Indian Journal of Agronomy **44** (3) : 509–513 (September 1999)

Competition studies in intercropping of wheat (*Triticum aestivm*), rapeseed (*Brassica campestris*) and pea (*Pisum sativum*)

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Received: December 1996

ABSTRACT

A field experiment was conducted during winter (*rabi*) seasons of 1990-92 on intercropping of wheat (*Triticum aestivum* L. emend. Fiori & Paol.), rapeseed [*Brassica campestris* (L.) Czernj & Casson] and pea (*Pisum sativum* Poir.) at Jorhat. Results showed that wheat+rapeseed was the best combination for getting yield advantage in intercropping over wheat + pea and rapeseed + pea as judged by wheat equivalent yield and various competitive functions like land-equivalent ratio and aggressivity. Among the proportions 1 : 1 was found to be the most favourable. Yield advantage in wheat + pea and rapeseed + pea combination was also observed except at 1 : 3 sowing proportion. Either with wheat or rapeseed when the sowing proportion of pea was more than 50%, intercropping became disadvantageous.

Key word : Intercropping, Wheat, Rapeseed, Pea, Competition

Wheat, rapeseed and pea are the major winter (*rabi*) season crops of Assam grown under rainfed condition. However, there has been a fluctuation in productivity of these crops, as because rainfed monocropping very often becomes less remunerative and risky. Intercropping as a potentially beneficial system of crop production can provide yield advantage, compared to sole cropping, greater stability of yield over different seasons and higher yield in a given season. Competitive behaviour of these crops also vary at different sowing proportions. Hence, the present experiment was undertaken to study the competitive behaviour of these crop in either of the 2-crop combinations at different sowing proportions.

MATERIALS AND METHODS

The experiment was conducted at the Assam Agricultural University Farm, Jorhat, on sandy loam soil during winter (*rabi*) seasons of 1990-91 and 1991-92. The soil with pH 5.5 was low in available nitrogen (256.5 kg/ha) and potassium (62.2 kg/ha) and medium in available phosphorus (21.7 kg/ha). Eighteen treatments viz. sole crop of wheat ('Sonalika'), rapeseed ('M 27') and pea ('Rachan') and intercropping of wheat + rapeseed, wheat + pea and rapeseed + pea

replacement series at 5 different sowing proportions, i.e. 1 : 1, 1 : 2, 1 : 3, 3 : 1 and 2 : 1, were tested in randomized block design with 3 replications. All the crops either as sole or as intercrop were sown in rows 25 cm apart, in the middle of November during both the years. Recommended doses of fertilizers were applied in sole crops and in case of intercropping the same doses were taken in accordance to the sowing proportions of different crops.

RESULTS AND DISCUSSION

Grain or seed and straw or stover yield

Grain or seed yield of wheat, rapeseed and pea during 1990-91 (Table 1) showed that the yield of sole crop was always higher as compared to their yield as component

Table 1. Grain or seed yield and straw or stover yield of wheat, rapeseed and pea as influenced by intercropping treatments

Treatment		Grain or seed yield (q/ha)			Straw or stover yield (q/ha)		
		Wheat	Rapessed	Pea	Wheat	Rapessed	Pea
Sole wheat		18.23			35.16		
Sole rapeseed			9.50			32.31	
Sole pea				8.12			56.92
Wheat + rapeseed	1 : 1	11.85	6.12		21.32	20.11	
	1 : 2	7.97	7.00		14.76	23.67	
	1 : 3	5.50	7.68		12.88	25.92	
	3 : 1	14.70	3.32		26.78	11.88	
	2 : 1	13.15	14.63		22.50	16.79	
		10.60	5.75		19.65	19.67	
Wheat + pea	1 : 1	9.83		4.91	20.53		35.36
	1 : 2	6.06		5.60	13.24		37.68
	1 : 3	3.42		6.40	7.42		44.58
	3 : 1	14.60		2.60	27.03		19.60
	2 : 1	12.90		3.26	23.06		24.83
		9.36		4.55	18.26		32.41
Rapeseed + pea	1 : 1		4.90	4.50		20.75	36.74
	1 : 2		3.86	5.25		17.93	38.67
	1 : 3		1.90	6.05		6.60	42.27
	3 : 1		7.26	2.75		28.35	23.24
	2 : 1		6.25	3.48		24.64	28.00
			4.83	4.41		19.42	33.78

crops in different intercropping treatments. The yield of each crop decreased gradually, as the sowing proportion of the crop decreased.

Grain yield of wheat in all the sowing proportions with rapeseed was higher than the corresponding treatments with pea. Rapeseed had comparatively shorter plant height and a short growing period of 93 days, whereas pea crop occupied the field for 1 week more than wheat. With different durations, rapeseed and wheat might have had their peak demand for light, moisture and nutrients at different periods thus producing complementary effects for each other.

Seed yield of rapeseed was also higher in association with wheat as compared to that with pea. Wheat, being erect in nature, might have resulted in less competition with rapeseed which was not the case of pea. Another reason for lower yield of wheat or rapeseed in association with pea might be more plant height and trailing habit of pea showing tendency to make a mechanical disturbance to the associated crop.

The grain yield of pea was higher in intercropping both with wheat and rapeseed as compared to its expected yield level and it was slightly higher in association with wheat than with rapeseed. Better mechanical support for a longer period when grown with wheat minimized the lodging of pea which might have created favourable condition for the crop resulting in higher yield.

