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Option of changing conventional cropping system with alternate cropping systems in Kangra valley of Himachal Pradesh

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Abstract

A field experiment was conducted during 2000 - 2003 at Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur to find suitable alternate crop for wheat in conventional cropping sequence of rice-wheat. Wheat crop of conventional sequence was replaced with one or two crops of oilseeds or vegetables crops viz., gobhi sarson (*Brassica napus* ssp *oleifera* DC. var. annua L.), linseed (*Linum usitatissimum* L.), potato (*Solanum tuberosum* L.), pea (*Pisum sativum* L.), radish (*Raphanus sativus* L.), sunnhemp (*Crotolaria juncea* L.) and French bean (*Phaseolus vulgaris* L.). Rice-pea- frenchbean sequence being on par with rice-radish-potato, recorded significantly highest rice equivalent yield and gross returns. However, rice-pea -French bean gave significantly higher net return of Rs 13032/ha compared to rice- radish-potato. Economic parameters indicate that rice-pea- French bean and rice – radish – potato are economically viable than rice - wheat and allows marginal farmers to put half of their land resources to some other use.

Key Words: Cropping sequence, rice-wheat, alternate sequences and productivity.

Introduction

Rice (*Oryza sativa* L.) - wheat [*Triticum aestivum* (L.) emend. Fiori and Paol.] is the conventional cropping system in mid-hills of Himachal Pradesh. Though the system has sustained over years but stagnation in total production has been reported (Nambiar and Abrol, 1992). This stagnation in productivity can be attributed mainly due to monotony of the system as well as exhaustive nature of cereal-cereal crop sequence. This system is also followed in irrigated areas, which constitute 18% of the total cropped area. As Kangra valley falls under high rainfall area and rice being the staple food, we cannot replace rice-wheat system completely. Only option left with us in this irrigated region is to replace the rice-wheat with some other rice-based cropping systems having oilseed and/or vegetable in place of wheat.

Keeping in view the above-mentioned factors, the present investigation was undertaken under the All India Coordinated Research Project on Cropping Systems Research to evaluate different rice-based cropping sequences under irrigated condition of Kangra valley.

Material and Methods

A field experiment was conducted for a period of three years (2000-01 to 2002-03) at Cropping Systems Research farm of the Department of Agronomy, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, which is situated at 32.6 °N latitude and 76.3 °E longitude at an elevation of 1290.8 m amsl. The acidic soil (pH 5.7) of experimental site recorded 590.0, 48.5 and 217.5 kg/ha, available nitrogen, phosphorus and potassium, respectively. The treatments comprised of six rice-based cropping sequences viz., rice - wheat, rice - potato (*Solanum tuberosum* L.), rice - gobhi sarson (*Brassica napus* ssp *oleifera* DC. var. *annua* L.), rice -linseed (*Linum usitatissimum* L.) - sunnhemp (*Crotolaria juncea* L.), rice - radish (*Raphanus sativus* L.) - potato, and rice - pea (*Pisum sativum* L.) - frenchbean (*Phaseolus vulgaris* L.). These sequences were evaluated in randomized block design with 4 replications in a permanently laid out experiment. The crops were raised with recommended package of practices under irrigated conditions. Rice was transplanted after normal puddling. Sunhemp was grown as a green manure crop and turned with a soil inverting plough at pre-flowering stage for

decomposition in the field before the transplanting of rice.

Main product as well as bye-product of economic importance for different crops of respective cropping sequence was converted to rice equivalent yield on the basis of prevailing market prices of produce and inputs (Verma and Modgal, 1983). The rice equivalent yield was pooled over the years and used for analysis of gross and net returns. Production efficiency was calculated by dividing equivalent yield with total duration of a sequence. Land use efficiency was calculated by dividing total duration of a sequence with number of days in a year and expressed as percentage. Area equivalent ratio (AER) of alternate sequence to conventional sequence (rice-wheat) was calculated by dividing cost of cultivation of conventional cropping system with the cost of cultivation of alternate cropping sequence. The relative profit of alternate cropping sequence was calculated by multiplying AER with net returns of corresponding alternate sequence. Additional profit was calculated by subtracting net return of conventional cropping sequence from relative profit of an alternate sequence. Likewise relative profit divided by net return of conventional cropping sequence gave profit equivalent ratio (Mohammad, 2002).

