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Evaluation of cotton based inter cropping for Northern Region of Bangladesh

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Abstract

Intercropping is the simultaneous cultivation of more than one crop species on the same piece of land and is regarded as the practical application of basic ecological principles such as diversity, competition and facilitation. The experiment on the cost benefit analyses of some cotton based intercropping was taken at Cotton Research Centre, Rangpur which is suitable for northern region of Bangladesh. The experimental design was Randomized Complete Block Design with three replications. Among six treatments, statically significant and profitable result was found in seed cotton yield, also for potato and wheat yield. The treatment T5. (Cotton + Red amaranth + Potato + Maize + Sunhemp), has given more benefits (Cost benefit ration 2.38) than others.

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Introduction

Intercropping is a well established practice and there are 12 million hectares under double cropping system in South Asia only (Woodhead *et al.,* 1994). Yield advantages from intercropping are often attributed to mutual complementary effects of component crops, such as better use of available farm resources (Legard & Steel, 1992), Influence on population dynamics of major insect-pests (Mogahed, 2003) and control of weed (Iqbal *et al.,* 2007). Upland cotton is one of the most important commercial crop in the world. But in Bangladesh, it has fall on a critical situation for its long duration and less benefit. Scarcity of land, introduction of high value crops are also the limiting factor for extensive cotton cultivation. To overcome the situation and for making it more benefited to the farmer, cotton based intercropping is emphasized instead of sole cotton cultivation. Intercropping provides an opportunity to avoid crop competition and advantage of increased production and greater profit or margin (Evans, 1960; Gribines, 1963).and The intercrop treatments gives higher resource use efficiency (Hashem and Maniruzzaman, 1986) and higher economic returns compared to the monocrop (Macuacua *et al*., 2007).

It also increased land equivalent ratio (LER) to varying degrees (Mehta and De, 1980: Hashem *et al.,* 1990). Islam *et al.* (2004) reported that maize and bush been exhibited similar competitiveness in simultaneous sowing and resulted in the highest intercrop productivity in maize-bush bean intercropping system. Intercropping is widely practiced by the farmers of Bangladesh. Generally legumes in association with non-legumes not only helps in utilization of the nitrogen being fixed in the current growing season, but also helps in residual nutrients build up of the soil (Sharma *et al.,* 1991). Suitable cropping pattern helps the farmer to become more benefited and also increase the intensity of cropping (Aal, 1991 and Raghuwanshi *et al.* 1994). The present studies were, therefore, carried out to introduce a suitable cotton based intercropping in the greater Rangpur district, which is the suitable northern region of Bangladesh. Some high value and popular crops are included in this experiment which will give more benefit to the farmer and will increase the cropping intensity.

Materials and methods

The experiment, cotton based intercropping was started from the year 2008-09. This is the 2nd year (2009-10) of the experiment. This experiment is conducted only at the Cotton Research Center, Rangpur. Six treatments encoded T_1 (cotton +lalshak) + wheat + maize + sunhemp, T_2 (cotton + radish) + wheat + miaze + sun hemp, T_3 (cotton + mungbean) + wheat + Mungbean + sunheamp, T_4 (cotton + mungbean) + wheat + maize+ sun hemp, T_5 (cotton + Red amaranth) + potato + maize + sunhemp, and T_6 sole cotton were included. Here cotton variety was CB-10, Red amaranth variety was Altapetti, Radish variety was Bomby., mungbean variety was BARI-5, wheat variety was Sotabdi, Maize variety was Specific -555 and potato variety was Phelsina. In case of sun hemp domestic indigenous variety was included.

The soil of the experimental plot was sandy loam under agro ecological zone 1-old Himalayan piedmont plain in Bangladesh (BRAC-1977), having P^H-5.5-6.5The seeds of Cotton, Red amaranth, Mungbean, and Radish were sown at the of29/7/09.Thinning was performed after 11 days and 21 days of seed emergence. Finally one seedling in one stand. Green manure (sun hemp) was plough down at the age of 45 days. Decomposed organic matter was applied at the rate of 1.5 ton/ha at the time of final land preparation. The nutrient elements such as Nitrogen (N), phosphorous (P), potassium (K), sulpher (S), Boron (B), and Zinc sulphat (Zn) were applied in plot at the rate of 23-81-52-88 and 8 kg/ha respectively as basal dose. No much more additional fertilizers were added for intercropping. The fertilizer dose was as same as for sole cotton. The rest 69 kg nitrogen was applied in 3 equal splits at 25, 42 and 55 days after seed sowing as top dressing. In case of potato and maize additional urea was used as top dressing. In case of cotton +

