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Performance of different Bi-intensive Need Based Cropping Systems under Irrigated Condition

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Abstract

A field experiment conducted at Kuthulia farm, College of Agriculture, Rewa under All India Coordinated Research Project on Integrated Farming System during 2010-11 to 2013-14. The study reveals that grain yield of rice was maximum 50.55 q per ha in rice-berseem followed by 48.73 q per ha in rice-pea-wheat and 48.27 q per ha in rice-lentil-green manure cropping system. These cropping systems gave 16.39 per cent to 21.89 per cent higher grain yield of rice as compared to existing rice-wheat cropping system. The rice equivalent yield was maximum in rice-garlic (186.93 q per ha) followed by rice-toria-onion (173.98 q per ha). The net profit of Rs. 1,47,580/- per ha with benefit cost ratio 3.65 was maximum in rice-berseem followed by Rs. 1,38,989/- per ha in rice-garlic cropping system. Benefit cost ratio 3.65 was maximum in rice-berseem and 3.33 in rice-green pea-wheat cropping system. These cropping systems were found to be more remunerative than existing rice-wheat and rice-chickpea cropping system in Rewa region of Madhya Pradesh under irrigated condition.

Rice is an important crop in Rewa region of Madhya Pradesh which occupy an area of 5.83 lakh ha. The average productivity of rice in Rewa region is 1237 kg per ha, which is less than state average. Rice-wheat, rice-chickpea and rice-lentil are the major cropping systems which are widely adopted by the farmers due to stable production and less labour requirement (Kumar *et al*, 2001). But, continuous adoption of these cropping systems have lead to the problem of specific weeds, reduced soil fertility in root zone, development of soil sickness and infestation of similar kind of pest and diseases which ultimately resulted in decline in the efficiency and productivity of this cropping system (Katyal, 2003 and Kumar and Yadav, 2005).

Development of soil sickness for rice and wheat crop has also been observed due to continuous cropping system (Kharub *et al*, 2003). The soil productivity is declining day by day because both crops are exhaustive (Choudhary and Singh Yogeshwar, 2007).The rice-wheat cropping system needs diversification particularly in *rabi* season with need based high value crops like chickpea, onion, mustard, berseem, potato, garlic, pea and other crops to different group of farmers which are most compatible, remunerative and stable in rice based cropping sequence. The rice followed legume crop sequence have the ability to improve soil fertility by fixing atmospheric nitrogen. Cultivation of berseem after early duration rice has been found more remunerative than wheat after rice in rice based cropping sequence (Upadhyay *et al*, 2007).

Rice is predominant crop in Rewa region of Madhya Pradesh and it is difficult to replace rice by any other crop in *rainy* season due to soil and climatic conditions. Hence, only option left is to replace the wheat and chickpea in winter season for double and multiple cropping systems in Rewa region which have not been studied.

Material and Methods

The present field experiment was conduct during 2010-11 to 2013-14 at JNKVV farm Kuthulia, Rewa (M.P.) under All India Coordinated Research Project on farming system. The soil of experimental field was silty clay loam in texture, neutral in reaction (pH 7.25), medium in organic carbon (0.56%) and low in available nitrogen (224 kg per ha) and phosphorus (8.2 kg per ha) and high in potash (315 kg per ha). Ten cropping systems (rice-wheat, rice-chickpea, rice-berseem, rice-potato-wheat, rice-garlic, rice-tori-onion, rice-lentil-green manure, rice-pea-wheat, rice-chickpea + linseed and rice-mustard-green manure) were laid out in randomized complete block design

with four replications. The rice variety Danteshwari was transplanted at the spacing of 20 cm × 15 cm. Fertilizer dose was kept 120 kg N per ha, 60 kg P_2O_5 per ha, 40 kg K_2O per ha for rice under all the treatments. All the recommended package of practices for different *rabi* crops were adopted for irrigated condition of Rewa region of Madhya Pradesh.

Results and Discussion

Performance of rice : Grain yield of rice under different cropping systems is presented in Table I. It is evident from the results that grain yield of rice was maximum 50.55 q per ha in rice-berseem followed by 48.73 q per ha in rice-pea-wheat and 48.27 q per ha in rice-lentil-green manure cropping systems. These cropping systems gave 16.39 per cent to 21.89 per cent higher grain yield of rice as compared to rice grown after wheat. It may be due to increase in residual soil organic carbon by 17.85 per cent, available nitrogen 12.05 per cent and available phosphorus by 12 per cent as compared to initial status. Increase in soil fertility in soil resulted in higher growth and yield contributing characters of rice which enhanced the grain yield of rice in rice-berseem, rice-pea-wheat and rice-lentil-green manure cropping system. Upadhyay *et al*, (2007) have also reported the similar finding from Jabalpur. The present experiment was started in the year 2006-07 therefore the crops like berseem, lentil, pea-wheat have good residual effect on succeeding rice by which rice yield was increased by 16.89 per cent to 21.89 per cent over existing rice-wheat cropping system. The grain yield of rice was found at par to existing rice-wheat cropping system in rice-chickpea, rice-potato-wheat, rice-garlic, rice-toria-onion, rice-chickpea + linseed and rice- mustard-green manure cropping systems.