As in case of grain or seed yield, the straw or stover yield of wheat, rapeseed and pea was highest in their respective sole crop treatments and the yield decreased gradually as the replacement proportion of the crop by the other increased.

Wheat equivalent yield

Wheat + rapeseed combination recorded the highest values of wheat equivalent yield (Table 2) which were significantly higher over those for wheat + pea, rapeseed + pea combinations and sole cropping of either of the crops, during both the years. Higher wheat equivalent yield in wheat + rapeseed combination was due to increase in intercrop yield of both the crops.

All the sowing proportions of wheat + pea except 1:2 and 1:3 were superior to sole cropping of pea. However there was no significant increase over sole cropping of wheat in both the years. In rapeseed + pea, the wheat equivalent yield increased as the sowing proportion of pea decreased, 3:1 and 2 : 1 sowing proportions recorded the highest values in the first and second year respectively, though these 2 treatment did not differ significantly in this respect. Although none of the sowing proportions could prove superiority over sole cropping of rapeseed, all the sowing proportions except 1 : 3 gave significantly higher wheat equivalent yield over sole cropping of pea.

A 1 : 1 sowing proportion of wheat + rapeseed recorded the highest wheat equivalent values of 24.09 and 27.29 q/ha during 1990-91 and 1991-92 respectively which were significantly higher over all the treatments of sole and intercropping. The findings are in agreement with those of Mannan (1987).

Land equivalent ratio

While comparing the different intercrop

Table 2. Wheat equivalent yield and competitive functions as influences by intercropping treatments

Treatments		Wheat equivalent yield (q/ha)		Land equivalent ratio		Aggressivity					
						Wheat		Rapeseed		Pea	
		A	B	A	B	A	B	A	B	A	B
Sole wheat		18.23	19.66								
Sole rapeseed		19.00	21.10								
Sole pea		16.24	15.32								
Wheat + rapeseed	1:1	24.09	27.29	1.29	1.33	0.01	0.03	-0.01	-0.03		
	1:2	21.79	23.96	1.17	1.16	0.18	0.24	-0.18	-0.24		
	1:3	20.86	22.13	1.11	1.07	0.12	0.19	-0.12	-0.19		
	3:1	21.34	23.29	1.16	1.15	-0.32	-0.35	0.32	0.35		
	2:1	22.41	24.18	1.22	1.19	-0.40	-0.61	0.40	0.61		
		22.10	24.17	1.19	1.18						
Wheat + pea	1:1	19.65	20.21	1.15	1.17	-0.13	-0.13			0.13	0.13
	1:2	17.26	16.92	1.02	1.01	-0.03	-0.04			0.03	0.04
	1:3	16.22	15.58	0.89	0.96	0.30	-0.27			0.30	0.27
	3:1	19.80	20.29	1.12	1.09	-0.21	0.25			0.21	0.25
	2:1	19.42	19.56	1.10	1.08	-0.15	-0.19			0.15	0.19
		18.47	18.51	1.06							
Rapeseed + pea	1:1	18.80	19.66	1.06	1.09			-0.08	-0.03	0.08	0.03
	1:2	18.22	18.26	1.05	1.06			0.25	0.27	-0.25	-0.27
	1:3	15.90	16.43	0.94	1.00			-0.19	-0.13	0.19	0.13
	3:1	20.02	20.31	1.10	1.04			-0.34	-0.17	0.34	0.17
	2:1	19.46	20.39	1.09	1.08			-0.30	-0.27	0.30	0.27
		18.48	19.08	1.05	1.05						
CD (P = 0.05)		1.84	1.23	0.09	0.15						
		0.74	0.46	0.06	0.07						

A, 1990-91; B, 1991-92

combinations (Table 2) wheat rapeseed was found superior to wheat + pea and rapeseed + pea for LER during both the years while the latter two combinations did not differ significantly in this respect. Dutta *et al.* (1994) on intercropping of wheat, rapeseed and pea observed higher LER in wheat + rapeseed compared to that of wheat + pea.

Wheat + rapeseed at 1:1 sowing proportion recorded the highest LER values of 1.29 and 1.33 during 1990-91 and 1991-92 respectively which were significantly higher over those of all other intercropping treatments except for 2:1 sowing proportion of wheat + rapeseed. Higher LER values in wheat + rapeseed was the resultant of higher partial LER values for both the component crops, indicating less competition between them or complementary effect of one crop on the other. Singh and Yadav (1990) also reported the complementary effect of wheat and mustard in intercropping as reflected by higher net return.

It was evident that when the sowing proportion of pea was more than 50% either with wheat or rapeseed the yield advantage in terms of LER reduced and at 1:3 sowing proportion the LER values were 1.0 or less than 1.0.

Aggressivity

In case of wheat + rapeseed, when sowing proportion of rapeseed was more, the wheat crop became dominant as shown by positive aggressivity values for 1:1, 1:2 and 1:3 sowing proportions (Table 2), however, as the sowing proportion of wheat increased the competitive behaviour changed and the same crop got dominated by rapeseed.

In intercropping of pea either with wheat or rapeseed at all the sowing proportions except at 1 : 2 of rapeseed + pea, the pea crop was dominant.

Wheat + rapeseed at 1 : 1 sowing proportion recorded the lowest values of aggressivity of 0.01 and 0.03 during 1990-91 and 1991-92 respectively indicating almost identical competitive behaviour of these two crops at this particular sowing proportion, and for this reason the competitive behaviour of these 2 crops differed when their sowing proportion was changed which was not observed in case of wheat + pea and rapeseed + pea.

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