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Diversification of Rice Based Cropping Systems for Higher Productivity, Profitability and Resource use Efficiency under Different Tillage Practices in Northern Telangana Zone

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ABSTRACT

A field experiment was conducted during Vanakalam and Yasangi, 2020-21 at Regional Agricultural research station, Jagtial to identify the profitable rice based cropping system under different tillage practices. The treatments comprised of two tillage practices viz., conventional tillage and zero tillage as main plots and four rice fallow crops maize, mustard, sunflower and chickpea as subplots in split plot design with three replication. Conventional tillage recorded higher rice equivalent yield (4723 kg ha^{-1}), production efficiency (40.2 kg ha^{-1} day^{-1}), gross returns (Rs 88091 ha^{-1}) and B:C ratio (2.91) over zero tillage practice. Rice sunflower cropping sequence was evaluated to be most remunerative with sustainable with maximum rice equivalent yield (5611 kg ha^{-1}), gross returns (Rs 104651 ha^{-1}), net returns (Rs 75151 ha^{-1}) and B:C ratio (3.54) followed by rice- chickpea cropping sequence having potential advantage of nutrient recycling.

Keywords Zero tillage, Crop diversification, Production efficiency, Rice equivalent yield.

INTRODUCTION

Rice - rice- fallow is the most dominant crop sequence in northern Telangana. Continuous cultivation of rice for longer periods with low system productivity, and often with poor crop management practices, led to loss in soil fertility due to emergence of multiple nutrient deficiencies (Dwivedi *et al.* 2001). Diversification and intensification of rice-based system to increase productivity per unit resource is very pertinent. Crop diversification shows lot of promises in alleviating these problems besides, fulfilling basic needs for cereals, pulses, oilseeds and vegetables and regulating farm income, withstanding weather aberrations, controlling price fluctuation, ensuring balanced food supply, conserving natural resources, reducing the chemical fertilizer and pesticide loads, ensuring environmental safety and creating employment opportunity (Gill and Ahlawat 2006) (Figs. 1, 2).

Further, an intensification of cropping sequence is essential in the existing farming situation. Non-rice crop like oilseeds, pulses and vegetables are receiving more attention owing to higher price due

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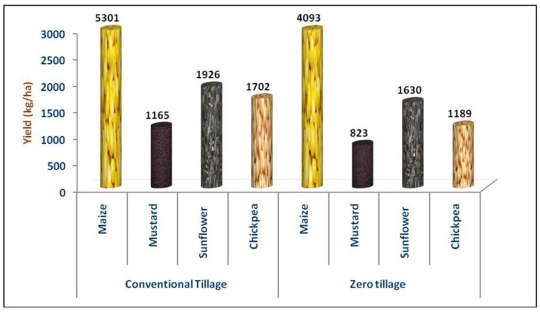

Fig. 1. Yields (kg ha^{-1}) of rice sequence crops under different tillage practices.

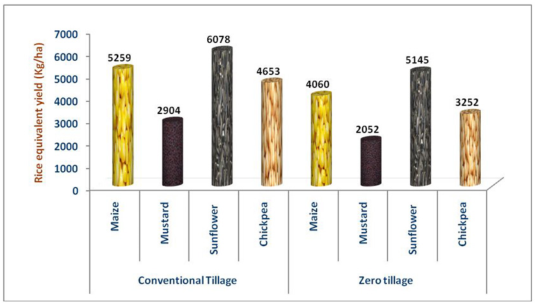

Fig. 2. Rice equivalent yield (kg ha^{-1}) of rice sequence crops under different tillage practices.

to increased demand. Inclusion of these crops in a sequence changes the economics of the cropping sequences (Samant 2015). Hence, the present study was carried out to identify the most adaptable rice fallow winter crop rotation and to customize appropriate crop establishment practice for a winter crop that could be remunerative to the farmers in northern Telangana zone.

MATERIALS AND METHODS

The field experiment was conducted during Vanakalam and Yasangi, 2020-21 at Regional Agricultural research station, Jagtial in split plot design with three replication. The treatment combination comprised of two tillage practices viz., Coventional tillage and zero tillage in the main plots and four rice fallow crops

Table 1. Effect of rice based cropping systems on land use efficiency (%) rice equivalent yield (kg ha^{-1}) and production efficiency (kg ha^{-1} day^{-1}) under different tillage practices.

Treatments	Duration of cropping system (No. of days)	Land use efficiency (%)	Grain/ Seed yield (kg ha^{-1})	Rice equivalent yield (kg ha^{-1})	Production efficiency (kg ha^{-1} day^{-1})
Main plot (Tillage practices)					
Conventional tillage	-	-	2523	4723	40.3
Zero tillage	-	-	1934	3627	37.7
SEm±				166	0.31
CD (at 5%)				1091	2.0
Sub plot (Rice sequence crops)					
Rice - Maize	231	63.2	4697	4659	48.5
Rice - Mustard	206	56.4	994	2477	36.4
Rice - Sunflower	231	63.2	1775	5611	35.8
Rice - Chickpea	224	61.3	1446	3952	35.4
SEm±				288	0.5
CD (at 5%)				898	1.5
Interaction (Factor (B) at same level of A)					
SEm±				333	0.63
CD (at 5%)				NS	NS
Interaction (Factor (A) at same level of B)					
SEm±				390	0.70
CD (at 5%)				NS	NS

Table 2. Economics of rice based cropping systems under different tillage practices.