Results and Discussion

Rice equivalent yield

The result emanating from Table 1 reveals that the replacement of wheat of the conventional cropping sequence, rice-wheat by a vegetable crop of potato could not improve rice equivalent yield significantly. Likewise, replacement of wheat by high priced oil-seed crop of gobhi-sarson could not give rice equivalent yield even comparable to rice-wheat. It was mainly due to lower yield level and uneconomical bye product of gobhi-sarson. Even inclusion of green manure crop of sunnhemp in rice- linseed crop sequence could not improve the productivity over conventional crop sequence. Shah *et al.* (1999) also recorded lower rice equivalent yield in rice - oilseed crop sequence as compared to rice - wheat. Rice – pea - French bean while remaining at par with rice-radish-potato, gave significantly highest rice

Table 1. Yield of main and bye products of crops along with rice equivalent yield (REY), production and land use efficiency of different crop sequences

Crop sequence (Duration in days)	Yield (q/ha)						REY (q/ha)	Production efficiency (kg/ha/day)	Land use efficiency %
	Kharif		Rabi I		Rabi II				
	MP	BP	MP	BP	MP	BP			
Rice – Wheat (321)	33.67	48.51	30.87	49.11	-	-	94.12	29.32	87.95
Rice – potato (278)	32.81	51.26	114.99	-	-	-	100.98	36.32	76.16
Rice – gobhi sarson (300)	33.55	50.09	6.64	-	-	-	59.48	19.83	82.19
Rice – linseed – sunhemp (336)	31.14	52.81	4.99	-	-	-	53.79	16.01	92.06
Rice – radish – potato (327)	35.61	52.51	163.88	-	134.50	-	195.74	59.86	89.59
Rice – pea – French bean (353)	34.51	50.89	44.61	61.27	31.45	49.33	204.13	57.83	96.71
CD (P = 0.05)							8.51		

Sale price of produce (Rs/q):

Main Product (MP): Rice = 600, Wheat =700, Gobhi sarson =1400, Linseed =1400, Pea (Veg.) = 1000, French bean (Veg.) =1000, Potato =300, Radish = 300

Bye Product (BP): Rice straw = 125, Wheat straw = 175, French bean straw = 175, Pea Straw =175

equivalent yield (204.13q/ha) than the remaining sequences. Higher production in these sequences was due to replacement of wheat with high volume/high priced vegetable crops like pea, French bean, radish and potato. Chaudhary *et al.* (2001) also reported more productivity by replacing wheat of rice - wheat system with vegetables like radish and potato.

Production and land use efficiency

Production efficiency followed almost similar trend as was followed by rice equivalent yield of different sequences. In spite of similar rice equivalent yield of rice – pea – French bean and rice – radish - potato crop sequences, rice – pea – French bean recorded slightly lower production efficiency (57.83 kg/ha/year) than rice - radish - potato (59.86 kg/ha/year) mainly because of longer duration of sequence and lower yield levels of rabi crops than rice-radish-potato sequence. Rice – linseed - sunnhemp and rice – gobhi sarson recorded lower production efficiency (16.01 and 19.83 kg/ha/year) mainly due to lower production level of main products of oil-seed crops without any economic use of their bye products. The land use efficiency was highest in rice – pea – French bean because the sequence used land resource for maximum part of the year. Rice - potato was most inferior in respect of land use, as the land remained idle for almost 3 months in a year (87 days).

