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Evaluation of Different Cropping System in Sri Muktsar Sahib District of Punjab

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ABSTRACT

A field experiment was conducted at Krishi Vigyan Kendra, Sri Muktsar Sahib to find out the suitable cropping system of the district. Twelve different cropping systems were evaluated for their yield and economics. During *kharif* season three crops namely rice, basmati, cotton were grown including direct seeded rice and basmati. In *rabi* season three crops namely wheat, barley and rapeseed mustard were grown. Among all cropping system, direct seeded basmati-wheat cropping system gave the higher average rice equivalent yield during the period of study and recorded 137.23 q/ha average rice equivalent yield, followed by basmati-gobhi sarson (133.23 q/ha) as compared to all other cropping system. The lower rice equivalent yield was obtained in desi cotton-barley (98.47 q/ha) and American cotton-wheat (100.47 q/ha) cropping systems. Net return was also higher in direct seeded basmati-wheat and basmati-sarson cropping system whereas lower net return was recorded from Bt cotton-transplanted gobhi sarson and Bt cotton-barley cropping systems. Whereas, B:C ratio was also higher under direct seeded basmati-wheat (1.78:1), Basmati- barley (1.71:1) and Basmati-gobhi sarson (1.60:1) cropping system as compared to other different cropping systems. B:C ratio among direct seeded basmati was higher due to low cost of cultivation and higher value of basmati crop. Direct seeded basmati-wheat performed better among all other cropping systems in sandy loam soil, having less availability of good quality underground irrigated water. Cropping systems with cotton crop in *kharif* recorded lower rice equivalent yield and net return due to less grain yield obtained with this crop in 2015, as the crop faced very severe attack of incidence of white fly to cotton crop in the area. So, direct seeded basmati based cropping system are resource conservative, highly profitable crop, best suited to the area and fetched more returns.

Key Words: Benefit cost ratio, Cropping System, Direct seeded basmati, Economics, Rice equivalent yield.

INTRODUCTION

The rice-wheat is the most important cropping system in India (Prasad, 2005). It occupies about 10.5 m ha productive lands in Indo-Gangetic plains and contributes near about 25 percent of the national food production (Sharma *et al*, 2015). Due of high productivity, stability and less risk of this cropping system, the wide adoption of this system will also play a major role in the future planning to sustain self sufficiency of food grains in the years to come (Singh *et al*, 2012). Rice based cropping systems is also very popular in Punjab and the water requirement of rice crop is more as compared to other crops decline of ground water table throughout Punjab. Several intensive rice based cropping systems have been identified and are being practiced by the farmers. The intensive agriculture contains exhaustive high yielding varieties of rice and cultivation practices, which resulting high withdrawal of nutrients from soil, which further resulted in deterioration of soil health (Porpavai *et al,* 2011 and Ali *et al*, 2012) and deterioration of soil physical properties (Desai *et al,* 2016) and also decline crop yields in high productivity areas. Puddling also breaks capillary pores, destroys soil aggregates and lowers soil strength in the puddled layer by making hard pan (Sharma and Datta, 1986). Cotton -wheat cropping system is also very popular among semi arid region of south western Punjab (Dhaliwal and Sandhu, 2015). Moreover, about two-thirds of the world's

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cotton is consumed in three countries: China, India and Pakistan with shares of 35 percent, 15 percent and 10 percent, respectively (Walia *et al*, 2010; Sabir *et al*, 2011). Direct seeded basmati-wheat is also a good cropping system due to high demand of basmati rice in the European countries. Therefore, selection suitably cropping system will plan to harvest the synergism towards efficient utilization of resource and to increase overall productivity (Reddy and Suresh, 2009 and Gill and Ahlawat, 2006). Hence, the present study was carried out to find out most economical, more productive and resource-use-efficient cropping system for this region.

