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Comparative performance of intercropping of pulses and oilseeds with rainfed wheat (*Triticum aestivum*) in Bangladesh

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ABSTRACT

A field experiment was conducted at Jamalpur, Bangladesh, on alluvial soils during winter seasons of 1995-98 to evaluate the economically and biologically sustainable intercrop association of wheat [*Triticum aestivum* (L.) emend. Fiori & Paol.], with yellow sarson (*Brassica campestris* L.) and local grasspea (*Lathyrus sativus* L.), grown for fodder and grain under rainfed condition. Intercropping of grasspea either for grain or fodder and yellow sarson with wheat was found biologically sustainable over sole wheat. Between the intercrop the association of wheat with grasspea was more beneficial than mustard. Association of wheat with grasspea (G) under either 3:1 or 1:1 and grasspea (F) under 3 : 1 row ratio was found more sustainable as these were accounted for better value in respect of biological parameters and were economically more remunerative. Three crop combination in alternate rows (1:1:1) failed to overcome double crops but more feasible agronomically over sole stand.

Key words : Intercroppring, Wheat, Grasspea, Yellow sarson

Wheat [*Triticum aestivum* (L.) emend. Fiori & Poal.] is grown in Bangladesh during *rabi* season mostly under rainfed condition. The average yield of rainfed wheat is generally low. Scope exists to improve and stabilize the productivity and profitability from wheat through proper choice of intercrops and adopting proper row ratios of the same (Jha *et al.*, 1991). Furthermore, shortage of green fodder prevails during dry season. It would be an advantage, if some extra yield, grain or fodder, could be harvested from the same unit of land in addition to pure stand. Thus, intercropping of some other crop with wheat may be a sustainable cropping system under low management and rainfed situation. Singh *et al.* (1992) observed beneficial advantage from legume with non-legume intercropping system. Row ratio of base and companion crop had competitive effect on both the crops (Jha *et al.*, 1991). Hence to address the above situations a study was undertaken to evaluate the biological and economic feasibility of rainfed wheat with yellow sarson (*Brassica campestris* L.) and grasspea (*Lathyrus sativus* L.) at different row ratios.

MATERIALS AND METHODS

The field experiment was conducted at the

Research Farm of the Regional Agricultural Research Station, Jamalpur, Bangladesh, during *rabi* seasons of 1995-98. The soil was silt loam of the Old Brahmaputra Floodplain. The soil had pH 5.95, containing organic carbon 1.079%, total nitrogen 0.0876%, available P and K 32 and 168 kg/ha. The total rainfall during the crop period of November to March in 1995-96, 1996-97 and 1997-98 was 144.4, 130 and 77 mm respectively. The treatment consisted of sole stands of each wheat 'Kanchan', yellow sarson mustard 'BARI Sharisha 6', grasspea 'Jamalpur Local' and intercrop association of wheat with each mustard and grasspea grain (G) and fodder (F) in row ratios of 1:1, 3:1 and 1:1:1. Thus, 12 treatments (Table 1) were replicated 4 times in randomized block design. The nutrients, recommended for the rainfed condition, in the sole stands of wheat, mustard and grasspea were applied as 60-60-40-0, 80-60-40-20 and 20-60-40-0 NPKS (kg/ha), respectively, and in intercrops as per their row ratios. The row spacing for all the crops was 20 cm.

The pooled grain yield of 3 years were

Table 1. Biological parameters of wheat, mustard and grasspea intercropping systems (pooled over 3 years)

Cropping system	Yield kg/ha			LER	RCC			Aggressivity	Weighted index
	Wheat	Intercrops	Wheat equivalent		K_1	K_2	K		
Wheat : mustard									
1:1	1,385	470	1,972	1.11	1.55	1.01	1.56	0.21	1.16
3:1	2,080	292	2,445	1.22	5.28	0.32	1.20	0.43	1.29
Wheat : grasspea (G)									
1:1	1,448	765	2,596	1.29	1.75	1.87	3.27	-0.99	1.28
3:1	2,152	464	2,848	1.33	8.61	0.33	2.81	0.23	1.37
Wheat : grasspea (F)									
1:1	1,419	5,850	1,784	1.21	1.65	1.43	2.35	-0.83	1.19
3:1	2,157	3,350	2,357	1.29	8.99	0.25	2.28	0.41	1.14
Wheat : mustard : grasspea									
1:1:1 (F)	1,005	294 + 4360	1,615	1.19	0.79	0.45	0.78	0.32	-0.95
1:1:1 (G)	959	307 + 424	2,045	1.11	0.73	0.49	0.56	0.20	-1.47
Wheat sole	2,277		2,277	1.00					
Mustard sole		935	1,108	1.00					
Grasspea sole (G)		1,175	1,762	1.00					
Grasspea sole (F)		9,950	622	1.00					
CD (P = 0.05)	39.1		46.75						

statistically analysed. It was further compared for different competition functions, total land-equivalent ratio (LER), coefficient (RCC) and their products of wheat on intercrops mustard, grasspea (G and F) and that of intercrops on wheat as described by Willey (1979). It was further evaluated on the basis of different economical parameters such as monetary advantage (value of combined intercrops yield) × (LER-1)/LER, net return, net return/Re. investment, differences in net return over sole stand of wheat.

