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INFLUENCE OF DIFFERENT RICE ESTABLISHMENT METHODS AND WEED MANAGEMENT PRACTICES ON ECONOMICS OF 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 2019-2020 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 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 was found to be the best treatment and it was on par with 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 resulted in higher grain yield, straw yield, net profit and B:C ratio.

Keywords **:** Different rice establishment methods, weed management practices, grain yield, straw yield, net profit and B:C ratio.

Introduction

Globally, rice (*Oryza sativa* L.) is being cultivated in tropical regions and it is cultivated in an area of 161.28 million hectares with an annual production of 715.75 million tonnes (MoAFW, 2018). One of the prime food crop it is consumed by more than half of the world population, providing 20 per cent of the world's dietary energy supply. It is also plays a pivot role in food security which accounts for about more than 42 per cent of food production. In India the projected production of rice during 2020-2021 is 117.47 million tonnes (Parida *et al.,* 2020). However, considering the current population growth rate of 1.5 per cent, the projected demand of the escalating population, the total rice requirement by 2025 would be around 125 million tonnes (Anwesha Dey *et al.,* 2020). To meet out the food requirement for the exploding population, the rice production has to be augumented substantially through adoption viable agro technologies with the shrinking availability of land, labour and water resources. Regardless the crops cultivated, the sustainable yield could be achieved only through the management crop technologies which would facilate the crops to exploit the available resources at their maximum extend, especially at the scarce availability of resource *viz.,* space, nutrients, irrigation, water and labour. 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. 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 the different establishment methods and weed management practices on economics of rice.

Materials and Methods

A field experiment was conducted at Experimental Farm, Department of Agronomy, Annamalai University during *kuruvai* season of 2019-2020 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. Grain from each net plot were cleaned, sundried, weighed and adjusted to 14 per cent moisture content and the grain yield was expressed in kg ha^{-1}. After threshing the grains, the straw was sundried. The dried straw was weighed plot wise and computed to kg ha^{-1}. The gross and net returns hectare^{-1} for each treatment were worked out based on the prevailing market rates. The net income was calculated by deducting the cost of cultivation from the gross return. Then the benefit cost ratio was worked out as follows,

$$\text{Benefit cost ratio} = \frac{\text{Gross return } \left(\text{Rs.ha}^{-1}\right)}{\text{Cost of cultivation } \left(\text{Ra.ha}^{-1}\right)}$$

Result and Discussion

Among the five establishment methods, SRI transplanting recorded higher grain yield. Because of adequate supply of resources which contributed towards higher dry matter accumulation and better partitioning of photosynthate resulting in higher grain yield and better vegetative growth which contributed the higher dry matter production resulting significantly higher straw yield. Similar result was found by Singh *et al.* (2015). Where as, direct dry seeded rice recorded significantly lesser grain yield which may be due to uneven or poor crop establishment, higher weed competition. Similar result was observed by Jagmohan Kaur and Avtar Singh (2017). SRI transplanting recorded higher yield than machine transplanting followed by conventional transplanting , drum seeded rice and direct dry seeded rice.

Weed management practices greatly influenced the rice grain yield. Among the weed management practices, 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 recorded higher grain and straw yield and it was on par with 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 higher grain yield is due to decreased weed competition and minimum nutrient removal by weeds which might have increased the capacity of nutrient uptake and enhanced the source and sink sizes which in turn increased the yield. Whereas, unweeded control plot recorded lowest grain and straw yield. The increased yield might be due to favorable growing condition and weed free environment of the crop which consecutively resulted in higher grain and straw yield. The result were in agreement with the finding of Moshiur Rahman (2016).

Thus the results clearly showed that SRI method of establishment recorded the highest net profit and BCR due to low cost of cultivation. This was followed by mechanical transplanting conventional transplanting which was on par with each other. Among the weed management practices 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 recorded highest net profit and B:C ratio.

Interaction effect was found to exist between crop establishment methods and weed management practices with respect to rice grain and straw yield. SRI transplanting with 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 registered higher

grain yield, straw yield, net profit and B:C ratio. Invariably, lowest straw yield was recorded under direct dry seeded rice with unweeded control.

Conclusion

Among the crop establishment methods and weed management practices SRI transplanting along with 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 was recorded higher yield of rice. This was on par with application of 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. SRI transplanted rice is a sustainable and very feasible alternative to other method of rice establishment and saves the cost of production. From the result, it can be concluded that to get higher B:C ratio crop should be established by SRI and weeds should be managed by 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 compared to other methods of establishment and weed management practices.

Table 1 : Effect of different rice establishment practices and weed management practices on grain yield and straw yield

Treatment	Grain yield kg ha^{-1}	Straw yield kg ha^{-1}
Establishment practices		
M_1	3758	6091
M_2	4014	6346
M_3	5573	8344
M_4	5263	8260
M_5	5183	8264
SEd	148.4	125.4
CD (p=0.05)	312.4	59.6
Weed management practices		
S_1	2652	4416
S_2	4793	7720
S_3	5117	7979
S_4	4425	7134
S_5	5922	8663
S_6	5641	8654
SEd	192.8	123.9
CD (p=0.05)	405.6	260.8

Table 2 : Effect of different rice establishment practices and weed management practices on net profit and B:C ratio

Treatment	Net Profit	B:C ratio
Establishment practices		
M_1	28941	2.07
M_2	32510	2.18
M_3	49422	2.53
M_4	45390	2.38
M_5	43020	2.25
Weed management practices		
S_1	13415	1.53
S_2	38675	2.18
S_3	43830	2.37
S_4	34760	2.11
S_5	55694	2.78
S_6	52764	2.72

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