1), but the efficiency in controlling different types of weeds varied significantly. Among the weed control measures, pre-emergence application of metsulfuron methyl at 6 g ha$^{-1}$ followed by an application of 2,4-D EE 500 g ha$^{-1}$ at 35 DAT recorded the least weed biomass (30.68g m$^{-2}$), highest weed control efficiency (76.7%) and lowest weed index (9.40%), although, the weed biomass (35.32 g m$^{-2}$) recorded under the treatments $T_9$ (butachlor at 1.5 kg ha$^{-1}$ as pre-emergence + 2, 4-D EE at 500 g ha$^{-1}$ as post-emergence) was found to be statistically on par to that obtained under treatment $T_{10}$ and higher weed control efficiency (76.70 %) was also recorded in treatment $T_{10}$ . The probable reasons for above findings might be due to the phytotoxicity of metsulfuron methyl on germinating weeds which inhibits the cell division in the meristematic tissues, resulting in death of most of the weeds within a few days of their emergence and an effective broad leaf weed control at later stages of growth by a post-emergence application of 2, 4-D EE. Almost similar findings were reported by Debbarma and Singh (2007) and Babar and Velayutham, 2012.

### *Effect on growth attributes of rice*

Plant height, number of tillers plant$^{-1}$, dry matter production and crop growth rate were influenced significantly by different treatments (Table 1). The tallest plants (92.95 cm), highest number of tillers plant$^{-1}$ (28.70), maximum dry matter production (69.30 g) and crop growth rate (1.00 g m$^{-2}$ day$^{-1}$) were observed under the treatment $T_3$ (weed free), whereas amongst the herbicidal treatments, the maximum plant height (88.07 cm), number of tillers plant$^{-1}$ (21.10), dry matter production (63.4 g) and crop growth rate (0.951 g m$^{-2}$ day$^{-1}$) were observed under the treatment $T_{10}$ (metsulfuron methyl at 6 g ha$^{-1}$ as pre-emergence + 2,4-D EE at 500 g ha$^{-1}$ as post-emergence). Results are in conformity with the findings of Saha and Rao (2010). This might be due to better weed control by the pre-emergence application of metsulfuron methyl and post emergence application of 2, 4-D EE due to which the plants faced lesser competition for space, light, moisture and nutrients, which ultimately led to better growth and development. These findings are in agreement with the findings of Ramana *et al.* (2007).

**Table 1. Effect of weed management practices on weed control and growth attributes of rice (at 90 DAT)**

| Treatment | Weed control | | | Growth attributes | | | |
|---|---|---|---|---|---|---|---|
| | Weed biomass (g m$^{-2}$) | Weed control efficiency (%) | Weed index (%) | Plant height (cm) | Tillers plant$^{-1}$ | Plant dry weight (g) | CGR (g m$^{-2}$ day$^{-1}$) |
| Control | 119.32 | - | 54.93 | 64.25 | 7.5 | 27.8 | 0.271 |
| Hand Weeding at 20 and 40 DAT | 39.48 | 69.1 | 10.52 | 72.35 | 16.5 | 52.9 | 0.671 |
| Weed free (Up to 90 DAT) | - | - | 0.00 | 92.95 | 28.7 | 69.3 | 1.000 |
| Conoweeding 20 and 40 DAT | 40.28 | 66.7 | 18.27 | 82.06 | 18.5 | 57.3 | 0.888 |
| Butachlor 1.5 kg ha$^{-1}$ (pre-emergence) | 54.00 | 55.0 | 26.72 | 77.18 | 15.7 | 49.6 | 0.867 |
| Metsulfuron methyl 6 g ha$^{-1}$ (pre-emergence) | 45.32 | 60.8 | 16.91 | 78.92 | 19.9 | 54.1 | 0.861 |
| Butachlor 1.5 kg ha$^{-1}$ (pre-emergence) + Conoweeding at 20 DAT | 41.32 | 66.1 | 13.13 | 85.46 | 20.9 | 60.7 | 0.914 |
| Metsulfuron methyl 6 g ha$^{-1}$ (pre-emergence) + Conoweeding at 20 DAT | 43.35 | 72.7 | 12.12 | 82.09 | 19.4 | 59.1 | 0.827 |
| Butachlor 1.5 kg ha$^{-1}$ (pre-emergence) + 2,4-D EE 500 g ha$^{-1}$ at 35 DAT | 35.32 | 70.5 | 11.47 | 85.68 | 21.1 | 61.5 | 0.884 |
| Metsulfuron methyl 6 g ha$^{-1}$ (PE) + 2,4-D EE 500 g ha$^{-1}$ at 35 DAT | 30.68 | 76.7 | 9.40 | 88.07 | 22.1 | 63.4 | 0.951 |
| S.Em ± | 2.24 | - | - | 3.30 | 1.5 | 1.9 | 0.060 |
| CD (P=0.05) | 6.72 | - | - | 9.80 | 4.5 | 5.8 | 0.190 |