Lalshak, cotton + Radish and cotton mungbean intercropping, 5 rows of Lalshak, and radish and 4 rows of Mungbean were sown in between two cotton rows. In case of cotton + wheat intercropping 4 rows wheat was sown between two cotton rows. For cotton potato intercropping one (1) row potato was sown between the two rows of cotton. In wheat + Maize, potato + maize and wheat + Mungbean intercropping one row maize one row mungbean was sown in the cotton rows (after uprooting). Weeding was performed two times. Two times irrigation was done at the third week of November and the last week of December. After 25 days of sowing 1st spray of choloropyriphose and pyrithroid was applied against sucking and chewing pest. Attack of spodoptera was Sevier but drastic control measures kept the insects under control. Hand picking, light trap and zollaghur (Molasses) trap were also used to kill moths and adults of the insects. Tilt, indofill and bavestone were sprayed to protect the fungal diseases. Data were collected on different yield contributing traits of cotton, wheat, potato, Red amaranth, Radish and Mungbean. Mean values are used for statistical analyses according to A Gomez and a Gomez and Zamal *et al.* (1982).

Table 1. Mean performance of different yield attributes of cotton.

Name of the Treatment	Monopodial Branches/ Plant	Sympodial Branches/ Plant	Plant Height (cm)	Boll per Plant	Single Boll Weight	Yield kg/ha
1. T_1	1.27	16.67	103.13	25.07	5.67	1474
2. T_2	0.77	16.33	88.23	19.63	5.59	1148
3. T_3	0.23	16.27	96.40	20.37	5.72	1358
4. T_4	0.50	16.87	100.2	24.77	5.65	1266
5. T_5	1.23	16.07	95.67	23.03	5.72	1402
6. T_6	1.25	16.50	93.4	21.75	5.50	1347
Level of significant	NS	NS	*	NS	NS	NS
LSD (0.5)	0.103	2.65	5.62	12.57	0.21	2.23
% CV	6.85	8.57	12.39	29.57	1.94	21.98

*=Significant at 5% level, **= Significant at 1% level ns=Non-significance

Table 2. Mean performance of different yield attributes of wheat.

Name of the Treatment	Number of Tillering per Plant	Plant Height (cm)	Length of Panicle	Spike let per Penical	Weight of 1000 Grain(gm)	Yield kg/ha
1. T_1	5.47	101.97	10.31	47.47	48.33	2759
2. T_2	4.67	100.40	10.41	51.23	46.67	2675
3. T_3	5.03	100.80	10.58	51.83	46.67	2922
4. T_4	4.87	103.83	10.50	50.00	48.33	3006
Level of significant	ns	ns	ns	ns	ns	ns
LSD (0.5)	1.44	5.5	12.29	7.83	4.41	3.11
% CV	1.44	1.72	5.88	7.82	4.04	13.54

*=Significant at 5% level, **= Significant at 1% level ns=Non-significance

Results and discussion

Effects of intercropping on the quality of cotton were minor and mostly below detection threshold (Zhang et al., 2007). Mean performance of the tested treatments for different yield attributes of cotton were shown in the Table-1 and for wheat Table-2. The mean yield of three replications for different intercrops was shown in the Table- 3.Variable cost, sowing time and cost benefit ratio were shown in the Table no 4 and 5 respectively. The cost benefit ration of the different intercropping of the previous year was shown in the Table- 6. No significant effect was found in yield contributing traits of cotton from different inter cropping (table-1). Only cotton plant

height showed significant result. The highest plant height was observed in T_1 (cotton + Red amaranth + wheat) + maize + sun hemp, inter cropping, the lowest was in T_6 (sole cotton). The highest amount of seed cotton was harvested from the treatment T_1 also.

Table 3. Mean yield and added crop residues in the soil from different intercropping.