Economics

The economics of cropping sequences indicate that rice – pea - French bean, while remaining at par with rice – radish - potato, recorded significantly higher gross returns as compared to the remaining sequences (Table 2). The net returns were also significantly higher in rice – pea - French bean than rice – radish - potato sequence. This can be attributed to comparatively higher cost of cultivation of latter mainly due to more expenses on labour and seed in potato cultivation. The net return of these rice – vegetable - vegetable sequences were considerably higher than the conventional rice-wheat sequence. Rao and Willey (1980) also reported that multiple cropping with legume offers special advantages to farmers and reduce the probability of low income in small and marginal farmers. On the contrary, rice-based sequences containing oilseed crops recorded lower net return than rice - wheat.

A farmer cultivating rice - wheat in one hectare with cultivation cost of Rs 21564 when switches to alternate cropping system of rice – pea - French bean can cultivate only half of the area with the same amount (Rs 21564) as indicated by area equivalent ratio (0.50). Consequently, relative profit from this alternate cropping sequence is also reduced to half of that obtained from one hectare (Rs 39679). However, relative profit is still higher by Rs 4771 as compared to conventional cropping system. Thus, rice – pea - French bean cultivation in half the area under rice - wheat gave 1.14 times higher profit than cultivation of rice – wheat in entire area. Thus by switching to cultivation of this alternate cropping system a farmer with resources just sufficient for cultivation of rice-wheat can spare half of his land resource for some other economic activity. All other alternate cropping sequences were found unviable.

It can be concluded that some of the farmers

Table 2. Economic parameters of crop sequences

Crop sequence	Gross Return (Rs/ha)	Cost of cultivation (Rs/ha)	Net return (Rs/ha)	Area equivalent ratio	Relative profit (Rs)	Additional profit (Rs)	Profit equivalent ratio
Rice – Wheat	56472	21564	34908	-	-	-	-
Rice – potato	60591	40938	19653	0.52	10219	-24689	0.292
Rice – gobhi sarson	35691	20682	15009	1.04	15609	-19299	0.447
Rice – linseed – sunhemp	32277	26980	5297	0.80	4237	-30671	0.121
Rice – radish – potato	117445	51119	66326	0.42	27856	-7052	0.798
Rice – pea – French bean	122482	43124	79358	0.50	39679	4771	1.136
CD (P = 0.05)	5106		5106				

of this region can replace rice-wheat system with rice – pea - French bean. Even poor/marginal farmers can improve his financial position by cultivating this alternate sequence on half of his entire land with amount they are spending to cultivate rice-wheat on entire area, thus, sparing half of the area to some other economical activity.

References

Chaudhary, J.B., Thakur, R.C., Bhargava, M. and Sood, R.D. 2001. Production potential and economics of rice (*Oryza sativa* L.) based cropping systems on farmers' fields under mid hill conditions of Himachal Pradesh. *Himachal Journal of Agricultural Research* 27 (1&2): 31-35.

Mohammad, S. 2002. Options of rice (*Oryza sativa*)-based cropping systems for efficient utilization of land and water. (*In*:) Extended Summaries of Second International Agronomy Congress on Balancing Food and Environmental Security - A Continuing Challenge Vol. 2: 793.

Nambiar, K.K.M. and Abrol, I.P. 1992. Long-term fertilizer experiments in India: An overview. *Fertilizer News* 37 (4): 11-20.

Rao, M.L. and Willey, R.W. 1980. Evaluation of yield stability in intercropping studies with sorghum or pigeon pea. *Experimental Agriculture* 16: 205-09.

Shah, M.H., Khan, G.M., Bali, A.S., Singh, K.N., Bali, A.S. and Kanth, R. 1999. Productivity potential of rice-based cropping sequences under temperate environment. *Indian Journal of Agronomy* 44 (1): 12-15.

Verma, S.P. and Modgal, S.C. 1983. Production potential and economics of fertilizer application as a resource constraint in maize-wheat crop sequence. *Himachal Journal of Agricultural Research* 9 (2): 89-92.

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