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AGRO-ECONOMIC STUDIES ON SOME WHEAT BASED INTERCROPPING SYSTEMS

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Studies on some wheat based intercropping systems were conducted at Agronomic Research Area, University of Agriculture, Faisalabad. Wheat was sown in 40 cm apart single rows as well as in 100 cm apart 4-row strips. Lentil, gram, methra, carrot, linseed, sarson, garlic and berseem were sown in space between the wheat strips. Intercropping of lentil, gram, carrot, methra, linseed, sarson and garlic decreased the wheat yield by 10.83, 3.34, 15.24, 6.78, 18.20, 16.02 and 0.83%, respectively compared to wheat alone in 4-row strips. However, at the cost of this much reduction in wheat yield, an additional harvest of 6.03, 6.10, 3.67, 5.22, 5.36, 5.56, 25.73 and 196.07 q ha^{-1} of lentil, gram, carrot, methra, linseed, sarson, garlic and berseem, respectively were obtained which compensated more than the losses in wheat production. The highest net income of Rs. 34377 with BCR of 2.90 was obtained from wheat-garlic intercropping while income was minimum of Rs. 5747 with BCR of 2.01 for wheat alone in 100 cm apart 4-row strips.

INTRODUCTION

Farmers in Pakistan are constrained by low crop productivity due to limited land resources. A possible way of increasing the productivity on small farms would be through intercropping, as it provides security against potential losses of monoculture. Moreover, there is a need for increased production of pulses and oilseeds as we are deficient in proteins and fats in our daily diet and huge amount of foreign exchange is spent annually on the import of these commodities. The area under rabi oilseed crops and pulses is limited and cannot be increased due to competition with wheat. An alternative to increase the production of oilseed and pulses could be through intercropping them with wheat.

There are reports showing no effect of intercropping on the yield of associated wheat crop (Ashraf, 1982; Singh *et al.*, 1983). In other cases, reduction in wheat yield has been reported upon intercropping (Khan, 1984). Nevertheless, the losses in wheat production by the respective intercrops were compensated by additional harvests of intercrops (Ahmed, 1990; Nazir *et al.*, 1988). Moreover, mixed cropping ensured better land utilisation and higher income than monoculture. However, conventional methods of planting wheat do not permit easy and systematic intercropping because of narrow row spacing. Consequently, a new method of planting wheat in 100 cm apart 4-row strips has been developed (Nazir *et al.*, 1988) which has made it feasible to practise intercropping in wheat conveniently without too much intercrop competition. The present study, therefore, aimed at exploring the interactive behaviour of some rabi crops with wheat in an intercropping system and to determine the feasibility and economics of some wheat based intercropping systems under the agro-ecological conditions of Faisalabad.

MATERIALS AND METHODS

The studies were carried out at the University of Agriculture, Faisalabad during 1989-90 on sandy clay loam soil. Experiment was laid out in randomised complete block design with four replications using a net plot size of 4.8 x 17.5 m. Intercropping systems comprised wheat alone in 40 cm apart single rows, wheat alone in 100 cm apart 4-row strips, wheat-lentil, wheat-sarson, wheat-garlic and wheat-berseem. Wheat variety SS-5 was planted on November 15, 1989 in 100 cm apart 4-row strips as well as in 40 cm apart single rows with single row hand drill on a well prepared seed bed. Seed rate used was 100 kg ha^{-1}. Lentil, gram, carrot, methra, linseed, sarson and berseem were interplanted in between the strips of wheat on the same day with the help of single row hand drill while garlic was planted by hand. In all the intercropping systems, both the component crops were sown on flat except wheat-lentil and wheat-gram where lower and upper bed technology was used. The height of beds on an average ranged between 4.5-6.0 cm. A basal dose of 100 kg N and 50 kg P_2O_5 per hectare in the form of urea and SSP was applied at the time of sowing while the remaining half of N was applied at different growth stages of wheat viz., crown root formation, tillering stage, booting stage, anthesis and milking stage. All the other agronomic practices were kept uniform for all the treatments. Standard procedures were followed to collect the data on number of spike bearing tiller per unit area, number and weight of grains per spike and 1000-grain weight. The data collected were subjected to Fisher's analysis of variance technique and LSD was used to compare differences among the treatment means (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Growth and yield parameters of wheat: The height of plants growing under various treatments did not vary to a significant extent (Table 1). This clearly indicated that growth behaviour of wheat plant is mainly controlled and regulated by its genetic constitution rather than by a change in environment as a result of various intercropping systems. The plant height ranged between 80.17 to 83.37 cm. These findings are similar to those of Khan (1986) and Nazir *et al.* (1988).