Name of the Treatments	Yield of Lalshak kg/ha	Yield of Radish kg/ha	Yield of Mung bean kg/ha	Seed Cotton Yield kg/ha	Yield of potato kg/ha	Yield of Wheat kg/ha
1. T_1-Co+Ra+W +Ma+S	Yield-7000 R-2000	-	-	1474 R-3045	-	2759 R-5062
2. T_2 – Co+Mu+ W+Ma+S	-	5000 R-1500	-	1148 R-2469	-	2675 R-5103
3. T_3-Co+Mu+W Ma+S	-	-	900 R-6000	1358 R-2140	-	2922 R-5267
4. T_4-Co+Mu+W + Mu+S	-	-	950 R-6150	1266 R-2346	-	3006 R-5597
5. T_5 –Co+Ra+Po + Ma+S	6600 R-1475	-	-	1402 R-3539	20000 R-11000	-
6. T_6 – Sole cotton	-	-	-	1347 R-3360	-	-

R=Crop residue. a=Maize, Co=Cotton, Mu=Mungbean,W=Wheat, Ra= Red amaranth S=sunhemp

Table. 4. List of variable cost.

Name of Crops	Cost for land preparation	Cost for seed	Fertilizer cost	Pesticide cost	Interculture operation and harvesting cost	Total cost/3 decimal	Total variable cost/ha
(1)Cotton	20.33	2.50	175.82	90.35	112.50	351.50	28940
(2)Red amaranth	-	15.00	-	-	75.00	90.00	7410
(3)Radish	-	15.00	-	-	75.00	90.00	7410
(4)Mungbean	-	10.00	-	40.00	75.00	125.00	10291
(5)Wheat	-	30.00	30.00	-	345.00	405.00	33345
(6)Maize	-	30.00	30.00	-	200.00	260.00	21406
(7)Potato	70.00	315.00	100.00	97.50	167.50	750.00	61750
(8)sunhemp	30.06	21.25	-	-	30.06	81.37	6700

From the Table 2 it was observed that no significant effect was found for different yield attributes of wheat but highest amount of wheat was harvested from the treatment T_4 –(cotton + mungbean + wheat + maize + sun hemp) intercropping (3006 kg/ha).From the table-3 it was seen that the highest amount of crop residues added in the soil from the T_5 treatments (Red amaranth +cotton+potato)=1475+3539+11000=16014 kg which was followed by T_4 (14093 kg/ha) and T_3 (13407 kg/ha). Still the return from T_5 is the highest in respect of crop yield (table-5) and added crop residues (table-3). In the Table-6, the results of the same treatments of the previous year have been shown. The yield, gross return, cost and net return and cost benefit ratio of different included intercrops in the year 2008-09 were shown in table-6. It was seen that the highest BCR was obtained from $T_{5\ -2.37}$ (cotton + Red amaranth +potato + maize + sunhemp) which was followed by T_1 (cotton +Red amaranth + wheat + maize + sunhemp) - 1.98 T_2 (cotton + radish) + wheat + maize + sunhemp-1.89 T3--(cotton + mungbean + wheat + mungbean + sun hemp)-1.82 and T_4 (cotton + mungbean) + wheat + maize+ sunhemp-1.81where as the lowest BCR was obtained from sole cotton.

It may be concluded that accommodation of five crops in a cotton field in a year will be very courageous to the farmers. All the test of intercrops

may bring good economical returns to the farmers, at the same time; fertility of the soil will be increased due to addition of crop residues. Among the combination of four crops with cotton T_1 is more profitable but T_4 and T_5 will be the popular intercropping for the farmers of northern district because wheat and potato is the popular crop in northern region of Bangladesh.

Table 5. Cost benefit ratio from different intercropping-2009-10.