### *Effect on yield attributes of rice*

The highest number of panicles hill$^{-1}$ (26.70), highest panicle length (18.60 cm), grains panicle$^{-1}$ (166.50) and test weight (25.67 g) were found in the treatment $T_3$ (weed free) {Table 2}. Among the herbicidal treatments, higher number of panicles hill$^{-1}$ (20.30), higher panicle length (18.60 cm), grains panicle$^{-1}$ (165.70) and test weight (25.50 g) were recorded in the treatment $T_{10}$ (metsulfuron methyl at 6 g ha$^{-1}$ as pre-emergence + 2, 4-D EE at 500 g ha$^{-1}$ as post-emergence). Number of panicles hill$^{-1}$ obtained under the treatments $T_9$ (butachlor at 1.5 kg ha$^{-1}$ as pre-emergence + 2, 4-D EE at 500 g ha$^{-1}$ as post-emergence), $T_7$ (butachlor at 1.5 kg ha$^{-1}$ as pre-emergence + conoweeding at 20 DAT) and $T_8$ (metsulfuron methyl at 6 g ha$^{-1}$ as pre-emergence + conoweeding at 20 DAT) were found to be statistically at par to that obtained under treatment $T_{10}$. Similar findings have been reported by Singh *et al.* (2007).

The higher values of yield contributing characters of rice recorded under treatment $T_{10}$ may be due to better crop growth because of lesser crop weed competition as a result of higher weed control efficiency, lower weed index and lesser weed

**Table 2. Effect of weed management practices on yield attributes, yield and economics of rice**

| Treatment | Yield attributes of rice | | | | Grain yield (q $ha^{-1}$) | Benefit cost ratio |
|---|---|---|---|---|---|---|
| | Number of panicles $plant^{-1}$ | Panicle length (cm) | Number of grains $panicle^{-1}$ | Test weight (g) | | |
| $T_1$ - Control | 6.4 | 18.4 | 147.6 | 23.29 | 26.09 | 1.09 |
| $T_2$ - Hand Weeding at 20 and 40 DAT | 15.3 | 18.5 | 153.3 | 25.48 | 49.56 | 1.77 |
| $T_3$ - Weed free (Up to 90 DAT) | 26.7 | 18.6 | 166.5 | 25.67 | 55.50 | 1.40 |
| $T_4$ - Conoweeding 20 and 40 DAT | 15.5 | 16.7 | 147.2 | 23.45 | 44.42 | 1.77 |
| $T_5$ - Butachlor 1.5 kg $ha^{-1}$ (pre-emergence) | 14.0 | 18.0 | 155.9 | 23.33 | 40.67 | 1.66 |
| $T_6$ - Metsulfuron methyl 6 g $ha^{-1}$ (pre-emergence) | 14.2 | 18.0 | 159.2 | 24.17 | 46.00 | 1.88 |
| $T_7$ - Butachlor 1.5 kg $ha^{-1}$ (pre-emergence) + Conoweeding at 20 DAT | 18.7 | 18.2 | 158.4 | 24.17 | 48.10 | 1.92 |
| $T_8$ - Metsulfuron methyl 6 g $ha^{-1}$ (pre-emergence) + Conoweeding at 20 DAT | 17.1 | 18.0 | 161.2 | 24.68 | 48.18 | 1.93 |
| $T_9$ - Butachlor 1.5 kg $ha^{-1}$ (pre-emergence) + 2,4-D EE 500 g $ha^{-1}$ at 35 DAT | 19.3 | 18.4 | 165.0 | 25.33 | 49.06 | 1.97 |
| $T_{10}$- Metsulfuron methyl 6 g $ha^{-1}$ (PE) + 2,4-D EE 500 g $ha^{-1}$ at 35 DAT | 20.3 | 18.6 | 165.7 | 25.50 | 50.17 | 2.02 |
| S.Em ± | 1.3 | 0.4 | 5.5 | 0.68 | 1.3 | |
| CD (P=0.05) | 3.96 | N.S. | N.S. | N.S. | 3.8 | |

biomass obtained with pre emergence sprayed metsulfuron methyl at 6 g $ha^{-1}$, followed by a post emergence spray of 2, 4 – DEE at 500 g $ha^{-1}$at 35 DAT, hence higher availability of light, space, nutrients, moisture and light to rice, therefore, better growth and yield of the crop.

***Effect on the yield of rice***

Grain yield of rice under SRI was significantly influenced by different weed management practices as depicted in Table 2. The highest grain yield (55.50 q $ha^{-1}$) was obtained under the treatment $T_3$ (weed free), whereas, amongst the herbicidal treatments, the highest grain yield (50.17 q $ha^{-1}$) was obtained under the treatment $T_{10}$ (metsulfuron methyl 6 g $ha^{-1}$ as pre-emergence + 2, 4-D EE 500 g $ha^{-1}$ as post-emergence), which was significantly higher than the yield obtained under all the other treatments. Increase in grain yield might be due to the phytotoxicity of pre-emergence herbicides on germinating weeds which inhibits the cell division in the meristematic tissues, resulting in death of most of the weeds within a few days of their emergence and an effective weed control by a post-emergence application of 2, 4-D EE at later stage. These findings are in conformity with the findings of Yadav *et al.* (2008) and Saha and Rao (2010).

## Conclusion

It can be concluded from the present study that for getting an effective weed control and higher productivity from rice sown under lowland transplanted conditions, pre-emergence application of Metsulfuron methyl at 6 g $ha^{-1}$ + 2, 4-D EE at 500 g $ha^{-1}$ as post-emergence application can be recommended.

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