International Journal of Agricultural Sciences
Volume 9 | Issue 1| January, 2013 | 213-215

RESEARCH PAPER

Crop diversification and intensification of rice based cropping system under irrigated condition of Madhya Pradesh

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Abstract : A field experiment entitled crop diversification and intensification of rice based cropping systems under irrigated condition of Madhya Pradesh was taken at J.N. Krishi Vishwa Vidyalaya farm of Kuthulia College of Agriculture Rewa during 2010-11 and 2011-12. The study reveals that grain yield of rice increased by 17.12 per cent in rice-berseem, 13.97 per cent in rice-musturd, 13.37 per cent in rice-chickpea+linseed and 10.43 per cent in rice –green pea-wheat cropping system as compared to rice-wheat cropping system. The rice equivalent yield of different cropping system was increased by 36.39 per cent in rice-berseem, 41.02 per cent in rice-potato-wheat, 87.43 per cent in rice-garlic, 88.08 per cent rice-toria-onion and 26.79 per cent in rice–greenpea-wheat cropping system as compared to rice-wheat cropping system. The gross and net return was maximum in rice-toria-onion cropping system (Rs- 244896/ha and 152922/ha) followed by rice-garlic (Rs-244039/ha and 114601/ha) and rice-berseem (Rs- 195960/ha and 140830/ha) which were 26.5 per cent to 68.8 per cent higher than rice-wheat cropping system. The benefit : cost ratio was maximum 3.55 in rice-berseem followed by 3.17 in rice-greenpea-wheat and 3.07 in rice-chickpea +linseed inter cropping.

Key Words : Crop diversification, Rice based cropping system

View Point Article : Tarwariya, M.K. and Maurya, B.M. (2013). Crop diversification and intensification of rice based cropping system under irrigated condition of Madhya Pradesh. *Internat. J. agric. Sci.*, **9**(1): 213-215.

Article History : Received : 07.08.2012**; Revised :** 10.10.2012**; Accepted :** 29.11.2012

INTRODUCTION

Rice and wheat are the important crop of rice-wheat zone of Madhya Pradesh which occupy an area of 16.75 lakh and 43.0 lakh hectares, respectively. The average productivity of these crops are 11.94 q/ha and 20 q/ha, respectively which are low. It is due to use of local varieties, erratic and uneven distribution of rains as well as prolonged dry spells observed frequently.

Rice- wheat, rice-gram and rice lentil are the major cropping system in Rewa region of Madhya Pradesh. These cropping systems are widely adopted by the farmers due to stable production and less labour requirement (Kumar *et al.* , 2001). But continuous adoption of these cropping system has led to the problem of specific weeds, reduced soil fertility in specific root zone, development of soil sickness and infestation of similar kind of pest which ultimately resulted in decline the efficiency and productivity of system (Katyal, 2003 and Kumar and Yadav, 2005).Diversification of cropping system is necessary to get higher yield and net profits. Introduction of pulses and oil seed in the system are more beneficial than cereal-cereal sequence (Umarani *et al.*, 1992). In cropping system inclusion of pulse, oilseed and vegetable are more beneficial than cereals after cereals (Kumpawat, 2001 and Raskar and Bhoi, 2001). Rice is the predominate crop in Rewa region of Madhya Pradesh. It is difficult to replace the rice by any other crop in rainy season due to soil and climatic condition. Hence, only option left is to replace the wheat and gram crop in winter season for diversification of rice based cropping system. The multiple cropping system has not been adopted in Rewa region of Madhya Pradesh. Keeping above facts in view, present experiment has been taken.

MATERIALS AND METHODS

The present field experiment was taken under All India co-ordinated research project on farming system at Kuthulia farm of J.N. Krishi Vishwa Vidyalaya, Rewa (M.P.) during 2010-11 and 2011-12 in which ten cropping systems (rice-wheat,

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rice-gram, rice-berseem fooder+seed, rice-potato-wheat, rice-garlic, rice-toria-onion, rice-lentil, rice-green pea-wheat, rice-gram-linseed and rice-mustard) were tried. The rice variety was Danteshwari. The experimental design was RBD with four replications.

