The Andhra Agric. J 63 (2): 251-255, 2016

Studies on Improvement of System Productivity Through Introduction of Pre *Kharif* Crops in Rice (*Oryza sativa* L.) Based Cropping System

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ABSTRACT

A field investigation was conducted during pre *kharif*, *kharif* and *rabi* 2012-13 on sandy clay loam soils of Agricultural College Farm, Naira to find out the effect of preceding crop on performance of succeeding rice and rice fallow blackgram. The experiment was laid out in randomized block design with four replications and seven treatments. Significant differences were noticed with pre *kharif* crops on yield attributes and yield of rice and yield of rice fallow blackgram. Significantly superior performance of rice was observed for all these parameters with sunhemp (T_2), while greengram (T_3) was the next best treatment. The seed yield of rice fallow blackgram was significantly superior with sunhemp (T_2), while the lowest with fallow (T_1). Although highest net returns ha^{-1} and system productivity was recorded with bhendi-rice-rice fallow blackgram (T_7), the returns per rupee invested were highest with sunhemp-rice-rice fallow blackgram (T_2).

Key words : Crop residues, *Kharif* rice, Pre *kharif* crops, R*abi* rice fallow blackgram, System productivity

In North Coastal Districts, summer showers generally start from the beginning of May and fair amount of rainfall occurs during May to August. As rice transplanting extends till the end of August leaving around 80-90 days period, which is sufficient to take up a short duration crop preceding to rice. There were sporadic events of taking successful pre *kharif* crop with the local farming community. *Kharif* rice is followed by rice fallow blackgram during *rabi*. Research work done elsewhere in India has shown encouraging results of improved productivity by accommodating a short duration crop preceding to *kharif* rice (Radha Kumari and Srinivasulu Reddy, 2010). In the light of the prospective situation, a field trial to identify suitable pre *kharif* crop and its effect on succeeding *kharif* rice, *rabi* rice fallow blackgram and on system productivity was studied .

MATERIAL AND METHODS

A field experiment was conducted during pre *kharif, kharif* and *rabi* 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}). The experiment was laid out in randomized black design with four replications and seven cropping systems *viz*., fallow-rice-rice fallow blackgram (T_1), sunhemp-rice-rice fallow blackgram (T_2), greengram-rice-rice fallow blackgram (T_3), blackgram-rice-rice fallow blackgram (T_4), sesame-rice-rice fallow blackgram (T_5), clusterbean-rice-rice fallow blackgram (T_6) and bhendi-rice-rice fallow blackgram (T_7).

The data on crop residues and greengram equivalent yield of pre *kharif* crops, yield attributes and yield of rice and yield of rice fallow blackgram were recorded and subjected to statistical analysis as per Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Seed yield was recorded in all the pre *kharif* crops with the exception of sunhemp, in which only green matter was obtained. As the economic yield of each of the pre *kharif* crop was different, it was beyond the statistical scope for uniform comparison. Hence, the economic yield of all pre *kharif* crops were converted into greengram equivalent yield (GEY) and compared statistically.

Greengram equivalent yield was the highest with pre *kharif* crop bhendi (T_7) followed

by blackgram (T_4) and both of them were significantly superior to all the other pre *kharif* crops tested. GEY of greengram (T_3) and sesame (T_5) were comparable. GEY of clusterbean (T_6) was the lowest. The equivalent yield was reduced in clusterbean by 94.09 per cent and by 84.16 per cent as compared to bhendi and blackgram respectively.

Due to frequent rains and dry humid conditions yellow vein mosaic disease incidence was mainly observed in bhendi and greengram which resulted their moderate yield performance. Clusterbean has not performed well particularly in this location as pre *kharif* crop, as it not only failed to produce considerable dry matter/biomass but also the economic yield indicating its non suitability to this region. During the growing period high temperatures coupled with rainfall favoured more vegetative growth while the pod/capsule formation was low in all the pre *kharif* crops. Similar findings were observed by Rahman *et al*. (2012) and Narayana Reddy and Surekha (2000).

The highest quantity of crop residue was produced by sunhemp (T_2) which was significantly superior to any of the pre *kharif* crops taken for the study. It was followed by greengram (T_3) which also produced highest crop residue than all the pre *kharif* crops except sunhemp. Crop residues of blackgram (T_4), bhendi (T_7) and sesame (T-$_5$) were comparable with each other. Crop residue with Clusterbean (T_6) was in lowest quantity and hence was inferior to all other crops in the treatments. With the advent of monsoon showers, sunhemp, greengram and blackgram has produced larger quantities of above ground biomass. Least crop residue of clusterbean could be attributed to the continuous rains received during the crop growth period leading to heavy leaf loss and thereby the lower shoot growth. The production of variable amounts of biomass by pre *kharif* crops could be attributed to the genetic characteristics of species and their fitness to particular agro-climatic conditions as reported by Zahir Shah *et al*. (2011).

