

**PRODUCTIVITY ENHANCEMENT OF *KHARIF* RICE THROUGH INTRODUCTION OF PRE
KHARIF CROPS IN RICE BASED CROPPING SYSTEM**

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ABSTRACT: A field experiment was conducted at Agricultural College Farm, Naira on sandy clay loam soil during pre *kharif* and *kharif* 2012-2013. The experiment was laid out in randomized block design, with four replications and seven cropping systems. Sunnhemp, greengram, blackgram, sesame, clusterbean and bhendi during pre *kharif* and rice during *kharif* were tried. Incorporation of different pre *kharif* crop residues significantly altered the growth and development of *kharif* rice. The results indicated that crop residue incorporation of sunnhemp recorded significantly higher growth parameters, yield attributes, yield (6501 kg ha^{-1}) and nutrient uptake of *kharif* rice while lowest was recorded with that of fallow (4125 kg ha^{-1}). Economics of rice was also observed with sunnhemp crop residue incorporation.

Key words: pre *kharif* crops, crop residues, *kharif* rice and cropping system

INTRODUCTION

Rice based cropping systems (RBCS) are the major contributing food production systems with rice as the premier food crop, forming an integral part of this system. Rice-rice system is followed in irrigated ecology while rice-pulse system is adopted in rainfed lowlands leaving land fallow during pre *kharif* season. The continuous cultivation of high yielding varieties of cereals has led to depletion of nutrients from soil resulting in a decline of soil organic matter content. Hence, crops which can improve the fertility status should be included in the cropping systems. Rice based cropping system is the most predominant in North Coastal Zone of Andhra Pradesh. However, the average productivity of rice in this zone is still hovering around 3 t ha^{-1} resulting in lower productivity of this system. Internalization of short duration pre *kharif* legume (or) green manure crops in RBCS supplements N need of the succeeding crop besides improving soil physical and chemical properties. Grain legumes are more preferable as they offer short-term additional benefits to farmers and are equally beneficial in sustaining the productivity over time in RBCS.

MATERIAL AND METHODS

A field experiment was conducted during pre *kharif* and *kharif* 2012-13 at the Agricultural College Farm, Naira, Andhra Pradesh. The experimental soil was sandy clay loam in texture with a pH of 7.55 and EC of 0.27 dSm^{-1} , low in organic carbon (0.24%), available nitrogen (175 kg ha^{-1}) and available phosphorus (17.5 kg ha^{-1}) and medium in available potassium (219 kg ha^{-1}). A total of 1030.8 mm rainfall was received during the cropping period. The experiment was laid out in randomized block design with four replications and seven cropping systems viz., fallow-rice (T_1), sunnhemp-rice (T_2), greengram-rice (T_3), blackgram-rice (T_4), sesame-rice (T_5), clusterbean-rice (T_6) and bhendi-rice (T_7). Sunnhemp, greengram, blackgram, sesame, clusterbean and bhendi during pre *kharif* and rice during *kharif* were tried. Pre *kharif* crops were grown for 84 days and were incorporated after taking economic yield wherever possible seven days prior to *kharif* rice transplanting. Thirty day old seedlings of *kharif* rice were transplanted at $20 \times 15 \text{ cm}$ and the test variety was vijetha (MTU 1001). The data on growth parameters, yield attributes, yield, nutrient uptake and economics of rice were recorded and subjected to statistical analysis as per Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Effect of pre *kharif* crops on *kharif* rice

Growth parameters

Plant height at flowering and dry matter production of rice was significantly influenced by different pre *kharif* crops through incorporation of their crop residues preceding to planting of *kharif* rice (Table 1).

The highest stature of plants were observed with incorporation of crop residue of sunnhemp (T_2), which was on par with greengram (T_3), bhendi (T_7) and blackgram (T_4) residues. The shortest rice plants were observed when preceded by fallow (T_1) which was, however, comparable with sesame (T_5) and clusterbean (T_6). Significantly highest dry matter (Table 1) of rice at harvest was produced when preceded by sunnhemp (T_2) over other pre *kharif* crops. Dry matter of rice when preceded by greengram (T_3), blackgram (T_4), bhendi (T_7) and sesame (T_5) were found to have similar influence on *kharif* rice and were on par with each other but were significantly superior to clusterbean (T_6) and fallow (T_1). Lowest dry matter of rice was registered with fallow (T_1). Increase in growth parameters due to incorporation of crop residue of sunnhemp may be ascribed to its fast decomposition rate, huge quantity of its residue and synchronized availability of major plant nutrients, especially that of nitrogen to the crop for a longer period essential for the growth of rice. The superior performance of rice with greengram, bhendi and blackgram residues might be due to continuous availability and slow release of nitrogen under submerged conditions at different stages of crop growth period. The results were in conformity with Ramachandra *et al.* (2008) and Deshpande and Devasenapathy (2011).