MATERIALS AND METHODS

A field experiment was conducted during during 2015-16 and 2016-17 at Krishi Vigyan Kendra, Sri Muktsar Sahib (Punjab), to find out the best suitable cropping system. The geographical location of the experimental site was 74°30'40" east longitude, 30°26'50" North latitude. The area is characterized by semi-arid type of climate with hot and dry period from April-June followed by hot and humid period during July-September and cold winters during December-January. The mean maximum and minimum temperatures show considerable fluctuations during different parts of the year. Summer temperature exceeds 38^0C and may go up as high as 45^0C with dry summer spells. The annual rainfall of the area is 430.7 mm, most of which is received during July to September (Anon, 2011). The soil was sandy loam, normal in reaction (pH 7.4), normal EC (0.55 dS/m), medium in available organic carbon (0.6 %), high in available phosphorus (28.5 kg/ha), high in available potassium (667 kg/ha), high in Zinc (7.25 kg/ha), very high in iron (80.2 kg/ha) and high in Manganese (17.8 kg/ha).

The ground water in the area is not fit for irrigation in most of the villages however the canal water in the district is in sufficient quantity. Twelve cropping systems were evaluated for their production potential and economics, viz., S_1; rice (*Oryza sativa* L.)-wheat (*Triticum aestivum* L.) S_2,rice-barley (*Hordeum vulgare*); S_3, Direct seeded rice-wheat; S_4, direct seeded rice-raya (Brassica napus); S_5, direct seeded basmati-wheat; S_6, basmati-barley; S_7,basmati-gobhi sarson (Brassica nigra); S_8, Bt cotton (*Gossypium hirsutum*)- gobhi sarson; S_9, desi cotton (*Gossypium arboreum*)-barley; S_{10}, desi cotton -wheat; S_{11}, American cotton (*Gossypium hirsutum*)-wheat; S_{12}, Bt cotton -wheat. Out of twelve cropping system five cotton based and 7 were rice based cropping system. Bt cotton variety RCH 650 BGII, American cotton F 2228, desi cotton FDK 124, wheat HD 3086 after rice and Bt cotton, WH 1105 after American cotton and PBW 550 after desi cotton, barley PL 807 after cotton and rice, gobhi sarson GSC 7, raya RLC 3, basmati Pusa 1121,rice PR 121 in transplanting and PR 115 in direct seeding were raised under irrigated condition with recommended package of practices. Nitrogen, phosphorus and potassium were applied through urea, single superphosphate/ DAP and muriate of potash, respectively. Other agronomic and plant protection practices for each crop were kept optimum.

The cost of cultivation of each crop was worked out and incomes of crop yields were calculated on prevailing market prices. The benefit cost ratio of each cropping pattern was also calculated. In *kharif* 2015, the market price of paddy, basmati, Bt cotton and desi cotton was Rs 1450/-, 2250/-, 4600/- and 4400/- per quintals, respectively. Whereas in *kharif* 2016 market price of paddy, basmati, Bt cotton and desi cotton was Rs 1510/-, 2750/-, 4800/- and 4600/- per quintals, respectively. In *rabi* 2015-16, the market price of wheat, barley and raya/gobhi sarson was Rs 1525/-, 1450/- and 3800/- per quintals, respectively. In *rabi* 2016-17, the market price of wheat, barley, raya and sarson was Rs 1625/-, 1525/-, 4000/- and 3900/- per quintals, respectively. For comparison between different crops, the yield of all crops was converted into rice equivalent yield on price basis. Rice equivalent yield=yield obtained by certain crop/market price of rice x market price of certain crop.

RESULTS AND DISCUSSION

Rice equivalent yield

Among all cropping system, DSR basmati-wheat cropping system gave the higher rice equivalent yield and recorded 137.23 q/ha, followed by basmati-gobhi sarson (133.23 q/ha), basmati-barley (126.17 q/ha), Rice –wheat (124.13 q/ha), DSR-wheat (121.32 q/ha), Bt cotton- wheat (118.62 q/ha) cropping system. The lower rice equivalent yield was obtained in Desi cotton-barley (98.47 q/ha) and American cotton-wheat (100.47 q/ha) cropping systems. However, in 2015-16 rice equivalent yield was higher in DSR Basmati-wheat (125.2 q/ha) followed by basmati-gobhi sarson (119 q/ha), Paddy –wheat (117.2 q/ha), DSR-wheat (114.5 q/ha) as compared to American cotton-wheat (77.6 q/ha), desi cotton-barley (79.7 q/ha) and desi cotton-wheat (82.1 q/ha) cropping systems. lower rice equivalent yield in cotton based cropping system was only due to the low yield obtained from cotton crop due to high incidence of white fly insect in 2015.