Number of panicles m^{-2} of rice at harvest and number of filled grains $panicle^{-1}$ increased with sunhemp (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) than all the preceding crops. Significantly highest thousand grain weight of rice was found with sunhemp (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 sunhemp 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. Sesame and clusterbean has performed inferior to other preceding crops due to lower availability of nutrients to succeeding crop of rice. Sunhemp 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), Hemalatha *et al*. (2000) and Menon *et al*. (1999).

Grain and straw yield of *kharif* rice was significantly influenced by different pre *kharif* crops. The highest grain yield of rice was realized with sunhemp (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 sunhemp and produced statistically similar yields. Greengram (T_3), blackgram (T_4) and bhendi (T_7) recorded significantly higher yields than clusterbean (T_6) and fallow (T_1). Comparable grain and straw yield was obtained with sesame (T_5) and clusterbean (T_6). The increase in grain and straw yield with sunhemp could also be due to the enrichment of soil fertility through profused nodulation. Among the other pre *kharif* crops tested, greengram produced

Table 1. Seed yield, greengram equivalent yield (kg ha^{-1}) and crop residues (t ha^{-1}) on fresh weight basis at harvest of pre *kharif* crops in rice based cropping system.

Treatments	Seed yield (kg ha^{-1})	Greengram equivalent yield (kg ha^{-1})	Crop residues on fresh weight basis (t ha^{-1})
T_1: Fallow	-	-	-
T_2: Sunhemp	-	-	30.11
T_3: Greengram	217	217	10.48
T_4: Blackgram	385	341	5.94
T_5: Sesame	139	205	3.79
T_6: Clusterbean	93	54	1.16
T_7: Bhendi	1743	915	4.73
S.Em ±	-	27.46	0.85
CD (P=0.05)	-	85	2.55

Table 2. Yield attributes and yield of *kharif* rice as influenced by pre *kharif* crops in rice based cropping system

Treatments	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-rice fallow blackgram	204	100	21.95	4125	5899
T_2: Sunhemp-rice-rice fallow blackgram	265	128	24.33	6501	8505
T_3: Greengram-rice-rice fallow blackgram	247	119	23.48	5789	7592
T_4: Blackgram-rice-rice fallow blackgram	243	118	23.33	5605	7522
T_5: Sesame-rice-rice fallow blackgram	232	114	22.98	5310	7257
T_6: Clusterbean-rice-rice fallow blackgram	223	109	22.78	4825	6627
T_7: Bhendi-rice-rice fallow blackgram	242	119	23.05	5512	7485
S.Em ±	5.59	2.56	0.27	177.24	217.81
CD (P=0.05)	17	8	0.79	527	647

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 sunhemp. 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), Narayana Reddy and Surekha (2000), Menon *et al*. (1999),

Seed and haulm yield of rice fallow blackgram varied significantly with different pre *kharif* crops. The highest seed and haulm yield of rice fallow blackgram was recorded with sunhemp (T_2) which was significantly superior to other pre *kharif* treatments including fallow. Yields of rice

Table 3. Seed and haulm yield (kg ha^{-1}) of *rabi* rice fallow blackgram, rice equivalent yield (kg ha^{-1}), net returns (Rs ha^{-1}) and benefit cost ratio of the cropping system as influenced by pre *kharif* crops in rice based cropping system.

Treatments	Seed yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	System productivity (kg REY ha^{-1})	Net returns of the cropping system (Rs ha^{-1})	B:C ratio of the cropping system
T_1 : Fallow-rice-rice fallow blackgram	225	462	4765	32434	1.97
T_2: Sunhemp-rice-rice fallow blackgram	382	743	7586	62758	2.52
T_3 : Greengram-rice-rice fallow blackgram	342	667	7455	49145	2.16
T_4 : Blackgram-rice-rice fallow blackgram	329	643	7633	57075	2.23
T_5 : Sesame-rice-rice fallow blackgram	278	551	6757	42646	2.11
T_6: Clusterbean-rice-rice fallow blackgram	263	538	5742	19973	1.34
T_7 : Bhendi-rice-rice fallow blackgram	291	569	9265	73238	2.45
S.Em $\pm$	11.92	24.18	225.70	3004.92	0.06
CD (P=0.05)	35	72	671	8928	0.19

fallow blackgram with greengram (T_3) and blackgram (T_4) were comparable between them, which was however, significantly higher to bhendi (T_7), sesame (T_5), clusterbean (T_6) and fallow (T_1). Bhendi (T_7), sesame (T_5) and clusterbean (T_6) recorded comparable yields of rice fallow blackgram. Lowest seed and haulm yield of rice fallow blackgram was registered with fallow (T_1). This might be due to higher biomass production and prolonged availability of nutrients to rice as well as rice fallow blackgram with sunhemp, greengram and blackgram. Influence on the economic yield of second succeeding crop due to pre *kharif* cropping was also reported by Ali *et al*. (2012), Radha Kumari and Srinivasulu Reddy (2010) and Narayana Reddy and Surekha (2000).

