*Plant Archives* Volume 20 No. 2, 2020 pp. 6564-6568 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

# EFFECT OF DIFFERENT CROP ESTABLISHMENT METHODS AND WEED MANAGEMENT PRACTICES ON WEEDS IN RICE

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## Abstract

The field experiment was conducted to study the influence of different rice establishment methods and weed management practices on growth and yield of rice crop during *kuruvai* season of 2020-2021 at Experimental farm, Department of Agronomy, Annamalai University, Annamalai Nagar with five main plots as establishment methods and six weed management practices as subplots in split plot design on clay loam soil. The main treatments consisted of $M_1$- Direct dry seeded rice, $M_2$- Drum seeded rice, $M_3$- SRI transplanting, $M_4$- Machine transplanting, $M_5$- Conventional transplanting and sub treatments consisted of $S_1$- Unweeded control, $S_2$- Two hand weeding on 20 and 40 DAT/ DAS, $S_3$- Pre-emergence application of bensulfuron methyl 0.6% + pretilachlor 6% GR @ 10 kg ha$^{-1}$ on 3 DAT/ 7 DAS + hand weeding on 40 DAT/DAS, $S_4$- Pre-emergence application of pretilachlor 6% + pyrazosulfuron-ethyl 0.15 % GR@ 10 kg ha$^{-1}$ on 3 DAT/ 7 DAS + hand weeding on 40 DAT/ DAS, $S_5$- Pre-emergence application of herbicide bensulfuron methyl 0.6% + pretilachlor 6% GR @ 10 kg ha$^{-1}$ on 3 DAT/ 7 DAS + Post-emergence application of bispyribac sodium 10% SC @ 200 ml ha$^{-1}$ on 15 DAT/DAS and $S_6$- Pre-emergence application of pretilachlor 6% + pyrazosulfuron-ethyl 0.15 % GR@ 10 kg ha$^{-1}$ on 3 DAT/ 7 DAS + Post-emergence application of bispyribac sodium 10% SC @ 200 ml ha$^{-1}$ on 15 DAT/DAS. Among the different establishment methods compared as main treatments, SRI transplanting was found to be significantly superior than the other treatments. Among the different weed management practices compared as sub treatments two hand weeding on 20 and 40 DAT/DAS was found to be the best treatment and it was on par with pre-emergence application of bensulfuron methyl 0.6% + pretilachlor 6% GR @ 10 kg ha$^{-1}$ on 3 DAT/ 7 DAS + Post-emergence application of bispyribac sodium 10% SC @ 200 ml ha$^{-1}$ on 15 DAT/DAS. These sub treatments were significantly superior than the rest of the treatments in reducing the weed population, weed biomass and there by higher weed control efficiency. Hence, for SRI crop establishment method either with two hand weeding on 20 and 40 DAT/DAS or with pre-emergence application of bensulfuron methyl 0.6% + pretilachlor 6% GR @ 10 kg ha$^{-1}$ on 3 DAT/ 7 DAS + Post-emergence application of bispyribac sodium 10% SC @ 200 ml ha$^{-1}$ on 15 DAT/DAS could be a better option in managing the weeds in rice. The population of weeds as well as weed biomass was higher in direct dry seeded rice and unweeded control plots.

***Key words:*** Different rice establishment methods, weed control efficiency, pre-emergence herbicides (bensulfuron methyl 0.6% + pretilachlor 6% GR, pretilachlor 6% + pyrazosulfuron-ethyl 0.15 % GR), post-emergence herbicide (bispyribac sodium 10% SC)

## Introduction

Rice is the important staple food crop of more than 70 per cent of the world population. The slogan " Rice is life" is the most pertinent for India as rice crops plays a crucial role in our national food security and is a means of livelihood for millions of rural household. Productivity of rice become reduced in India due to various reasons like improper crop establishment methods, water insufficiency, weed infestation, unpredictable monsoon seasons etc. Although, transplanting in rice is considered as effective method for higher productivity of rice crop but sometimes it is not much profitable due to unavailability of labour during peak period of operation. Some alternatives such as System of rice intensification (SRI) and machine transplanting must be explored to overcome these problems. On the other hand weeds by their faster growth dominate the habitat of crop and by virtue of their higher adaptability, it reduces the yield potential of the rice crop. Unchecked weed growth causes a reduction