Treatments	Crops	Sowing Date	Harvesting Date	Yield kg/ha	Grosse Return/ha (taka)	Variable Cost/ha (taka)	Net Income/ ha(taka)	Benefit Cost Ratio
T1	Cotton	29/7/09	13/2/10	1482	59280	28940	30340	1.76
	Red amaranth	29/7/09	6/9/09	2058	14408	7410	6998	
	Wheat	18/11/09	23/3/10	2882	48330	33342	14985	
	Maize	14/2/10	30/5/10	3251	42263	21406	20857	
	Sunhemp	1/6/10	15/7/10	30000	30000	6700	23300-	
	Total				122018	82042	39973	
T_2	Cotton	29/7/09	13/2/10	1153	46107	28940	17167	1.54
	Radish	29/7/09	11/9/09	2058	10292	7410	2882	
	Wheat	18/11/09	23/3/10	2635	46107	33342	12765	
	Maize	14/2/10	30/5/10	2889	37537	21406	16151	
	Sunhemp	1/6/10	15/7/10	30000	30000	670	23300	
	Total				102506	82042	20464	
T_3	Cotton	29/7/09	13/2/10	1357	54360	28940	25400	1.55
	Mung bean	29/7/09	11/10/09	535	21407	10292	11115	
	Wheat	18/11/09	23/3/10	2923	51150	33342	17808	
	Mung bean	14/2/10	30/5/10	470	18800	10219	8581	
	Sunhemp	1/6/10	15/7/10	30000	30000	6700	23300	
	Total				126917	84992	41973	
T4	Cotton	29/7/09	13/2/10	1276	51046	28940	22107	1.64
	Mung bean	29/7/09	11/10/09	494	19760	10292	9468	
	Wheat	18/11/09	23/3/10	3005	52590	33342	19284	
	Maize	14/2/10	30/5/10	2510	32630	21406	11224	
	Sunhemp	1/6/10	15/7/10	30000	30000	6700	23300	
	Total				123096	84924	38509	
T_5	Cotton	29/7/09	13/2/10	1400	56000	28940	27060	2.38
	Red amaranth	29/7/09	6/9/09	2141	14984	7410	7575	
	Potato	7/6/10	20/7/10	17455	122183	61750	60433	
	Maize	23/2/10	6/6/10	8206	106678	22406	84272	
	Sunhemp	7/6/10	20/7/10	30000	30000	6700	23300	
	Total				193167	110450	82718	
T6	Cotton	29/7/09	13/2/10	1523	60927	41290	31986	1.47

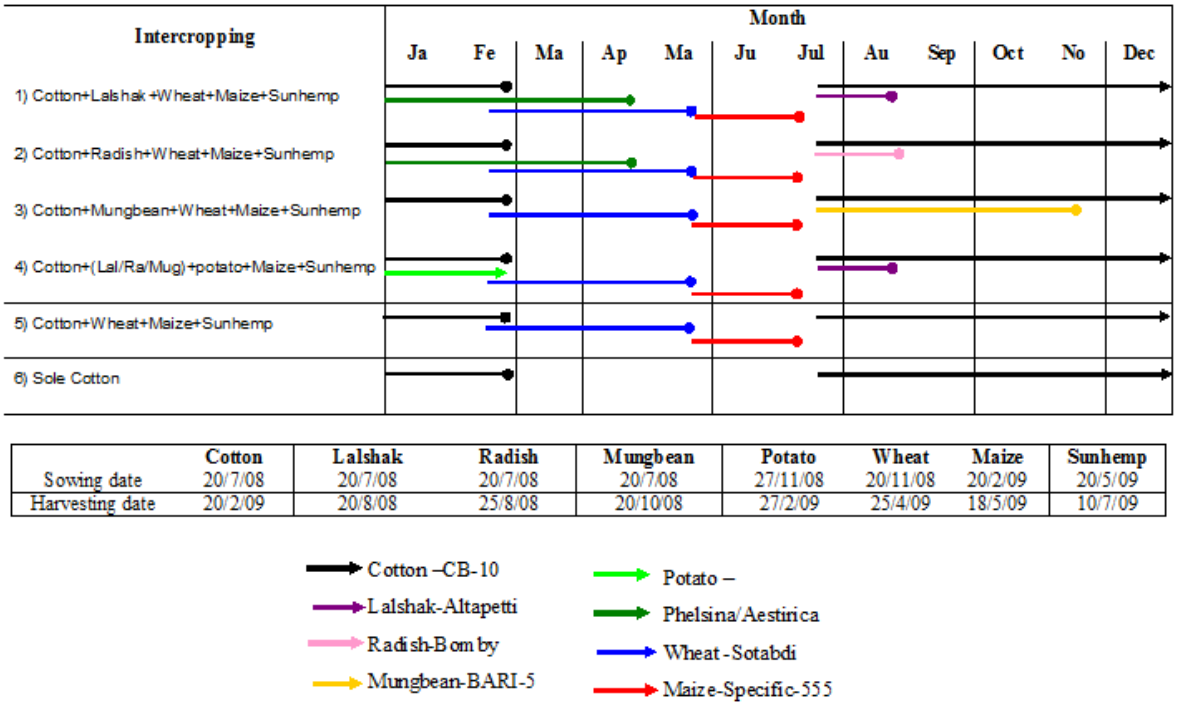
Cotton=40Taka/kg,Wheat=17.5taka/kg,Lalshak=7 Taka/kg,Radish=5Taka/kg,Mung bean=40Taka/kg, Potato=7Taka/kg,Landleige=12350Taka/ha/year Netincome=Grossreturn-Variablecost-Landleigedrent Benefit Cost Ratio=Gross return/Total variable cost.