Wheat intercropped with carrots, sarson, linseed and methra produced significantly lesser number of spike bearing tillers per unit area than intercropped with garlic, lentil, berseem and gram which were at par with one another including monocropped wheat (Table 1). Lower number of tillers per unit area in case of wheat-carrot, wheat-linseed and wheat-sarson intercropping systems might be attributed to severe competition between the component crops for essential growth factors. These results are quite in line with findings of Khan (1984) and Ahmed (1990).

The data pertaining to number of grains per spike showed non-significant differences (Table 1). It appeared from the results that the grain formation potential in wheat is more or less genetically controlled and is least affected by intercropping. The results are in conformity with those of Virk (1985).

Wheat alone in single rows gave significantly higher grain weight per spike. The lowest grain weight of 1.34 g per spike was recorded for wheat intercropped with lentil

which was at par with wheat intercropped with sarson, linseed or carrot. Here, lower grain weight per spike might be attributed to continuous competitive and exhaustive effect of these intercrops with wheat throughout its growing period. Almost similar observations were made by Khan (1986).

The data on 1000-grain weight revealed significant differences among the various intercropping systems under study (Table 1). Wheat grown alone or intercropped with methra, gram, berseem, garlic and sarson produced statistically similar 1000-grain weight while differed significantly from

Table 1. Growth and yield parameters of wheat as affected by different intercropping systems

Intercropping system	Plant height (cm)	Number of spike bearing tillers (m^{-2})	Number of grains per spike	Weight of grains per spike (g)	1000-grain weight (g)	Grain yield (q ha^{-1})	
						Wheat	Intercrop
Wheat alone single rows	81.01NS	268 a	34.00NS	1.58 a	48.65 a	38.43 a	
Wheat alone in 4-row strips	82.20	266 ab	31.75	1.46 b	48.13 a	36.14 b	
Wheat-lentil	80.27	267 ab	32.77	1.34 c	45.73 bc	32.21 d	6.03
Wheat-gram	80.90	265 abc	31.32	1.46 b	48.12 a	34.93 bc	6.19
Wheat-carrot	80.30	259 e	29.82	1.38 c	43.78 d	30.63 e	3.67
Wheat-methra	83.37	264 bcd	32.00	1.46 b	48.70 a	33.69 cd	5.22
Wheat-linseed	82.17	262 cde	29.37	1.38 c	45.26 cd	29.56 e	5.36
Wheat-sarson	80.90	261 de	32.07	1.38 c	47.33 ab	30.35 e	5.56
Wheat-garlic	80.17	268 a	31.70	1.46 b	47.36 a	35.84 b	25.73
Wheat-berseem	81.10	266 ab	31.80	1.56 þ	48.39 a	36.45 b	196.07 (Fodder)

Figures sharing similar letter(s) do not differ statistically at P = 0.05.

The magnitude of grain development in wheat is indicated by its 1000-grain weight. wheat intercropped with carrots, linseed and lentil that produced lower 1000-grain weight.