Table I

Economical yield of crops under different cropping systems

Sl. No.	Treatments	*Kharif* Rice yield q per ha			Mean	Yield of *rabi* crops q per ha			Mean	
		2011-12	2012-13	2013-14		2011-12	2012-13	2013-14		
T_1	Rice-Wheat (GW273)	40.07	45.85	38.49	41.47	64.35	50.47	49.34	54.72	
T_2	Rice-Chickpea (JG 322)	42.67	49.33	39.28	43.76	20.52	17.32	4.49	14.11	
T_3	Rice-Berseem (F)/S	46.93	55.76	48.98	50.55	857.85	738.27	656.29	749.8	F
						5.37	3.74	2.55	3.88	(S)
T_4	Rice-Potato-Wheat (HD 2864)	42.83	50.63	42.95	45.47	115.62	116.41	95.59	109.20	PT
						49.05	44.78	35.84	43.22	(W)
T_5	Rice-Garlic	41.09	41.8	4358	42.15	65.07	70.35	76.66	70.69	
T_6	Rice-Toria-Onion	42.35	49.52	44.5	45.45	6.6	7.25	14.19	9.34	T
						288.52	259.32	53.44	200.42	(O)
T_7	Rice-Lentil-Green mannuring	43.46	53.32	48.04	48.27	15.61	12.62	4.73	10.98	L
						87.39	150.8	91.49	109.89	GM
T_8	Rice-Green Pea-Wheat (HD 2864)	44.45	53.48	48.27	48.73	37.14	35.57	34.89	35.86	P
						58.44	45.9	37.54	47.29	W
T_9	Rice-Chickpea + linseed (3:1)	45.43	47.01	42.51	44.98	16.55	11.04	2.08	9.89	G
						7.01	8.36	8.51	7.96	Ln
T_{10}	Rice-Mustard-Green mannuring	45.67	45.43	47.23	46.11	12.93	27.76	18.04	19.57	M
						95.43	153.09	88.34	112.28	GM
SEm±		1.42	2.26	1.86	1.84	-	-	-	-	
CD at 5%		4.10	6.58	5.40	5.36	-	-	-	-	

F = Fodder (berseem), S = Berseem seed ,G = Gram ,L = Lentil, Ln = Linseed, PT= Potato tuber, W = Wheat, GM = Green manure, P = Pea pod, M = Mustard, T = Toria and O = Onion bulb.

Rice equivalent yield under different cropping system : The rice equivalent yield under different cropping systems is presented in Table II reveals that, rice-garlic cropping system gave 186.93 q per ha of rice equivalent yield followed by rice-toria-onion 173.98 q per ha which were significantly superior to rest of the cropping systems. Other cropping systems like rice-potato-wheat, rice-berseem and rice-green pea-wheat were found superior than existing rice-wheat system. These cropping systems gave 39.88 per cent to 51.54 per cent higher rice equivalent yield as compared to existing rice-wheat cropping system. It may be due to higher productivity of these crops having higher market rate as compared to rice-wheat cropping system. Similar findings were also reported by Sharma *et al*, (2004) and Upadhyay *et al,* (2007). The cropping systems rice-chickpea, rice-lentil-green manure, rice-chickpea + linseed and rice-mustard-green manure were found inferior than rice-wheat system. It may be due to lower productivity of gram, linseed and lentil as compared to wheat by which these systems were not found much remunerative than rice-wheat existing system. The present results were in conformity with Tarwariya (2012) who has also reported the similar findings.

Economics : The net profit and benefit cost ratio of different cropping systems is presented in Table II which reveals that, net profit of Rs. 147580 per ha with B:C ratio 3.65 was maximum in rice-berseem followed by Rs. 138989 per ha in rice-garlic. These cropping systems were found more remunerative than all other cropping systems. The cropping system rice-chickpea, rice-lentil, rice-chickpea + linseed were found less remunerative than existing rice-wheat cropping system. The benefit cost ratio 3.65 was maximum in rice-berseem followed by 3.33 in rice-green pea-wheat cropping system. Rice-chickpea, rice-potato-wheat, rice-toria-onion and rice-lentil recorded less benefit cost ratio as compared to existing rice-wheat cropping system. These finding are in conformity with the findings of Dubey (2010).

TABLE II

Rice Equivalent Yield (q per ha), Net profit (Rs per ha) and benefit cost ratio under different cropping systems.

