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Research Article

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Effect of Plant Density and Weed Management Practices on Economic Performance of direct Drum Seeded and Transplanted Rice

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ABSTRACT

An experiment was carried out at the Agronomy Field Laboratory, agricultural college, Bapatla, ANGRA University, in kharif-2012 to study "effect of plant density and weed management practices on economic performance of direct drum seeded and transplanted rice". Two factors were included in the experiment- six plant densities viz., of 71, 47, 35, 28, 20 and 33 hills m^{-2}, respectively and five weed management practices viz., weedy check (W_1), hand weeding at 20 and 40 DAS (W_2), cono weeding at 20 and 40 with modified cono weeder (W_3), pre-emergence application of anilofos @ 0.375 kg a.i ha^{-1} followed by post-emergence application of 2, 4 D sodium salt @ 1.0 kg a.i ha^{-1} 20-25 DAS (W_4), pre-emergence application of pendimethalin @1.0 kg a.i ha^{-1} followed by post-emergence application of bispyribac sodium @ 20 g a.i ha^{-1} 30 DAS (W_5). The experiment was laid out in a strip-plot design assigning plant density in the horizontal factor and herbicide application in vertical factor with three replications. The highest cost of cultivation (Rs 22036 ha^{-1}) was recorded with $D_6\times W_3$ treatment (manual transplant in combination with cono weeding twice). It was followed by $D_2\times W_3$ (Rs 21210 ha^{-1}), $D_6\times W_2$ (Rs 20847 ha^{-1}) and $D_6\times W_5$ (Rs 20067 ha^{-1}) because of high labour wages where ever manual input is involved. The higher cost involvement in transplanting method was due to extra labour required in seedling raising, uprooting and transplanting, accounting 8.40% of input cost.

Drum seeding method, with plant density of 47 hills m^{-2} in combination with cono weeding twice ($D_2\times W_3$) through resulted in highest gross returns (Rs 61202 ha^{-1}), the high cost of cultivation (Rs 21210 ha^{-1}) resulted in lesser net returns (Rs 39992 ha^{-1}) in turn lead to reduced returns per rupee invested (1.89) as compared with hand weeding $D_2\times W_5$ (2.36), $D_1\times W_5$ (2.15), $D_2\times W_2$ (2.15) respectively. Although transplanted method required more investment than direct seeded rice but return was more in direct wet seeded method, consequently direct seeded thick and thin row methods produced an additional profit over transplanted rice because of labor saving and higher grain yield in the former case.

Keywords: *bispyribac- sodium,Weed population, Drum seeding, cono weeding, pendimethalin, Hand weeding.*

INTRODUCTION

Rice (*Oryza sativa* L.) is the dominant staple food for many countries in Asia and Pacific, South and North America as well as Africa[1] and also is a staple food for nearly half of the world's seven billion population. However, more than 90 per cent of rice is consumed in Asia, where it is a staple food for a majority of the population, including the 560 million hungry people in the region[2]. Globally, India stands first in rice area and second in production after China. It is also a staple food for more than 65 per cent of the Indian population and accounts for more than 42 per cent of food production.

The area under direct - seeded rice is increasing as farmers in India seek higher productivity and profitability to overcome increasing costs and scarcity of farm labour. One of the major reasons for non-remunerative rice production in recent times is augmented cost of cultivation because of scarce and costly farm labour during the peak period of farm operations. Establishing rice by transplanting is labour intensive and increasingly difficult due to higher cost and shortage of labour. Inadequate plant population with hired labour for transplanting is the major lacuna in this method[3].

Drum seeding is an alternative method to transplanting. It reduces labour requirement and performs as good as transplanting method at many places[4]. However, drum seeding method is subjected to severe weed infestation than conventionally puddled transplanted rice that leads to because of the absence of the size disparity between the crop and weed plants and the suppressive effect of standing water on weed growth at crop establishment.

Weeds compete with rice plant severely for space, nutrients, air, water and light by adversely affecting plant height, leaf architecture, tillering habit, shading ability, growth pattern and crop duration.Weed depresses the normal yield of grains per panicle and grain weight[5]. Subsistence farmers of the tropics spend more time, energy and money for weed control than any other aspect of crop production . Weed can be controlled by mechanical means or chemical means. Mechanical weed control is expensive and chemical method leads to environmental pollution and in many weed species have developed resistance against the herbicides.

MATERIALS AND METHODS

A field experiment entitled "Effect of plant density and weed management practices on economic performance of direct drum seeded and transplanted rice " was conducted at the Agricultural College Farm, Bapatla on sandy loam soil during *kharif* 2012. The treatments consisted of combination of five drum seeder spacings (20×7cm, 20×10.5cm, 20×14cm, 20×17.5cm, 20×24.5cm, and manual planting (20×15cm), with a rice plant population of 71, 47, 35, 28, 20 and 33 hills m^{-2}, respectively, and five weed management practices *viz.*, weedy check (W_1), hand weeding at 20 and 40 DAS (W_2), cono weeding twice at 20 and 40 DAS with modified cono weeder (W_3), pre-emergence application of anilofos @ 0.375 kg a.i ha^{-1} and post-emergence application of 2, 4 D salt @1.0 kg a.i ha^{-1} at 25 DAS (W_4), pre-emergence application of pendimethalin @1.0 kg a.i ha^{-1}post-emergence application of bispyribac sodium @ 20 g a.i ha^{-1} 30 DAS (W_5).