During 2016-17, higher rice equivalent yield was recorded with DSR Basmati-wheat (149.3 q/ha) followed by Basmati-gobhi sarson (148.4 q/ha), Bt cotton-wheat (141.1 q/ha), Basmati-barley (138.4 q/ha), Bt cotton-transplanted gobhi sarson (135.2 q/ha), desi cotton-wheat (134.4 q/ha), rice –wheat (131.1 q/ha), DSR-wheat (128.1 q/ha) as compared to DSR-raya (111.4 q/ha), desi cotton-barley (117.2 q/ha) and American cotton-wheat (123.4 q/ha) cropping systems (Table 1). Among rice based cropping system DSR basmati-wheat and basmati-gobhi sarson are best suitable for the area and give higher rice equivalent yield under DSR cropping system due to the higher yield and high value of basmati crop. Among cotton based cropping system Bt cotton-wheat are best suitable for the area and produced higher rice equivalent yield (Table 1). Dhaliwal and Sandhu (2015) also recorded the similar results where, basmati based cropping system produced higher rice equivalent yield.

Economics and Benefit-cost ratio

The gross return from all cropping system is higher in DSR basmati-wheat (Rs 2,03,459/ha) cropping system followed by basmati-gobhi sarson (Rs 1,98,337/ha), basmati-barley (Rs 1,87,102/ha), Rice–wheat (Rs 1,83,920/ha), DSR-wheat (Rs 1,79,752/ha), Bt cotton- wheat (Rs 1,76,237/ha) cropping system. The lower gross return was obtained with desi cotton-barley (Rs 146295/ha) and American cotton-wheat (Rs 1,49,380/ha) cropping systems. Similarly, the net return was also higher in DSR basmati-wheat (Rs 1,30,359/ha), basmati-gobhi sarson (Rs 1,22,088/ha), basmati-barley (Rs 1,18,031/ha), rice–wheat (Rs 1,10,314/ha) from American cotton-wheat (Rs 72,689/ha) and desi cotton-barley (Rs 77,060/ha) cropping systems. Net return in these comparative cropping systems was higher due to higher gross return and low variable cost.

In 2015-16, The B:C ratio was higher under direct seeded basmati-wheat (141.1:1), Basmati-barley (1.41:1), direct seeded rice–wheat (1.40:1) and Rice-barley cropping system (1.40:1) and lower in Bt cotton-gobhi sarson (0.27:1) and Bt cotton-wheat (0.47:1) from all cropping systems. The B:C ratio was lower in cotton based cropping system due to less yield obtained from cotton during 2015 by facing severe attack of white fly to this crop. However, in 2016-17, The B:C ratio was also higher under direct seeded basmati-wheat (2.01:1) Basmati-barley (2.01:1) and Basmati- gobhi sarson (1.92:1) from desi cotton-wheat (1.78:1), rice-barley (1.76:1) and DSR-wheat (1.65:1) and lower B:C ratio obtained with in Bt cotton-sarson (1.05:1) and Bt cotton-wheat (1.15:1) from all cropping systems (Table 2). Similarly the average B:C ratio of these two year was also higher in direct seeded basmati-wheat (1.78:1), basmati-barley (1.71:1) and basmati- gobhi sarson (1.60:1). Cropping system with basmati gave the higher B:C ratio due to higher grain yield and good market price of basmati crop. Among cotton based cropping systems, desi cotton-wheat was the best suitable cropping system in the cotton growing area of Sri Muktsar Sahib district.

Table 1. Economical yield and rice equivalent yield in different cropping system.

