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Production Potential and Economics of Aerobic Rice-based Cropping Systems in Southern Agroclimatic Zone of Andhra Pradesh

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ABSTRACT

Field experiments were conducted during Kharif and rabi seasons 2011-12 and 2012-13 at the dry land farm of S.V.Agricultural college, Tirupati to study about the nutrient management in aerobic rice - based cropping systems. The significantly higher rice equivalent yield was with sunhemp-rice-groundnut cropping system during both the years of study. The residual effect of different graded nutrient levels to *kharif* aerobic rice on *rabi* crops shown that rice equivalent yield was highest with 175% recommended dose of nutrients (140-70-70 N, P_2O_5 and K_2O kgha^{-1}), but it was comparable with 150% recommended dose of nutrients (120-60-60 N, P_2O_5 and K_2O kg ha^{-1}). Among all the cropping systems, sunhemp-rice-groundnut recorded the highest gross returns, net returns and benefit cost ratio under the influence of 175% recommended dose of nutrients applied to *kharif* rice, but it was on par with 150% recommended dose of nutrients.

Key words : Aerobic rice, Cropping system, Graded nutrient levels.

Aerobic rice is the rice grown on non puddled and non flooded soil, just like upland rice, but with higher inputs such as supplementary irrigation and fertilizers. The influence of cropping system on the dynamics of soil fertility cannot be appraised with precisely because of the contribution of native soil fertility, residual effect of previous crop and variations in nutrient management of the crops in the cropping system. Information on the residual effect of green manure crop on succeeding crop of aerobic rice and influence of preceding aerobic rice on the succeeding rabi crops in a cropping system with reference to productivity is lacking.

Identifying a suitable cropping system involving aerobic rice as principle component crop and developing a sound and viable nutrient management for aerobic rice based croppig system under sandyloam soils of Southern Agro – Climatic Zone of Andhra Pradesh is need of home. Keeping these points in view, the present study was takenup.

MATERIAL AND METHODS

A field experiment was conducted during *kharif* and rabi seasons of 2011-12 and 2012 -13 at S.V. Agricultural college, Tirupati. The first season (*summer*) crop was laid out in a randomized block design without any treatments comprising of sunhemp as a preceding bulk crop to aerobic rice. After weighed for green matter the crop residue was incorporated in- situ. In the second season (*kharif*), aerobic rice was raised in the same undisturbed lay out replicated four times with five graded nutrient levels (N_1 - 75% recommended dose of nutrients, N_2 - 100% recommended dose of nutrients, N_3 - 125% recommended dose of nutrients, N_4 -150% recommended dose of nutrients and N_5 - 175% recommended dose of nutrients). The 100% recommended dose of nutrients was 80-40-40 N, P_2O_5 and K_2O kg ha^{-1}. In the third season (*rabi*), each of the *kharif* treatments were sub divided into three plots in the same undisturbed layout to accommodate groundnut, maize and sunflower. The graded nutrient levels to *kharif* rice were considered as main plot treatments where as *rabi* crops as sub - plot treatments. Recommended dose of nutrients for the respective crops were applied during *rabi* season.

The soil was sandy clay loam in texture with pH 7.5, low in organic carbon 0.36 % and available nitrogen 165.4 kg ha-1, medium in available phosphorus 17.4 kg ha-1 and potassium 235.4 kg ha-1. Five graded levels of nutrients (75%, 100%, 125%, 150% and 175% of recommended dose of nutrients) were applied as per the prescribed treatments. Entire quantities of P_2O_5 and K_2O were applied basally at the time of sowing while nitrogen was applied in three equal splits at sowing, tillering and panicle initiation stages to *kharif* aerobic rice.

The sources of N, P_2O_5 and K_2O were urea, single super phosphate and muriate of potash, respectively. The varieities of different crops used were: rice (NLR-33359), groundnut (Narayani), maize (DHM-117) and sunflower (sunbred-275). As the green manure crop was incorporated into the soil, hence its economic value not taken into consideration. The actual yields of different *rabi* crops from the individual cropping system were converted into rice grain equivalents on the basis of the prevailing market price by using the following formula.

The data recorded on various parameters of crop was subjected to statistical scrutiny by the method of analysis of variance.