The trail was laid out in strip plot design and replicated thrice. The rice variety used was NLR - 33358 (*SOMASILA*). Fertilizer was applied at the rate of 120:60:60 N: P_2O_5:K_2O kg ha^{-1}. Nitrogen was applied in two split doses at time of tillering and panicle initiation stage along with basal dose. Phosphorus and potassium was applied as basal.

ECONOMICS

The cost of cultivation for each treatment was worked out. Similarly gross returns were calculated based on prevailing market price of the produce. The net returns were obtained after deducting the cost of cultivation from gross returns. Later, the return per rupee was calculated using the formula:

$$\text{Return per rupee (Rs.)} = \frac{\text{Net returns (Rs.)}}{\text{Total operational cost (Rs.)}}$$

STATISTICAL ANALYSIS

The experimental data are statistically analysed by using Fisher's method of analysis of variance as outlined by Panse and Sukhatme (1978). Critical Difference (CD) was calculated wherever F-test was found significant. The level of significance used in F-test was five per cent.

Predominant weed flora of the experimental field:

Weed flora such as *Echinochloa colonum, Echinochloa crusgalli, Cynodon dactylon, Chloris barbata* (among the grasses); *Cyperus rotundus, Cyperus difformis, Fimbristylis miliacea* (among the sedges) and *Eclipta alba, Ludwigia parviflora, Ammania baccifera, Euphorbia hirta* among the (broad-leaved weeds) were found to be the predominant weeds in the experimental field.

Data collection of crop characters:

Data were collected from five hills per plot and then averaged.. Grains obtained from randomly selected five hills were sun dried and weighed carefully. Then it was averaged to get grain weight hill^{-1}. Straw obtained from randomly selected five sample hills of respective plot was dried in sun and weighed and then averaged. Grains obtained from each unit plot were sun dried and weighed carefully. The dry weights of grains from the panicle of the sample hills were added to the respective plot yield to record the grain yield plot^{-1}. Straw obtained from each unit plot including the straw of five sample hills of respective plot was dried in sun and weighed to record the straw yield plot^{-1}. The grain and straw yields per plot were subsequently converted to ha^{-1}and recorded. Data recorded for different crop parameters were compiled and tabulated in proper form for statistical analysis. The experimental data are statistically analyses by using Fisher's method of analysis of variance as outlined by Panse and Sukhatme[6]. Critical Difference (CD) was calculated wherever F-test was found significant. The level of significance used in F-test was five per cent.

RESULT AND DISCUSSION

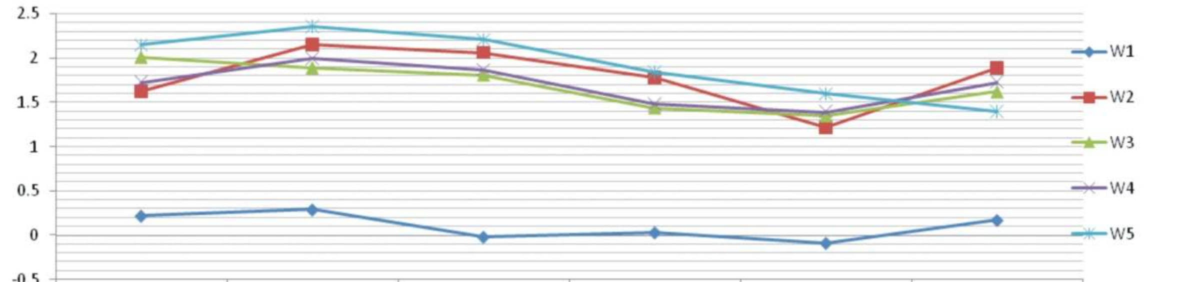
The economics of plant density and weed management practices are present in Table 4.11, the data were not statistically analysed. The highest cost of cultivation (Rs 22036 ha^{-1}) was recorded with $D_6 \times W_3$ treatment (manual transplant in combination with cono weeding twice). It was followed by $D_2 \times W_3$ (Rs 21210 ha^{-1}), $D_6 \times W_2$ (Rs 20847 ha^{-1}) and $D_6 \times W_5$ (Rs 20067 ha^{-1}) because of high labour wages where ever manual input is involved. Drum seeding method, with plant density of 47 hills m^{-2} in combination with cono weeding twice ($D_2 \times W_3$) through resulted in highest gross returns (Rs 61202 ha^{-1}), the high cost of cultivation (Rs 21210 ha^{-1}) resulted in lesser net returns (Rs 39992 ha^{-1}) in turn lead to reduced returns per rupee invested (1.89) as compared with hand weeding $D_2 \times W_5$ (2.36), $D_1 \times W_5$ (2.15), $D_2 \times W_2$ (2.15) and some other treatments which gave round Rs.2.00 per rupee invested. Utilisation of pre and post emergence herbicides in W_5 treatment in combination with drum seeding with 47 hills m^{-2} ultimately appears to be the best treatment combination which gave highest returns of 2.36 per rupees invested mainly because of exclusion of labour input and effective working of pendimethalin followed by bispyribac sodium. Similar results were reported by Halder and Patra[7] and Singh *et al.*[8]. The higher cost of production in transplanting was associated the higher labour requirement in seedling raising, uprooting and transplanting. Similar results were found by Pandey and Velasco (2002) and Ho and Romil[9]. The distribution of labour (human and animal) over different operations of rice under different methods of crop establishment differed considerably with the method of crop establishment (Table 1). The higher number of human labour required in transplanting method was due to the higher labour involvement in transplanting (30 man-day ha^{-1}), 22.56% of the total labour requirement than those of direct seeding (8 man-day ha^{-1}). Direct seeding required an extra number of labour to prepare the field for direct seeding (levelling, drain out of water and removal of stubbles) and guard against birds (5 man-day ha^{-1}) which was compensatory to labour required in seedling raising in case of transplanting. Similar results were observed by Ho and Romil (2002) who stated that direct seeded method required only. It is evident that total cost of production (TCP) under transplanting, direct seeded thick row and direct seeded thin row were Tk. 40526.28, Tk. 3880.06 and Tk. 38360.06, respectively. The total cost of production ha^{-1}and it's distribution over different heads of expenditure under methods of crop establishment have been presented in Table 1.