in grain yield by 30-36 per cent in transplanted rice and 45- 48 per cent in direct sown rice. Rice was dominated by natural infestation of broad leaved weeds like *Ammania baccifera, Centella asiatica, Commenlina benghalensis, Monochoria vaginalis*, sedges like *Cyperus rotundus, Cyperus iria,* and *Cyperus difformis,* grasses like *Echinochloa colonum, Echinochloa crusgalli* and *Cynodon dactylon* (Subramanian *et al.,* 2012). Weed management in rice through herbicide application may be the best suited option. It is widely practiced by farmers for past several decades as it offers a selective and economic control of weeds right from the beginning of crop growth and thus minimizing the crop-weed competition. This also saves valuable time by covering more area in short period. The unavailability of manpower and skilled manpower to work with machinery, so the farmers are interested to use the herbicides for controlling the weeds in different times during the crop period. Hence, the present study was conducted to find out an efficient weed management practice in relation to different crop establishment methods.

## Materials and Methods

A field experiment was conducted at Experimental Farm, Department of Agronomy, Annamalai University during *kuruvai* season of 2020-2021 to study the effect of different rice establishment methods and weed management practices on growth and yield of rice. The study area has mean annual rainfall of about 1500 mm, majority of which was received during North East Monsoon. The climate of the region is characterized by a tropical climate with a hot dry summer (March-May), and extended wet period from November to February. The soil is clayey loam with a pH of 7.3.

In this study the performance of different crop establishment and weed management practices was evaluated. The experiments were conducted in split plot design with three replications. The treatment comprised of five establishment method as main treatments *viz.*, ($M_1$)- Direct dry seeded rice, ($M_2$)- Drum seeded rice, ($M_3$)- SRI transplanting, ($M_4$)- Machine transplanting, ($M_5$)- Conventional transplanting and six weed management practices as sub treatments *viz.*, ($S_1$)- Unweeded control, ($S_2$)- Two hand weeding on 20 and 40 DAT/ DAS, ($S_3$)- Pre-emergence application of bensulfuron methyl 0.6% + pretilachlor 6% GR (pre-mix) @ 10 kg $ha^{-1}$ on 3 DAT/ 7 DAS + hand weeding on 40 DAT/DAS, ($S_4$)- Pre-emergence application of pretilachlor 6% + pyrazosulfuron-ethyl 0.15 % GR (pre-mix)@ 10 kg $ha^{-1}$ on 3 DAT/ 7 DAS + hand weeding on 40 DAT/DAS, ($S_5$)- Pre-emergence application of bensulfuron methyl 0.6% + pretilachlor 6% GR (pre-mix) @ 10 kg $ha^{-1}$ on 3 DAT/ 7 DAS + Post-emergence application of bispyribac sodium 10% SC @ 200 ml $ha^{-1}$ on 15 DAT/DAS and ($S_6$)- Pre-emergence application of pretilachlor 6% + pyrazosulfuron-ethyl 0.15 % GR (pre-mix)@ 10 kg $ha^{-1}$ on 3 DAT/ 7 DAS + Post-emergence application of bispyribac sodium 10% SC @ 200 ml $ha^{-1}$ on 15 DAT/DAS. The variety taken for experiment was CO 51 during *kuruvai* 2019-2020. The plot size of experiment was 5 × 4 m. A fertilizer schedule of 120 : 40: 40 NPK kg $ha^{-1}$ was adopted as the common practice for the experiment. Full dose of phosphorous and half dose of nitrogen and potassium were applied basally. The remaining half dose of nitrogen and potassium were applied into two splits during maximum tillering and panicle primordium initiation (PPI) stage. Nitrogen, phosphorous and potassium were supplied through urea, single super phosphate, and muriate of potash respectively. As per the treatment schedule required quantity of herbicides was sprayed and for the treatment $S_2$ hand weeding was done at 20 and 40 DAT/DAS. The pre-emergence and post-emergence herbicides were sprayed with high volume knapsack sprayer fitted with flood jet nozzle using 500 liters of water $ha^{-1}$. All the pre-emergence herbicides were sprayed on 3 DAT/ 7 DAS and post-emergence herbicides were sprayed on 15 DAT/ DAS respectively.