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/ha) and phosphorous (8.2 kg/ha) and high in available potash (315 kg/ha). The total rainfall was 1146.2 mm distributed in 46 rainy days in *Kharif* and 50.2mm in *Rabi*.

The rice crop was transplanted on 15/07/2011 at planting geometry of 20 cm x 15 cm in which two seedlings/hill were transplanted. The rice crop was harvested on 02/10/2011. The *Rabi* crops like toria, berseem, potato, garlic, greenpea and mustard crops were sown on 06/10/2011 while the wheat, lentil, gram+linseed and gram crops were sown on 08/11/2011. After harvest of toria, pea and potato on 23/12/2011 the onion and wheat crops were sown. The fertilizer doses for rice was 120 kg N, 60 kg P_2O_5 and 40 kg K_2O /ha. All the *Rabi* crops were fertillzed by recommended doses. The row to row spacing was 20 cm for wheat, 30 cm for gram, pea and mustard, 20 cm for garlic and onion, 60 cm for potato and 30 cm for lentil, pea, toria and gram+linseed while berseem crop was broadcasted. All the recommended package of practices were adopted for the irrigated condition in all the *Rabi* crops. The error variances for two years were found homogenous therefore, results have been presented on pooled basis.

RESULTS AND DISCUSSION

The experimental findings obtained from the present study have been discussed in following heads:

Effect on rice :

The Grain yield of rice under different cropping has been given in Tabel 1. It is evident from the result that grain yield of rice was maximum 46.93q/ha in rice-berseem followed by rice-mustard, rice-chickpea+linseed and rice-greenpea-wheat cropping system. These cropping system gave 13.37 per cent to 17.12 per cent higher grain yield as compared to rice-wheat cropping system. This experiment was started in the year 2006-07 therefore, these *Rabi* crops have good residual effect on succeeding rice by which rice yield was increased by 13.37 per cent in rice-chickpea +linseed, 13.97 per cent in rice-mustard, 10.43 per cent in rice-greenpea-wheat and 17.12 per cent in rice-berseem cropping system. Similar finding was also reported by Upadhyay *et al*. (2007).

Rice equivalent yield under different cropping system :

The rice equivalent yield is given in Table 1 reveals that the rice-toria-onion cropping system gave 220.60 q/ha and rice-garlic (219.84q/ha) of rice equivalent yield which were significantly superior to all the cropping system tried. The rice-berseem cropping system gave 159.98q/ha rice equivalent yield which was also superior to rice-wheat cropping system. The higher rice equivalent yield was obtained by 36.39 per cent in rice-berseem, 41.02 per cent in rice-potato-wheat, 87.43 per cent in rice-garlic and 88.08 per cent in rice-toria-onion cropping system as compared to rice-wheat cropping system. Similar findings were also reported by Sharma *et al*. (2004), and Upadhyay *et al*. (2007).

Economics :

The net profit of different under cropping system has been given in Table 1. It is clear that the net monetary return Rs- 152922/ ha was maximum in rice-toria-onion cropping system followed by Rs- 140830/ha rice-berseem and Rs 118809/ ha in rice-green pea-wheat cropping system. Rice-chickpea, rice-lentil, rice-mustard and rice-chickpea+linseed cropping system were not more remunerative than rice-wheat system. These findings are in conformity with the findings of Dubey (2010). The growing of berseem after rice gave net profit Rs. 140830/ha and benefit : cost ratio 3.55 which was better than rice-wheat, rice-garlic, rice-gram, rice-lentil and rice-mustard cropping system.