The percentage of total cost of production over different heads viz. labour, seeds, fertilizer, herbicide, irrigation water, insecticide, interest on input cost, interest on value of land and miscellaneous cost in drum seeded plant densities integrated with weed management treatments i.e. D1×W1,toD5×W5 (Table:1and Fig:2) were 0.22, 1.63, 2.01, 1.73, 2.15, 0.29, 2.15, 1.89, 2.00, 2.36, 0.02, 2.06, 1.81, 1.87, 2.21, 0.03, 1.73, 1.44, 1.48, 1.84, -0.09, 1.22, 1.35, 1.39, 1.60 respectively, while they were 0.17,1.89, 1.02, 1.73, 1.4 in transplanted method. It is evident that total cost of production (TCP) under transplanting, 17067, 20847, 2036, 18237, 20067 (D6×W1, D6×W2, D6×W3, D6×W4, D6×W5) respectively. As and when compare with optimum spaced drum seeded plant density i.e.47 hills m^{-2} 15297,19266,21210,16467,16277 (D2×W1, D2×W2, D2×W3, D2×W4, D2×W5), respectively.

Table 1. Economics of rice as affected by varied plant densities and weed management practices in drum seeded rice

Treatment	Gross return (Rs. ha^{-1})	Cost of cultivation (Rs. ha^{-1})	Net return (Rs. ha^{-1})	Return per Rupee
D1W1	20258.7	16657.0	3601.7	0.22
D1W2	51646.7	19626.0	32020.7	1.63
D1W3	56090.7	18657.0	37433.7	2.01
D1W4	45961.3	16827.0	29134.3	1.73
D1W5	52390.7	16637.0	35753.7	2.15
D2W1	19694.7	15297.0	4397.7	0.29
D2W2	60638.0	19266.0	41372.0	2.15
D2W3	61202.0	21210.0	39992.0	1.89
D2W4	49482.7	16467.0	33015.7	2.00
D2W5	54670.7	16277.0	38393.7	2.36
D3W1	14811.3	15057.0	-245.7	-0.02
D3W2	48997.3	16037.0	32960.3	2.06
D3W3	53492.0	19026.0	34466.0	1.81
D3W4	46602.7	16227.0	30375.7	1.87
D3W5	57876.0	18057.0	39819.0	2.21
D4W1	15424.7	14952.0	472.7	0.03
D4W2	44226.7	15932.0	28294.7	1.78
D4W3	46213.3	18921.0	27292.3	1.44
D4W4	39974.0	16122.0	23852.0	1.48
D4W5	50973.3	17952.0	33021.3	1.84
D5W1	13598.0	14952.0	-1354.0	-0.09
D5W2	42082.7	18921.0	23161.7	1.22
D5W3	42098.7	17952.0	24146.7	1.35
D5W4	38489.3	16122.0	22367.3	1.39
D5W5	41420.7	15932.0	25488.7	1.60
D6W1	20046.7	17067.0	2979.7	0.17
D6W2	55084.0	20847.0	37237.0	1.89
D6W3	55217.3	22036.0	34181.3	1.62
D6W4	49796.0	18237.0	31559.0	1.73
D6W5	48240.7	20067.0	28173.7	1.40

Fig: 1 Graphical representation on Economics of rice as affected by varied plant densities and weed management practices in drum seeded rice



	D1	D2	D3	D4	D5	D6
W1	0.22	0.29	-0.02	0.03	-0.09	0.17
W2	1.63	2.15	2.06	1.78	1.22	1.89
W3	2.01	1.89	1.81	1.44	1.35	1.62
W4	1.73	2	1.87	1.48	1.39	1.73
W5	2.15	2.36	2.21	1.84	1.6	1.4

RICE PLANT DENSITY (D)

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