Yield attributes

Yield attributes (Table 1) of *kharif* rice was significantly influenced by different pre *kharif* crops. Number of panicles m^{-2} of rice at harvest and number of filled grains panicle $^{-1}$ increased with sunnhemp (T_2), which was significantly higher than that of remaining treatments. Among these, greengram (T_3), blackgram (T_4) bhendi (T_7) and sesame (T_5) were in comparison with each other. Lowest number of panicles m^{-2} and number of filled grains panicle $^{-1}$ of rice was observed with fallow (T_1). Significantly highest thousand grain weight of rice was found with sunnhemp (T_2) when compared to other pre *kharif* crops. Grain weight of greengram (T_3), blackgram (T_4), bhendi (T_7), sesame (T_5) and clusterbean (T_6) was on par and was significantly superior to that preceded by fallow (T_1), which recorded the lowest weight.

Panicles m^{-2} were highest with sunnhemp as the continuous supply of nutrients during the entire cropping period under this treatment facilitated in conversion of more number of total tillers to productive tillers. The slow and timely release of nutrients, especially that of nitrogen during the crop growth period resulted in differentiation to higher number of panicles m^{-2} in greengram, blackgram and bhendi. Sunnhemp has recorded highest filled grains panicle $^{-1}$ followed by greengram, bhendi and blackgram which might be due to more number of total grains panicle $^{-1}$ and lower sterility facilitated through favourable supply of nutrients and thereby better performance over other preceding crops. A higher thousand grain weight and a narrower grain-straw ratio are evidences of more efficient translocation to the grain from the vegetative parts. These results were in close conformity with Radha Kumari and Srinivasulu Reddy (2009).

Yield

Grain and straw yield (Table 1) of *kharif* rice was significantly influenced by different pre *kharif* crops. The highest grain and straw yield of rice was realized with sunnhemp (T_2) which was significantly superior to all the other pre *kharif* crops tested. *Kharif* rice when preceded by greengram (T_3), blackgram (T_4), bhendi (T_7) and sesame (T_5) are next best to sunnhemp and produced statistically similar yields. The grain yield of rice recorded with fallow (T_1) was lower by 36.55 per cent and by 28.74 per cent compared to sunnhemp and greengram residues incorporation respectively. Increase in rice yield owing to sunnhemp incorporation preceding to *kharif* rice may be attributed to the significant quantity of crop residue produced and its subsequent incorporation might have aided in the release of nutrients to soil slowly for longer duration after its faster decomposition, resulting in better plant growth and elevated yield structure. Among the other pre *kharif* crops tested, greengram produced the next highest yields which can be attributed to higher crop residue of preceding crop, enhanced soil fertility which might have created favourable growing conditions to succeeding rice as evidenced in its higher number of panicles m^{-2} , filled grains panicle $^{-1}$ and thousand grain weight, which was next only to sunnhemp. Better performance of rice with the inclusion of preceding crops in the system was also well documented by Vijay Pooniya and Yashbir Singh Shivay (2012), Radha Kumari and Srinivasulu Reddy (2009), Porpavai *et al.* (2006) and Narayana Reddy and Surekha (2000).

Nutrient uptake

Nutrient (N, P and K) uptake by *kharif* rice differed significantly due to incorporation of preceding crops in the cropping system (Table 2). Uptake of N,P and K was the highest with sunnhemp (T_2) crop residue incorporation than all the rest of the treatments. Uptake was similar with incorporation of greengram (T_3), blackgram (T_4), bhendi (T_7) and sesame (T_5) residues. Uptake with incorporation of sesame (T_5) and clusterbean (T_6) residues were comparable between them. Fallow (T_1) registered the lowest nutrient uptake compared to all preceding crops.