Soil properties :

After harvest of *Rabi* crop soil samples were taken and

Table 1: Yield of rice and different *Rabi* crops under different cropping system (2 years pooled)

Treatments	Yields (q/ha)			REY (q/ha)	NMR (Rs/ha	GMR (Rs./ha)	B:C Ratio
Rice-Wheat	40.07	-	64.35	117.29	90,590	139594	2.84
Rice-Gram	42.67	-	20.52	99.50	73,375	116,129	2.71
Rice-Berseem	46.93	851.85 (F)	5.37(S)	159.98	140,830	195,960	3.55
Rice-Potato-Wheat	42.83	115.62	49.05	165.41	102,564	190,561	2.16
Rice-Garlic	41.09	-	65.07	219.84	114,601	244,039	1.88
Rice-Toria-Onion	42.35	6.60	288.52	220.60	152,922	244,896	2.66
Rice-Lentil-GM	43.46	15.61	87.39 (GM)	92.47	55,623	107,809	2.06
Rice-Green Pea-Wheat	44.25	37.14	58.44	148.72	118,809	173,320	3.17
Rice-Gram-Linseed	45.43	-	16.55(G) 7.01(L)	112.05	86,761	128,631	3.07
Rice-Mustard-GM	45.67	12.93	95.43 (GM)	83.94	59,592	97,845	2.55
CD 5%	4.10	-	-	18.39	-	14970	-

Table 2: Changes in chemical properties of soil after completion of 4 years of different cropping systems

Treatments	Soil pH	Soil EC Mmhos/cm2	OC%	Available N kg/ha	Available P_2O_5 kg/ha	Available K_2O kg/ha
T_1 Rice (Danteshwari)– Wheat (GW-273)	6.69	0.10	0.61 (108.92%)	80 (35.71%)	16.12 (196.58%)	171.95 (54.58%)
T_2 Rice (Danteshwari) - Chick pea (JG- 322)	6.75	0.10	0.67 (119.64%)	80 (35.71%)	18.81 (229.39%)	170.80 (54.22%)
T_3 Rice(Danteshwari) - Berseem (JB-1) (fodder+seed)	6.76	0.15	0.58 (103.57%)	90 (40.17%)	19.26 (234.87%)	160.35 (50.90%)
T_4 Rice (Danteshwari) –Potato(Kufri Chandramudhi)-Wheat (HD-2864)	6.68	0.12	0.73 (130.35%)	75 (33.48%)	12.99 (158.41%)	206.70 (65.61%)
T_5 Rice(Danteshwari) - Garlic (G-1)	6.73	0.20	0.65 (116.07%)	80 (35.71%)	12.09 (147.43%)	164.00 (52.06%)
T_6 Rice(Danteshwari)-Toria (T_9)-Onion (AFR)	6.75	0.10	0.61 (108.92%)	80 (35.71%)	14.33 (174.75%)	177.10 (56.19%)
T_7 Rice (Danteshwari)- Lentil (JL-1)	6.74	0.13	0.65 (116.07%)	80 (35.71%)	19.26 (234.87%)	152.60 (48.44%)
T_8 Rice(Danteshwari) - Pea (Arkel)-Wheat (HD-2864)	6.82	0.11	0.69 (123.21%)	80 (35.71%)	9.40 (14.63%)	182.75 (58.01%)
T_9 Rice(Danteshwari)- Chickpea+Linseed (JL-23 in 3:1)	6.59	0.21	0.61 (108.92%)	80 (35.71%)	12.54 (152.92%)	192.55 (61.12%)
T_{10} Rice(Danteshwari) - Mustard (Pusa bold)	6.80	0.23	0.61 (108.92%)	80 (35.71%)	16.57 (202.07%)	175.05 (55.57%)
Total initial value	7.25	0.46	0.56	224 kg	8.2 kg	315 kg

Figures in parentheses are % over rice-wheat system

analyzed for different chemical properties of soil which are presented in Table 2. It is clear from the results that soil pH was decreased under different cropping system as compared to initial status. The electrical conductivity of soil was also decreased over initial status under different cropping system. The organic carbon status was increased by 3.57 per cent to 30.35 per cent under different cropping system over initial status. The maximum increased in organic carbon status was observed in rice-potato-wheat followed by rice-chickpea, rice-greenpea-wheat and rice-lentil cropping system. The available nitrogen status was decreased by 60-65 per cent under different cropping system as compared to initial status. The available phosphorus status was increased by 14.63 per cent to 134.87 per cent under different cropping system. The maximum increase in available phosphorus status was 134.87 per cent in rice-berseem and rice-lentil followed by rice-chickpea and rice-mustard cropping system. The available potash was decreased by 34.39 per cent to 51.56 per cent over initial status under different cropping system.

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