Total weed population and weed biomass were recorded at 30, 45 and 60 DAT/DAS and their original values were transformed using $\sqrt{X+0.5}$ formula. Weeds were sampled in each plot at 30, 45 and 60 DAT/DAS of crop from an area of 0.5 $m^2$ counted and dried to constant weight at 80°C in hot air oven. The weed population and total dry weight of weeds were expressed as number $m^{-2}$ and g $m^{-2}$ respectively. Weed control efficiency was worked out on the basis of weed population recorded in each treatment at 30, 45 and 60 DAT/DAS using the formula suggested by Mani *et al.* (1973).

$$\text{WCE (\%)} = \frac{\text{Weed population in control plot - weed population in treated plot}}{\text{weed population in control plot}} \times 100$$

## Result and Discussion

In the experimental field the weed species namely *Cyperus difformis, Cyperus rotundus,* among the sedges, *Leptochloa chinensis, Echinochloa colonum* among grasses contributed largely for the total weed count and were found to be significantly influenced by the treatment. *Bergia capensis, Eclipta alba, Marsilia quadrifolia* among broad leaved weeds occurred in negligible proportion and the influence of treatments on these weeds was not significant.

**Table 1:** Effect of different rice establishment practices and weed management practices on total weed count at 30, 45 and 60 DAT/DAS (No. $m^{-2}$).

| Treatment | 30 DAT/DAS | 45 DAT/DAS | 60 DAT/DAS |
|---|---|---|---|
| **Establishment practices** | | | |
| $M_1$ | 5.87 (29.44) | 7.73 (59.40) | 9.42 (88.27) |
| $M_2$ | 4.89 (23.46) | 7.48 (55.51) | 8.39 (69.95) |
| $M_3$ | 3.95 (15.11) | 6.55 (42.52) | 7.03 (49.20) |
| $M_4$ | 4.37 (18.61) | 7.02 (48.79) | 7.78 (60.10) |
| $M_5$ | 4.48 (19.29) | 7.09 (49.80) | 7.86 (61.36) |
| SEd | 0.07 | 0.06 | 0.09 |
| CD (p=0.05) | 0.15 | 0.12 | 0.18 |
| **Weed management practices** | | | |
| $S_1$ | 8.49 (71.72) | 11.99 (143.43) | 13.09 (170.92) |
| $S_2$ | 3.80 (13.95) | 5.05 (25.06) | 7.04 (37.09) |
| $S_3$ | 2.89 (8.05) | 5.73 (32.40) | 6.65 (43.75) |
| $S_4$ | 5.1 (25.51) | 6.57 (42.79) | 7.49 (55.72) |
| $S_5$ | 2.08 (3.84) | 5.05 (25.06) | 6.13 (37.09) |
| $S_6$ | 2.12 (4.02) | 5.18 (26.38) | 6.20 (37.97) |
| SEd | 0.15 | 0.15 | 0.13 |
| CD (p=0.05) | 0.30 | 0.30 | 0.26 |

(Figures in parenthesis are original values)

**Table 2:** Effect of different rice establishment practices and weed management practices on total weed biomass (kg $ha^{-1}$).

| Treatment | 30 DAT/DAS | 45 DAT/DAS | 60 DAT/DAS |
|---|---|---|---|
| **Establishment practices** | | | |
| $M_1$ | 10.31 (105.93) | 14.09 (198.2) | 18.73 (350.46) |
| $M_2$ | 9.48 (89.38) | 11.78 (138.48) | 15.03 (225.60) |
| $M_3$ | 7.01 (48.71) | 7.45 (55.07) | 10.04 (100.32) |
| $M_4$ | 8.55 (72.65) | 10.07 (100.93) | 13.15 (172.43) |
| $M_5$ | 8.67 (74.83) | 10.05 (102.66) | 13.49 (181.67) |
| SEd | 0.13 | 0.06 | 0.14 |
| CD (p=0.05) | 0.27 | 0.13 | 0.28 |
| **Weed management practices** | | | |
| $S_1$ | 16.45 (270.28) | 22.88 (525.03) | 31.50 (991.98) |
| $S_2$ | 6.76 (45.29) | 6.88 (46.85) | 7.75 (59.69) |
| $S_3$ | 6.32 (39.48) | 6.39 (40.45) | 6.83 (46.27) |
| $S_4$ | 7.24 (51.96) | 7.39 (54.16) | 8.33 (68.99) |
| $S_5$ | 5.58 (30.71) | 5.79 (33.02) | 5.83 (33.52) |
| $S_6$ | 5.72 (32.29) | 5.93 (34.68) | 6.05 (36.14) |
| SEd | 0.17 | 0.10 | 0.18 |
| CD (p=0.05) | 0.34 | 0.21 | 0.37 |