Increased nutrient uptake (N, P and K) with the pre *kharif* crops wherever recorded was mainly associated with increase in dry matter production of rice. Increased uptake of nitrogen might be due to increased availability of soil N, mineralization of N added by sunnhemp and its rapid decomposition. Uptake of nitrogen increased with incorporation of greengram and blackgram residues might be due to biological nitrogen fixation of greengram and blackgram during the pre *kharif* season. Contribution of phosphorus and potassium from sunnhemp, greengram and blackgram coupled with the solubilisation of native phosphorus and potassium by organic acids produced during decomposition of crop residues might have improved their uptake by rice with these treatments. These results were in close conformity with those of Porpavai (2007).

Table 1: Growth parameters, yield attributes and yield of *kharif* rice as influenced by pre *kharif* crops in rice based cropping system

Treatment	Plant height (cm) at flowering	Dry matter (kg ha^{-1}) at harvest	Panicles m^{-2} at harvest	Number of filled grains panicle $^{-1}$	Thousand grain weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
T_1 : Fallow-rice	96.55	7754	204	100	21.95	4125	5899
T_2 : Sunnhemp-rice	109.95	14455	265	128	24.33	6501	8505
T_3 : Greengram-rice	106.93	12199	247	119	23.48	5789	7592
T_4 : Blackgram-rice	104.93	11838	243	118	23.33	5605	7522
T_5 : Sesame-rice	103.05	10486	232	114	22.98	5310	7257
T_6 : Clusterbean-rice	101.40	9692	223	109	22.78	4825	6627
T_7 : Bhendi-rice	105.75	11645	242	119	23.05	5512	7485
S.Em \pm	2.50	642.39	5.59	2.56	0.27	177.24	217.81
CD (P=0.05)	7.42	1909	17	8	0.79	527	647

Table 2: Nutrient uptake of *kharif* rice as influenced by pre *kharif* crops in rice based cropping system

Treatment	N uptake (kg ha^{-1})	P uptake (kg ha^{-1})	K uptake (kg ha^{-1})
T_1 : Fallow-rice	69.04	17.48	78.23
T_2 : Sunnhemp-rice	123.69	34.66	137.90
T_3 : Greengram-rice	105.58	28.48	117.88
T_4 : Blackgram-rice	103.87	28.11	114.68
T_5 : Sesame-rice	93.17	24.99	103.80
T_6 : Clusterbean-rice	85.14	22.27	94.59
T_7 : Bhendi-rice	101.59	27.44	112.22
S.Em \pm	4.31	1.2	4.78
CD (P=0.05)	12.82	3.58	14.19

Economics

Computation of gross returns, net returns and benefit cost ratio (economics) of rice indicated significant variations with different pre *kharif* crops tried (Table 3).

The highest gross, net returns and benefit cost ratio of rice were realized with incorporation of crop residue of sunnhemp (T_2) which was significantly higher than all the other pre *kharif* treatments which was obviously due to the highest grain and straw yield recorded with this treatment. Economics were comparable for the treatments involving incorporation of greengram (T_3), blackgram (T_4), bhendi (T_7) and sesame (T_5) residues. Lowest economics of rice were recorded when rice was preceded by fallow (T_1) due to lower yields recorded with this treatment. The results were in conformity with Radha Kumari and Srinivasulu Reddy (2009).

Table 3: Economics of *kharif* rice as influenced by pre *kharif* crops in rice based cropping system

Treatment	Gross returns (Rs ha ⁻¹)	Net returns (Rs ha ⁻¹)	B:C ratio
T ₁ : Fallow-rice	57465	32075	2.26
T ₂ : Sunnhemp-rice	89770	64380	3.54
T ₃ : Greengram-rice	79955	54565	3.15
T ₄ : Blackgram-rice	77581	52191	3.06
T ₅ : Sesame-rice	73635	48245	2.90
T ₆ : Clusterbean-rice	66937	41547	2.64
T ₇ : Bhendi-rice	76385	50995	3.01
S.Em ±	2381.89	2381.89	0.09
CD (P=0.05)	7077	7077	0.28

CONCLUSION

Growth parameters, yield attributes, yield, nutrient uptake and economics of *kharif* rice were significantly highest with incorporation of sunnhemp crop residue and hence sunnhemp-rice was suggested for North Coastal Zone of Andhra Pradesh.

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