Bhendi-rice-rice fallow blackgram (T_7) system produced the highest rice equivalent yield (REY) which was significantly superior to all the other cropping systems tested. REY of blackgram-rice-rice fallow blackgram (T_4), sunhemp-rice-rice fallow blackgram (T_2) and greengram-rice-rice fallow blackgram (T_3) cropping system was comparable with each other and significantly superior to sesame-rice-rice fallow blackgram (T_5), clusterbean-rice-rice fallow blackgram (T_6) and fallow-rice-rice fallow blackgram (T_1). Sesame-rice-rice fallow blackgram (T_5), clusterbean-rice-rice fallow blackgram (T_6) and fallow-rice-rice fallow blackgram (T_1) were in disparity with each other. The lowest REY was registered with fallow-rice-rice fallow blackgram (T_1) which was significantly inferior to all other cropping systems. The highest REY of T_7 was because of increased yield of bhendi and high price of the produce. REY of different cropping systems were different due to differences in the yield of all the component crops in the cropping system. These findings were in close conformity with those of Jat *et al*. (2012) and Roy *et al*. (2011).

Based on the above findings, it was concluded that raising sunhemp/bhendi was most suitable as pre *kharif* crop preceding to *kharif* rice. Bhendi-rice-rice fallow blackgram was the highest for system productivity only. Hence, sunhemp-rice-rice fallow blackgram was found to be the best as it improved the performance of *kharif* rice as well as rice fallow blackgram and also recorded highest returns per rupee invested. Hence, for sustainability of rice based cropping system, sunhemp-rice-rice fallow blackgram was suggested for North Coastal Zone of Andhra Pradesh.

LITERATURE CITED

Ali R I, Awan T H, Ahmad M, Saleem M U and Akhtar M 2012 Diversification of rice-based cropping systems to improve soil fertility, sustainable productivity and economics. *The Journal of Animal and Plant Sciences*, 22(1): 108-112.

Hemalatha M, Thirumurugan V and Balasubramanian R 2000 Effect of organic sources of nitrogen on productivity, quality of rice (*Oryza sativa*) and soil fertility in single crop wetlands. *Indian Journal of Agronomy,* 45(3): 564-567.

Jat R A, Dungrani R A, Arvadia M K and Sahrawat K L 2012 Diversification of rice (*Oryza sativa* L.) based cropping systems for higher productivity, resource-use efficiency and economic returns in South Gujarat of India. *Archives of Agronomy and Soil Science*, 58(6): 561-572.

Menon M V, Achuthan Nair M and Potty N N 1999 Effect of preceding fodder crops and fallow on productivity mechanics in first crop season rice. *Journal of Tropical Agriculture*, 37: 85-86.

Narayana Reddy M and Surekha K 2000 Improving productivity of rice based cropping systems through pre-*kharif* sole/ dual purpose legume green manures in a vertisol. *Oryza*, 37(3): 213-217.

Panse U G and Sukhatme P V 1985 Statistical methods for agricultural workers. Indian Council of Agricultural Research, New Delhi, pp: 100-174.

Porpavai S, Palchamy A, Ramachandra Boopathi S N M and Jayapanl P 2006 Effect of integrated nutrient management on yield of rice (*Oryza sativa*) and soil fertility. *Indian Journal of Agricultural Research*, 40(3): 216-219.

Radha Kumari, C and Srinivasulu Reddy D 2009 Performance of rice under crop residue incorporation and different nitrogen management practices. *Madras Agricultural Journal*, 96(7-12): 365-369.

Radha Kumari C and Srinivasulu Reddy D 2010 Residue management and N dynamics in legume-rice (*Oryza sativa*)-groundnut (*Arachis hypogaea*) cropping system for sustainable crop production. *Journal of Oilseeds Research,* 27(2): 130-135.

Rahman M H, Islam M R, Jahiruddin M and Haque M Q 2012 Management of organic manure and inorganic fertilizer in the maize-mungbean/dhaincha-T.aman rice cropping pattern for increased crop production. *Bangladesh Journal of Agricultural Research*, 37(2): 225-234.

Roy D K, Rakesh Kumar and Anjani Kumar 2011 Production potentiality and sustainability of rice-based cropping sequences in flood prone lowlands of North Bihar. *Oryza,* 48(1): 47-51.

Zahir Shah, Rashid Ahmad S, Hidayat Ur Rahman, Latif A and Shah A 2011 Rice and wheat yields in relation to biomass of green manure legumes. *Sarhad Journal of Agricultural,* 27(1): 73-84.

(Received on 24.06.2013 and revised on 19.04.2015)