Rice equivalentyield (kg ha^{-1}) = Economicyield of crop (kg ha^{-1}) x Price of unit yield (Rs kg^{-1}) / Price of rice (Rs kg^{-1})

RESULTS AND DISCUSSION

Rice equivalent economic yield

The economic yield of *rabi* crops converted into rice equivalent economic yield was significantly influenced by the residual effect of different graded nutrient levels to *kharif* aerobic rice during both the years of study with similar trend (Table 1).

The residual effect of nutrients supplied to *kharif* rice through N_5 (175 per cent recommended dose of nutrients), resulted in the highest rice equivalent economic yield, which was however at par with N_4 (150 per cent recommended dose of nutrients). These might be due to higher N, P_2O_5 and K_2O availability and eventually increased rice equivalent economic yield. The lowest rice equivalent economic yield was noticed with N_1 (75 per cent recommended dose of nutrients). These results corroborate with findings of Patra *et al.*(2000) and Jahangir *et al.*(2006).

Rabi crops significantly differed among them with producing economic yield during both the years of study. Groundnut registered the highest rice equivalent economic yield, which was significantly superior to maize and sunflower. Higher prices for groundnut in the market besides having good productivity contribute to the highest rice equivalent economic yield. Lower sale price of sunflower registered minimum rice equivalent economic yield. These findings are in accordance with those of Setty and Gowda (1997), Bastia *et al.* (2008) and Dharam Singh *et al.* (2013).

Marked interaction effect was noticed between *kharif* treatments and *rabi* crops during both the years of study with similar trend. The highest rice equivalent economic yield was observed with groundnut under N_5 (175 per cent recommended dose of nutrients). The lowest rice equivalent economic yield was recorded with sunflower under N_1 (75 per cent recommended dose of nutrients) to *kharif* aerobic rice.

Irrespective of the different graded nutrient levels to *kharif* rice, rice equivalent economic yield of groundnut was significantly superior to the other two crops under the residual effect of N_5 (175 per cent recommended dose of nutrients), which was distinctly superior to other nutrient levels, regardless of the *rabi* crops during both the year of study.

Economics

The residual effect of graded nutrients supplied to *kharif* rice through N_5 (175% recommended dose of nutrients) recorded the highest gross returns, net returns and benefit cost ratio, which was statistically on par with N_4 (150 per cent recommended dose). Gross returns, net returns and benefit cost ratio of *rabi* crops recorded due to the residual effect of N_1 (75% recommended dose of nutrients) to *kharif* rice was the lowest during both the years of study (Table 2 to 4).

Groundnut as a *rabi* crop realized the highest gross and net returns. The highest benefit cost ratio was also realized with groundnut, but on par with maize, while sunflower realized the lowest gross returns, net returns and least benefit cost ratio during both the years of investigation. This was due to higher gross returns with less cost of cultivation of groundnut These results corroborate with the findings of Parihar *et al.* (1999) and Kumar *et al.* (2005).

Table 1. Rice equivalent economic yield (kg ha^{-1}) of different rabi crops as influenced by graded nutrient levels to preceding aerobic rice.

Treatments to *kharif* rice	*Rabi*, 2012				*Rabi*, 2013			
	Groundnut (C_1)	Maize (C_2)	Sunflower (C_3)	Mean	Groundnut (C_1)	Maize (C_2)	Sunflower (C_3)	Mean
N_1 – 75% RDN	3507	2712	1930	2716	3792	3069	2109	2990
N_2 – 100% RDN	4854	3945	2554	3784	5107	4121	2767	3998
N_3 – 125% RDN	5846	4829	3202	4626	6134	4966	3411	4837
N_4 – 150% RDN	6640	5567	3832	5346	6883	5748	4061	5564
N_5 – 175% RDN	6880	5652	3924	5485	7120	5830	4178	5709
Mean	5545	4541	3088		5807	4747	3305	

	SEm±	CD (P=0.05)		SEm±	CD (P=0.05)
N	95	310	N	98	320
C	109	322	C	132	390
C at N	216	652	C at N	221	667
N at C	205	619	N at C	210	635

Table 2.Gross returns (Rs ha^{-1}) of different rabi crops as influenced by graded nutrient levels to preceding aerobic rice.