(Figures in parenthesis are original values)

## Weed population

Among various rice establishment methods compared, significantly lower population of grasses, sedges and broad leaved weeds was recorded in SRI transplanting method (15.11, 42.52, and 49.20 $m^{-2}$ at 30, 45 and 60 DAT/DAS respectively). This might be due to reduction of competition during the early stages of growth decreased the weed population and submergence of the transplanted crop have effective suppression of weed population and weed germination under the SRI method of rice cultivation. Highest weed population was recorded in direct dry seeded rice (29.44, 59.40, 88.27 $m^{-2}$ at 30, 45 and 60 DAT/ DAS, respectively) because of greater weed competition due to weed emergence before or at the same time of crop emergence compared to transplanted rice. Among the various weed management practices compared pre-emergence application of bensulfuron methyl 0.6% + pretilachlor 6% GR @ 10 kg $ha^{-1}$ on 3 DAT/ 7 DAS + post-emergence application of bispyribac sodium 10% SC @ 200 ml $ha^{-1}$ on 15 DAT/DAS recorded the lowest weed population (3.84, 25.06, 37.09 $m^{-2}$ at 30, 45 and 60 DAT/DAS respectively). This might be due to reasons that in sequential application pre-emergence followed by post-emergence herbicide control broad spectrum of weeds in rice crop especially grasses which had grown along with rice crop seedlings in same hill and closer similarity of rice. This finding is in line with Revathi *et al*. (2017). This treatment was on par with pre-emergence application of pretilachlor 6% + pyrazosulfuron-ethyl 0.15 % GR@ 10 kg $ha^{-1}$ on 3 DAT/ 7 DAS + Post-emergence application of bispyribac sodium 10% SC @ 200 ml $ha^{-1}$ on 15 DAT/DAS that recorded lower weed population during the cropping period. This is mainly because of pre-emergence application of pretilachlor 6% + pyrazosulfuron-ethyl which reduced the weed population of complex weed

**Table 3:** Effect of different rice establishment practices and weed management on weed control efficiency (%) 45 DAT/DAS.

| Treatment | Weed control efficiency (%) |
|---|---|
| **Establishment practices** | |
| $M_1$ | 73.09 |
| $M_2$ | 74.28 |
| $M_3$ | 82.35 |
| $M_4$ | 78.39 |
| $M_5$ | 78.12 |
| **Weed management practices** | |
| $S_1$ | - |
| $S_2$ | 74.02 |
| $S_3$ | 77.52 |
| $S_4$ | 70.26 |
| $S_5$ | 82.70 |
| $S_6$ | 81.74 |

(Data statistically not analyzed)

flora at early stage of crop emergence and also gave good result in controlling broad spectrum of weeds by their quick knock down effect. This finding are conformed with the results of Sunil *et al.* (2010) and Yadav *et al.* (2010). All the weed control treatments were significantly superior than unweeded control in curtailing the population of sedges, broad leaved weeds and grasses. Unweeded control recorded the highest weed population during the experiment (71.72, 143.43, 246.19 $m^{-2}$ at 30, 45 and 60 DAT/DAS respectively) because of the continuous growth of weeds throughout the period of crop cultivation which increased the population of the weeds.