RESULTS AND DISCUSSION

Biological feasibility

Significant variation in grain and fodder yields of all the crops and crop combinations were recorded (Table 1). Yield of wheat, mustard and grasspea as grain (G) and fodder (F) in pure stand was the highest and declined substantially in intercropping combinations. The declination may be attributed to row ratios and the population *per se* at harvest. Sinde *et al.* (1991) reported similar reduction in the yield of intercrops. Intercropping wheat outyielded expected yields regardless of sowing ratios. Wheat grown in association with grasspea whether for grain or fodder gave 41 and 27% more yield than expected in 3:1 and 1:1 row ratios respectively. Accordingly the significantly highest equivalent yield (2,848 kg/ha), LER (1.33), weighted index, RCC and finally aggressivity were recorded with wheat + grasspea in 3 : 1 row ratio. The higher equivalent yield dictated higher biomass production and efficient use of available growth resources under intercropping than under sole cropping (Sinde *et al.*, 1991). The superiority of LER might be ensured with the optimum utilization of solar radiation, time (grasspea harvested earlier), soil moisture more efficiently and maintained yield stability (Jha *et al.*, 1991). Weighted index (Chatty and Rao, 1981) again confirmed the legume nonlegume assciation either for 3:1 or 1:1 row ratio. Relative crowding coefficient of mustard and grasspea showed more non-competitive than wheat giving marginal relative value. Wheat was aggressive under both row ratios (3:1 and 1:1) with mustard and was acted as dominant crop.

Wheat in mustard failed to produce equivalent yield to that of legume association but higher than expected yield in both the row ratios. The adverse effect of mustard on wheat and wheat on mustard was more conspicuous in 1:1 row ratio. Because mustard grow faster than wheat and had upper hand competition for growth resources (Kumar and Ahlawat, 1986). Three-crop combination was better than sole but inferior to double crops. The differential behavior of these 3 crops with respect to inter-row competition might be due to varying canopy of those crops. Average grasspea height was lower than that of mustard and wheat. Thus in 3-crop combination mustard had the advantage as it was more exposed to sun, whereas wheat and grasspea growing under canopy and suffered more. Singh *et al.* (1992) observed the same trend in mustard+wheat+lentil combination.

Economic feasibility

The monetary advantage evaluated over sole wheat indicated a positive gain from intercropping system. Maximum monetary advantage was recorded from wheat +

Table 2. Economic parameters of wheat, grasspea or mustard in intercropping system (pooled over 3 years)

Cropping system	Monetary advantage (Rs/ha)	Net (Rs/ha) return	% increase in net return over wheat	Net return/Re investment	Net return (Rs/day)
Wheat sole		10106	100	1.49	91.87
Mustard sole		1592	16	0.18	15.16
Grasspea sole (G)		8250	82	1.41	75.00
Grasspea sole (F)		2433	25	0.96	44.24
Wheat : mustard					
1:1	1563	7892	78	0.89	71.75
3:1	3527	12137	120	1.44	110.33
Wheat : grasspea (G)					
1:1	4669	12544	124	1.53	114.04
3:1	5653	14764	146	1.84	134.22
Wheat ; grasspea (F)					
1:1	2477	6452	64	0.83	58.65
3:1	4238	11836	117	1.69	107.60
Wheat mustard : grasspea					
1:1:1 (F)	2063	4686	46	0.57	42.60
1:1:1 (G)	1621	8271	82	1.02	75.10

Price (Rs/kg) Wheat 5.00, mustard 10.00, grasspea 12.00, fodder 0.50

grasspea (G) (3:1), followed by the same crops with 1:1 row ratio (Table 2). Sole crops failed to give maximum net return. It appeared that wheat, mustard and grasspea are less benefited under sole cropping. Wheat when grown with grasspea (G) in either combination gave 24 to 46% higher monetary advantage over sole wheat. But grasspea (F) and mustard in 1:1 row ratio failed to give increase return over sole wheat. Three-crop combination is not economically feasible. The row proportion of 3:1 wheat + grasspea gave maximum net return/Re investment (Rs 1.84 and 1.69) followed by 1:1 row ratio of the same crop combination (Rs 1.53). Similar trend was also noticed in the case of net return per day.

The results reveal that intercropping of grasspea either for grain or fodder or mustard with wheat can be biologically sustainable and economically viable over sole wheat. It is also observed that the association of wheat with grasspea is more beneficial than mustard.

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