Treatments	Cost of cultivation (Rs ha-1)	Gross returns (Rs ha^{-1})	Net returns (Rs ha^{-1})	B:C ratio
Main plot (Tillage practices)				
Conventional tillage	30500	88091	57591	2.90
Zero tillage	25500	67645	42145	2.66
SEm±	3106	3105	3105	0.12
CD (at 5%)	20348	NS	NS	NS
Sub plot (Rice sequence crops)				
Rice - Maize	32500	86897	54397	2.66
Rice - Mustard	27500	46209	18709	1.66
Rice - Sunflower	29500	104651	75151	3.54
Rice - Chickpea	22500	73715	51215	3.25
SEm±		5374	5374	0.21
CD (at 5%)		16743	16743	0.66
Interaction (Factor (B) at same level of A)				
SEm±		6211	6211	0.24
CD (at 5%)		NS	NS	NS
Interaction (Factor (A) at same level of B)				
SEm±		7278	7278	0.28
CD (at 5%)		NS	NS	NS

Maize, Mustard, sunflower and chickpea allotted in subplots. The soil of the experimental field was sandy loam in texture, neutral pH- 7.6, EC- 0.33 (dsm^{-1}), organic carbon 0.45% and available N, P and status of the soil was 212 kg ha^{-1}, 21.9 kg ha^{-1} and 251 kg ha^{-1}, respectively.

Final crop yield were recorded and gross return (Rs ha^{-1}) were calculated on the basis of prevailing market price of the produce. To compare the performance of different cropping sequences, economic yield of all the crops were converted into rice equivalent yield (REY) based on prevailed market price using the formula :

REY (of a crop) = Yx (Px)/Pj
Where, Yx is the yield of crop × (t/ha of economic harvest),

Px is the price of crop x and Pj is the price of rice

The benefit : Cost ratio (BC ratio) for different sequences was calculated by dividing gross return by cost of cultivation. Profitability of the system was calculated by dividing the net return ha^{-1} in a sequence by 365 days. The production efficiency value was calculated by dividing the total grain production ha^{-1} in a sequence with total duration of crops in a sequence (Tomar and Tiwari 1990).

Land use efficiency (LUE) was calculated by taking total duration of crops in a sequence and dividing by 365 (Samant 2015). The data was statistically analyzed applying the techniques of analysis of variance and the significance of different sources of variations were tested by error mean square of Fisher Snedecor's '*F*' test at probability level 0.05.

RESULTS AND DISSUSSION

The maximum land use efficiency of 63.2% was observed in rice-maize and rice - sunflower cropping sequences with greater combined yield followed by rice- chickpea (61.3%) and rice-mustard (56.4%) sequence which had given relatively lower yield.

Higher yield of rice – Maize, rice – mustard, rice- sunflower and rice – chickpea recorded in conventional tillage compared to zero tillage (Tables 1, 2). Significantly higher rice equivalent yield recorded with conventional (4723 kg ha^{-1}) over zero tillage (3627 kg ha^{-1}) under rice based cropping systems. During *rabi* season among rice sequence crops significantly higher rice equivalent yield was recorded with sunflower (5611 kg ha^{-1}) over maize (4659 kg ha^{-1}) and chick pea (3952 kg ha^{-1}) inturn, lowest rice equivalent yield was recorded with mustard (2477 kg ha^{-1}).

Among tillage practices significantly higher production efficiency (40.3 kg ha^{-1} day^{-1}) was found in conventional tillage over zero tillage (37.7 kg ha^{-1} day^{-1}) owing to higher seed/ grain yield in conventional tillage. Among rice sequence crops the maximum production efficiency (48.5 kg ha^{-1} day^{-1}) was obtained in rice – maize followed by rice-mustard (36.4 kg ha^{-1} day^{-1}), rice- sunflower (35.8 kg ha^{-1} day^{-1}) and rice - chickpea (35.4 kg ha^{-1} day^{-1}).

Economic analysis (Table 2) showed that conventional tillage and zero tillage are on par interms of net returns (57591 Rs ha^{-1} and 42145 Rs ha^{-1}) and B:C ratio (2.90 and 2.66) during *rabi* season under rice sequence cropping system. Among the rice cropping systems highest net return (Rs 75151 ha^{-1}) and B:C ratio (3.54) were recorded with rice-sunflower followed by rice-sunflower sequence with net return (Rs 51215 ha^{-1}) and B:C ratio of 3.25. The lowest economic yield from rice-mustard system showed the poor net return (Rs 18709 ha^{-1}) and B:C ratio (1.66). The B:C ratio of rice-maize sequence is (2.66) and was found to be higher than rice- mustard cropping system (1.66).

CONCLUSION

During the *rabi* season, the existing rice-based cropping system can be efficiently diversified with sunflower and chickpea, which are both productive and profitable. In addition, legumes are potentially important to diversify rice-based mono cropping into rice-chickpea which had nutrient cycling advantage.

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