**Weed biomass**

Among the rice establishment methods SRI registered the lowest weed biomass (48.71, 55.07, 100.32 kg $ha^{-1}$ at 30, 45 and 60 DAT/DAS respectively) because of the lowest weed population at the time of critical period of crop weed competition. Highest weed biomass was recorded in direct dry seeded rice (105.92, 198.2, 350.46 kg $ha^{-1}$ at 30, 45 and 60 DAT/DAS respectively) compared to other establishment methods. This might be due to weed seeds and rice plant might have grown simultaneously and weeds competed for nutrients, solar energy and water. Regarding the weed management practices pre-emergence application of bensulfuron methyl 0.6% + pretilachlor 6% GR @ 10 kg $ha^{-1}$ on 3 DAT/ 7 DAS + post-emergence application of bispyribac sodium 10% SC @ 200 ml $ha^{-1}$ on 15 DAT/DAS recorded lowest weed biomass (30.71, 33.03, 33.52 kg $ha^{-1}$ at 30, 45 and 60 DAT/DAS respectively) compared to other weed management practices and this might be due to removal of all groups of weeds and subsequently reduced the dry weight of the weeds. This finding is in line with the results of Jayadeva *et al.* (2019). This treatment was found to be on par with of pretilachlor 6% + pyrazosulfuron-ethyl 0.15 % GR@ 10 kg $ha^{-1}$ on 3 DAT/ 7 DAS + Post-emergence application of bispyribac sodium 10% SC @ 200 ml $ha^{-1}$ on 15 DAT/DAS which also recorded lower weed biomass during the cropping period. This finding is in line with Charan Teja *et al.* (2015). Unweeded control plot recorded the highest weed biomass compared to other sub treatments.

**Weed control efficiency**

Among the establishment methods compared highest weed control efficiency was recorded in SRI method of rice establishment (82.35 per cent at 45 DAT/DAS). It is mainly because in SRI transplanting has enough spacing and using of young seedlings during the transplanting enables better root growth and tiller formation which reduced the weed density and dry weight. The lowest weed control efficiency was recorded in direct dry seeded plot (73.09 per cent at 45 DAT/DAS). This is due to higher weed population at early stage of the crop growth. It is influenced by the simultaneous growth of weeds and crop in the experimental field. This due to the absence of standing water at the time of crop emergence and also difficult to identify the weeds to control at early stage in direct seeded rice cultivation. This findings are conformed with Jagmohan Kaur and Avtar Singh (2017). Among the weed management practices pre-emergence application of bensulfuron methyl 0.6% + pretilachlor 6% GR @ 10 kg $ha^{-1}$ on 3 DAT/ 7 DAS + post-emergence application of bispyribac sodium 10% SC @ 200 ml $ha^{-1}$ on 15 DAT/DAS recorded the highest weed control efficiency (82.20 per cent at 45 DAT/DAS) which is due to sequential application of herbicides completely removed all types of weeds. This result is in line with Kankal (2015). This was on par with the pre-emergence application of pretilachlor 6% + pyrazosulfuron-ethyl 0.15 % GR@ 10 kg $ha^{-1}$ on 3 DAT/ 7 DAS + Post-emergence application of bispyribac sodium 10% SC @ 200 ml $ha^{-1}$ on 15 DAT/DAS which also recorded the higher weed control efficiency during the cropping period. Pinjari *et al.* (2016) reported similar results as they concluded that weeds can be effectively controlled in the rice crop by using these herbicides.

## Conclusion

Among the various rice establishment practices and weed management practices compared, SRI transplanting + pre-emergence application of bensulfuron methyl 0.6% + pretilachlor 6% GR @ 10 kg $ha^{-1}$ on 3 DAT/7 DAS + application of post-emergence herbicide bispyribac sodium 10% SC @ 200 ml $ha^{1}$ on 20 DAT/DAS recorded

the lowest weed population, weed biomass and highest weed control efficiency and it was on par with SRI transplanting + pre-emergence application of pretilachlor 6% + pyrazosulfuron-ethyl 0.15 % GR@ 10 kg $ha^{-1}$ on 3 DAT/ 7 DAS + Post-emergence application of bispyribac sodium 10% SC @ 200 ml $ha^{-1}$ on 15 DAT/DAS. These combinations were found to be significantly superior to other treatment combinations. Hence, for SRI crop establishment method either with pre-emergence application of bensulfuron methyl 0.6% + pretilachlor 6% GR @ 10 kg $ha^{-1}$ on 3 DAT/7 DAS + application of post-emergence herbicide bispyribac sodium 10% SC @ 200 ml $ha^{1}$ on 20 DAT/DAS or pre-emergence application of pretilachlor 6% + pyrazosulfuron-ethyl 0.15 % GR@ 10 kg $ha^{-1}$ on 3 DAT/ 7 DAS + Post-emergence application of bispyribac sodium 10% SC @ 200 ml $ha^{-1}$ on 15 DAT/ DAS could be better option in combating the weeds in rice crop.

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