Sr. No.	Cropping system	Economic yield (q/ha)		Economic yield (q/ha)		Rice equivalent yield (q/ha)						
		2015-16		2016-17		2015-16			2016-17			Average
		Kharif	*Rabi*	*Kharif*	*Rabi*	*Kharif*	*Rabi*	*Total*	*Kharif*	*Rabi*	Total	
1	Rice- Wheat	66.7	48	76.3	50.9	66.7	50.5	117.2	76.3	54.8	131.1	124.13
2	Rice- Barley	68	40.3	75.5	46.2	68.0	40.3	108.3	75.5	46.7	122.2	115.23
3	DSR –Wheat	63	49	73	51.2	63.0	51.5	114.5	73.0	55.1	128.1	121.32
4	DSR- Raya	61.3	15.5	69	16	61.3	40.6	101.9	69.0	42.4	111.4	106.65
5	DSR Basmati- Wheat	49	46.7	53.5	48.2	76.0	49.1	125.2	97.4	51.9	149.3	137.23
6	Basmati-Barley	45.7	43	51.5	44.2	70.9	43.0	113.9	93.8	44.6	138.4	126.17
7	Basmati-Gobhi sarson	46.3	18	51	21.5	71.8	47.2	119.0	92.9	55.5	148.4	133.71
8	Bt cotton-Transplanted Gobhi sarson	13.3	16.4	27.5	18.5	42.2	43.0	85.2	87.4	47.8	135.2	110.19
9	Desi cotton-Barley	11.5	44.8	23.5	45.2	34.9	44.8	79.7	71.6	45.6	117.2	98.47
10	Desi cotton-Wheat	11.8	44	27	48.5	35.8	46.3	82.1	82.3	52.2	134.4	108.26
11	American cotton-Wheat	9.3	45.7	23	46.7	29.5	48.1	77.6	73.1	50.3	123.4	100.47
12	Bt cotton-Wheat	15.3	45.3	28.5	46.9	48.5	47.6	96.2	90.6	50.5	141.1	118.62

Table 2. Economics and Benefit-cost ratio of different cropping system.

Sr. No.	Cropping system	Gross return (Rs./ha)			Total variable cost (Rs./ha)			Net return (Rs./ha)			B:C ratio		
		2015-16	2016-17	Average	2015-16	2016-17	Average	2015-16	2016-17	Average	2015-16	2016-17	Average
1	Rice- Wheat	169915	197925	183920	71767	75445	73606	98147	122480	110314	1.37:1	1.62:1	1.50:1
2	Rice- Barley	157035	184460	170747	65515	66935	66225	91520	117525	104522	1.40:1	1.76:1	1.58:1
3	DSR –Wheat	166075	193430	179752	69205	72955	71080	96870	120475	108672	1.40:1	1.65:1	1.53:1
4	DSR- Raya	147785	168190	157987	69995	71760	70877	77790	96430	87110	1.11:1	1.34:1	1.23:1
5	DSR Basmati-Wheat	181467	225450	203459	71355	74845	73100	110112	150605	130359	1.54:1	2.01:1	1.78:1
6	Basmati-Barley	165175	209030	187102	68602	69540	69071	96572	139490	118031	1.41:1	2.01:1	1.71:1
7	Basmati- Gobhi sarson	172575	224100	198337	75645	76855	76250	96930	147245	122088	1.28:1	1.92:1	1.60:1
8	Bt cotton-Transplanted Gobhi sarson	123500	204150	163825	97232	99380	98306	26267	104770	65519	0.27:1	1.05:1	0.67:1
9	Desi cotton-Barley	115560	177030	146295	68905	69565	69235	46655	107465	77060	0.68:1	1.54:1	1.11:1
10	Desi cotton-Wheat	119020	203012	161016	75157	73075	74116	43862	129937	86900	0.58:1	1.78:1	1.17:1
11	American cotton-Wheat	112472	186287	149380	75232	78150	76691	37240	108137	72689	0.49:1	1.38:1	0.95:1
12	Bt cotton-Wheat	139462	213012	176237	95192	99075	97134	44270	113937	79104	0.47:1	1.15:1	0.81:1

Whereas, from rice based cropping system direct seeded basmati-wheat is the best cropping system among rice belt of the district. Similarly higher B:C ratio with basmati-wheat cropping system was reported by Dhaliwal and Sandhu (2015).

CONCLUSION

Direct seeded basmati-wheat cropping system gave higher rice equivalent yield and higher B:C ratio than all other cropping system. Thus this cropping system may helps to diversify the area from rice-wheat cropping system in rice growing belt. Direct seeded basmati-wheat also performed better among all cropping systems in sandy loam soil, having less availability of good quality underground irrigated water. These cropping systems are well suitable for those areas which are dependent on only canal water for irrigation and where canal water is of good quantity. Hence, direct seeded basmati based cropping system are resource conservative, highly profitable crop, best suitable to the area and fetch more returns per unit area. Cropping system desi cotton-wheat prove good for those area where irrigated water is not sufficient and underground water is not fit for irrigation.

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