Treatments to *kharif* rice	*Rabi*, 2012				*Rabi*, 2013			
	Groundnut (C_1)	Maize (C_2)	Sunflower (C_3)	Mean	Groundnut (C_1)	Maize (C_2)	Sunflower (C_3)	Mean
N_1 – 75% RDN	43840	34450	24136	34142	47400	38363	26376	37379
N_2 – 100% RDN	60680	49309	32340	47443	63840	51519	34692	50017
N_3 – 125% RDN	73080	60359	40880	58106	76680	62075	42840	60532
N_4 – 150% RDN	82900	69489	47808	66732	86040	71851	50764	69551
N_5 – 175% RDN	83700	70155	48906	67587	89000	72878	52220	71366
Mean	68840	56752	38814		72592	59337	41378	

	SEm±	CD (P=0.05)		SEm±	CD (P=0.05)
N	559	1825	N	627	2047
C	652	1928	C	715	2112
C at N	1275	3850	C at N	1400	4225
N at C	1210	3652	N at C	1358	4100

Groundnut raised under the residual influence of N_5 (175% recommended dose of nutrients) to *kharif* rice, realized the highest gross returns, net returns and benefit cost ratio while lowest gross returns, net returns and benefit cost ratio were reported with sunflower raised under N_1 (75% recommended dose of nutrients) to *kharif* rice during both the years of study.

Based on the outcome of the investigation, it could be inferred that raising a reasonably short duration sunhemp as a preceding crop to aerobic rice and supply of 150% recommended dose of nutrients (120-60-60 N, P_2O_5 and K_2O kg ha^{-1}) to aerobic rice fallowed by raising groundnut as residual crop to resulted in higher productivity and economic returns.

Table 3. Net returns (Rs ha^{-1}) different of rabi crops as influenced by graded nutrient levels to preceding aerobic rice.

Treatments to *kharif* rice	*Rabi*, 2012				*Rabi*, 2013			
	Groundnut (C_1)	Maize (C_2)	Sunflower (C_3)	Mean	Groundnut (C_1)	Maize (C_2)	Sunflower (C_3)	Mean
N_1 – 75% RDN	23951	17940	7101	16331	27511	21853	9341	19568
N_2 – 100% RDN	40791	32799	15305	29632	43951	35009	17657	32205
N_3 – 125% RDN	53191	43849	23845	40295	56791	45565	25805	42720
N_4 – 150% RDN	63011	52979	30773	48921	66151	55341	33729	51740
N_5 – 175% RDN	64361	53645	31871	49959	69111	56368	35185	53554
Mean	49061	40242	21779		52703	42827	24343	

	SEm±	CD (P=0.05)		SEm±	CD (P=0.05)
N	559	1825	N	627	2047
C	652	1928	C	715	2112
C at N	1275	3850	C at N	1400	4225
N at C	1210	3652	N at C	1358	4100

Table 4. Benefit cost ratio of different rabi crops as influenced by graded nutrient levels to preceding aerobic rice.

Treatments to *kharif* rice	*Rabi*, 2012				*Rabi*, 2013			
	Groundnut (C_1)	Maize (C_2)	Sunflower (C_3)	Mean	Groundnut (C_1)	Maize (C_2)	Sunflower (C_3)	Mean
N_1 – 75% RDN	2.20	2.08	1.42	1.90	2.38	2.32	1.55	2.08
N_2 – 100% RDN	3.05	2.98	1.89	2.64	3.21	3.12	2.03	2.79
N_3 – 125% RDN	3.67	3.65	2.39	3.24	3.85	3.76	2.51	3.38
N_4 – 150% RDN	4.17	4.20	2.80	3.72	4.31	4.35	2.98	3.88
N_5 – 175% RDN	4.20	4.24	2.87	3.77	4.47	4.41	3.06	3.98
Mean	3.46	3.43	2.27		3.65	3.59	2.42	

	SEm±	CD (P=0.05)		SEm±	CD (P=0.05)
N	0.077	0.18	N	0.070	0.23
C	0.084	0.25	C	0.108	0.32
C at N	0.168	0.51	C at N	0.215	0.65
N at C	0.125	0.38	N at C	0.152	0.46

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