Table 6. Yield and cost- benefit ratio from different intercropping during the year 2008-2009.

Treatments	Crops	Sowing Date	Harvesting Date	Yield kg/ha	Grosse Return/ha	Variable Cost/ha	Net Income/ha	Benefit Cost Ratio
T1	Cotton	20/7/ 08	20/2/09	1500	60000	28091	31909	1.98
	Red amaranth	20/ 7/ 08	20/8/08	4500	31500	7800	23700	
	Wheat	20/11/08	25/4/09	2960	47360	33342	14018	
	Maize	20/2/09	18/5/09	5500	55000	21406	33393	
	Sunhemp	20/5/09	10/7/09	25700	25700	6700	19000	
	Total				217560	97339+12350	122220	
T_2	Cotton	20/7/ 08	20/2/09	1458	58320	28091	30229	1.89
	Radish	20/ 7/ 08	25/8/08	4245	25470	7410	18060	
	Wheat	20/11/08	25/4/09	2800	44800	33342	11458	
	Maize	20/2/09	18/5/09	5356	53560	21406	32154	
	Sunhemp	20/5/09	10/7/09	24347	24347	6700	17647	
	Total				206497	96949+12350	109548	
T_3	Cotton	20/7/ 08	20/2/09	1347	53880	28091	25789	1.82
	Mung bean	20/ 7/ 08	20/10/08	747	29880	10291	19589	

	Wheat	20/11/08	25/4/09	3000	48000	33342	14685	
	Mung bean	20/2/09	18/5/09	700	28000	10291	17709	
	Sunhemp	20/5/09	10/7/09	24047	24047	6700	17347	
	Total				183807	88715+12350	95092	
T4	Cotton	20/7/ 08	20/2/09	1420	56800	28091	28709	1.81
	Mung bean	20/ 7/ 08	20/10/08	750	30000	10291	19709	
	Wheat	20/11/08	25/4/09	2690	43040	33342	9698	
	Maize	20/2/09	18/5/09	4847	48470	21406	27064	
	Sunhemp	20/5/09	10/7/09	24980	24980	6700	18280	
	Total				203290	99830+12350	103460	
T_5	Cotton	20/7/ 08	20/2/09	1498	59920	28091	31829	2.37
	Red amaranth	20/ 7/ 08	20/8/08	5000	35000	7800	27200	
	Potato	27/11/08	27/2/09	16000	152520	62000	90320	
	Maize	20/2/09	18/5/09	5600	56000	21406	34594	
	Sunhemp	20/5/09	10/7/09	2500	25000	6700	8300	
	Total				328240	125997+12350	202243	
T6	Cotton	20/7/08	20/2/09	1550	62000	28091+12350	33909	1.53

Cotton=40Taka/kg,Wheat=16taka/kg,Lalshak=7 Taka/kg,Radish=6Taka/kg,Mung bean=40Taka/kg, Potato=9.25Taka/kg,Landleige=12350Taka/ha/year.Netincome=Grossreturn-Variablecost-landleigedrent BenefitCostRatio=Gross return/Total variable cost.



	Cotton	Lalshak	Radish	Mungbean	Potato	Wheat	Maize	Sunhemp
Sowing date	20/7/08	20/7/08	20/7/08	20/7/08	27/11/08	20/11/08	20/2/09	20/5/09
Harvesting date	20/2/09	20/8/08	25/8/08	20/10/08	27/2/09	25/4/09	18/5/09	10/7/09

Fig. 1. Crop calendar of intercropping.

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