Sl. No.	Treatments	Rice equivalent yield q per ha			Mean	Net profit Rs per ha	B:C ratio
		2011-12	2012-13	2013-14			
T_1	Rice-Wheat (GW273)	117.29	99.87	93.29	103.48	87247	2.64
T_2	Rice-Chickpea (JG 322)	995	90.3	49.11	79.63	62076	2.37
T_3	Rice-Berseem (F)/S	159.98	135.18	165.79	153.62	147580	3.65
T_4	Rice-Potato-Wheat (HD 2864)	165.41	151.55	153.5	156.82	115019	2.25
T_5	Rice-Garlic	219.84	155.77	185.2	186.93	138989	2.48
T_6	Rice-Toria-Onion	220.6	180.82	120.29	173.9	121504	2.27
T_7	Rice-Lentil-Green mannuring	92.47	84.99	72.19	83.21	53269	1.95
T_8	Rice-Green Pea-Wheat (HD 2864)	148.72	143.9	141.63	144.75	134869	3.33
T_9	Rice-Chickpea + linseed (3:1)	112.05	91.96	69.26	91.09	74082	2.67
T_{10}	Rice-Mustard-Green mannuring	83.39	111.23	106.97	100.53	89910	2.98
SEm±6.50		3.30	4.14	4.64	-	-	
CD at 5%		18.39	9.58	12.03	13.33	-	-

TABLE III

Changes in chemical properties of soil after completion of 8 years of different cropping systems

Sl. No.	Treatments	Soil pH	Soil EC Mmhos per cm	OC %	Available N kg per ha	Available P_2O_5 kg per ha	Available K_2O kg per ha
T_1	Rice-Wheat (GW273)	7.32	0.55	0.63 (12.5%)	236 (5.35%)	8.96 (9.26%)	293 (-6.98%)
T_2	Rice-Chickpea (JG 322)	7.19	0.45	0.65 (16.07%)	248 (10.71%)	9.28 (13.17%)	280 (-11.11%)
T_3	Rice-Berseem (F)/S	7.25	0.47	0.66 (17.85%)	251 (12.05%)	9.17 (11.82%)	296 (-6.03%)
T_4	Rice-Potato-Wheat (HD 2864)	7.23	0.48	0.65 (16.07%)	231 (3.12%)	8.91 (8.65%)	294 (-6.66%)
T_5	Rice-Garlic	7.24	0.55	0.66 (17.85%)	231 (3.12%)	8.79 (7.19%)	295 (-6.34%)
T_6	Rice-Toria-Onion	7.22	0.45	0.64 (14.28%)	241 (7.58%)	9.20 (12.19%)	295 (-6.34%)
T_7	Rice-Lentil-Green mannuring	7.37	0.47	0.66 (17.85%)	253 (12.94%)	8.96 (9.26%)	294 (-6.66%)
T_8	Rice-Green Pea-Wheat (HD 2864)	7.33	0.48	0.65 (16.07%)	239 (6.69%)	9.07 (10.60%)	284 (-9.84%)
T_9	Rice-Chickpea + linseed (3:1)	7.35	0.47	0.64 (14.28%)	243 (8.48%)	8.87 (8.17%)	287 (-8.88%)
T_{10}	Rice-Mustard-Green mannuring	7.34	0.48	0.64 (14.28%)	237 (5.80%)	8.86 (8.04%)	275 (-12.69%)
initial value		7.25	0.46	0.56	224 kg	8.2 kg	315 kg

Effect of chemical properties of soil : After harvest of *rabi* crops the soil samples were collected and analysed for different chemical properties of soil which are presented in TableIII. After perusal of the result it is clear that soil pH and electrical conductivity of soil was unaffected as compared to initial status.

The organic carbon status was increased by 12.5 per cent to 17.85 per cent under different cropping system and maximum increase in organic carbon status was noted in rice-berseem, rice-garlic and rice-barley-green manure cropping system. Available nitrogen status was increased by 3.12 per cent to 12.94 per cent under different cropping systems and maximum available nitrogen was observed in rice-barley-green manure followed by rice-berseem cropping system. Available phosphorous status was increased by 7.19 per cent to 13.17 per cent under different cropping systems. Available phosphorus was maximum in rice-chickpea followed by rice-toria-onion cropping systems. Available potassium status after eight year of different cropping systems had decreased by 6.03 per cent to 12.69 per cent. The maximum decrease in available potassium was observed in rice-mustard-green manure followed by rice-chickpea cropping system. It may be due to heavy depletion of potassium from soil by different intensive cropping systems. Tarwariya and Maurya (2013) also reported the decrease in potassium status in soil due to adoption of intensive cropping.

From the above study, it is concluded that rice crop perform better in rice-berseem, rice-pea-wheat and rice-lentil-green manure cropping systems. Rice-garlic, rice-toria-onion and rice-berseem cropping systems are better than existing traditional rice-wheat and rice-gram cropping systems in Rewa region of Madhya Pradesh.

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