Table 2. Economic analysis and wheat grain yield equivalents of wheat based intercropping systems

Intercropping system	Yield (q ha^{-1})			Gross income (Rs. ha^{-1})	Total expenditure (Rs. ha^{-1})	CBR	Net income (Rs. ha^{-1})	Wheat grain equivalent of inter-crops (q ha^{-1})	Total wheat grain yield equivalent (q ha^{-1})	Increase over wheat alone
	Wheat grain	Bhoosa	Inter-crops							
Wheat alone single rows	38.43	54.54	-	12123.9	5674.54	2.14	6449.36	-	-	-
Wheat alone 4-row strips	36.14	52.10	-	11421.7	5674.56	2.01	5747.16	-	36.14	-
Wheat-lentil	32.21	45.87	6.03	19964.3	7131.97	2.80	12832.33	35.0	67.21	85.97
Wheat-gram	34.93	49.59	6.19	14734.15	6590.14	2.23	8143.91	13.25	48.18	33.31
Wheat-carrot	30.63	43.81	3.67	17011.65	6781.54	2.50	10230.11	26.20	56.83	57.25
Wheat-methra	33.69	48.10	5.22	16508.20	6898.14	2.39	9610.06	20.83	54.62	51.13
Wheat-linseed	29.56	42.41	5.36	14697.05	6632.54	2.21	8064.51	19.14	48.70	34.75
Wheat-sarson	30.35	44.02	5.56	13768.50	6373.04	2.16	7395.46	14.84	45.19	25.04
Wheat-garlic	35.84	50.55	25.73	52466.95	18089.54	2.90	34377.41	146.91	182.74	405.67
Wheat-berseem	36.45	50.71	196.07	18336.20	8704.54	2.10	9631.66	24.51	60.96	68.68

Name of crop	Rate (Rs. q-1)	Name of crop	Rate (Rs. q-1)
Wheat	280.00	Linseed	1000.00
Lentil	1625.00	Sarson	750.00
Gram	600.00	Garlic	1600.00
Carrot	2000.00	Berseem	35.00
Methra	1125.00		

Similar results were reported by Khan (1984), Khan (1986) and Ahmad (1990).

Wheat intercropped with berseem, garlic and gram gave significantly higher grain yield per hectare than rest of intercropping treatments but was similar to wheat alone planted in 4-row strips (Table 1). The highest grain yield of 38.43 q ha^{-1} was recorded in the sole wheat planted in single rows as against 36.64, 35.84, 34.93 and 36.14 q ha^{-1} for wheat-berseem, wheat-garlic, wheat-gram and wheat alone in 4-row strips, respectively. Decrease in wheat yield by intercropping of lentil, carrot, methra, linseed and sarson over wheat alone was compensated by additional harvest of 6.03, 3.67, 5.22, 5.36 and 5.56 q ha^{-1} of these intercrops, respectively (Table 2). The lowest grain yield of 29.56, 30.35 and 30.63 q ha^{-1} was recorded in case of wheat-linseed, wheat-sarson and wheat-carrot intercropping systems, respectively which might be attributed partly to over shading of wheat by sarson and carrot plants (kept for seed purpose) and partly by exhaustive competition between the component crops. These results are in line with those reported by Khan (1986), Nazir *et al.* (1988) and Ahmed (1990).

Economic analysis and wheat grain yield equivalents of wheat based intercropping systems: Economic analysis revealed that all the wheat intercropping systems under study gave considerably higher net income than sole wheat (Table 2). The highest net income of Rs. 34377 was obtained for wheat-garlic followed by wheat-lentil (Rs. 12832) intercropping but was minimum of Rs. 8064 for wheat-linseed intercropping system. The highest benefit cost ratio (BCR) value of 2.90 was recorded for wheat-garlic intercropping and was minimum of 2.01 for wheat alone in 4-row strips.

Wheat grain yield equivalents of all the wheat based intercropping systems under study were found to be substantially higher than that for the sole cropping of wheat (Table 2). Intercropping of garlic, lentil, berseem, carrot, methra, linseed, gram and sarson increased total wheat grain yield equivalents by 405.67, 85.97, 68.68, 57.25, 51.13, 34.75, 33.31 and 25.04%, respectively compared to wheat alone grown in 4-row strips.

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