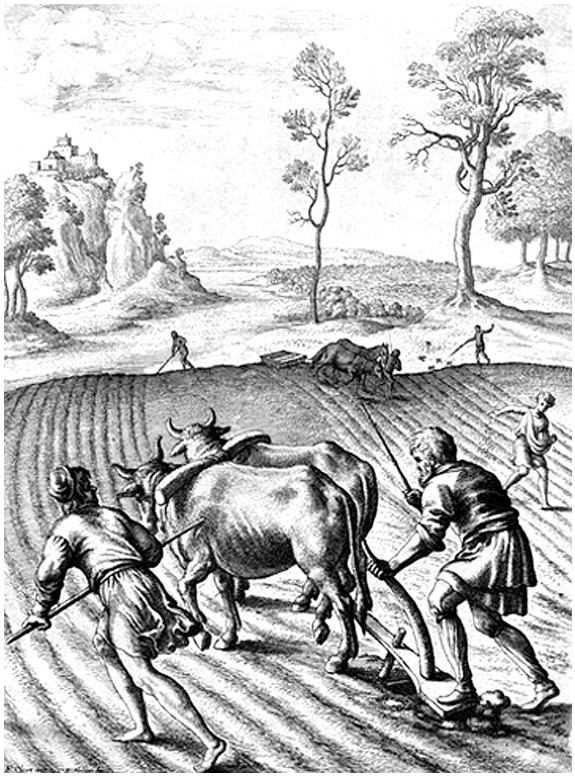
ISSN : 1812-5379 (Print)
ISSN : 1812-5417 (Online)
http://ansijournals.com/ja

JOURNAL OF AGRONOMY



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Journal of Agronomy 5 (2): 228-231, 2006
ISSN 1812-5379

Banana Based Intercropping System in North-west Part of Bangladesh

[1]M.Z. Rahman, [1]M.H. Rahman, [1]M.E. Haque, [1]M.H. Kabir, [1]S.L. Naher,
[1]K.M.K.B. Ferdaus, [1]A.K.M. Nazmul Huda, [2]M.S. Imran and [2]M. Khalekuzzaman
[1]Institute of Biological Sciences, [2]Department of Genetics and Breeding,
University of Rajshahi, Rajshahi-6205, Bangladesh

Abstract: An experiment was conducted to find out a suitable banana (Ranginsagar and Sabari) based intercrop combination of potato and mustard in the research field of Institute of Biological Science of Rajshahi University, Rajshahi-6205, during Rabi season of 2003-2004. Average over the two years, it revealed that the highest yield of banana was observed in Ranginsagar + potato (64.72 t ha^{-1}) and the lowest in sole mustard (1.92 t ha^{-1}). Combinations of Ranginsagar + potato intercropping showed better performance than other combination and sole crop in respect of gross return (Tk. 735219 ha^{-1}), net return (Tk. 359794 ha^{-1}) and benefit cost ratio (1.95). The highest land equivalent ratio (LER) was 1.82 in Ranginsagar + Potato followed by Sabari + potato (1.79) and the lowest in Sabari + mustard (1.60). The economic return was more in intercropping than all sole crops.

Key words: Intercropping, ranginsagar, sabari, potato, mustard, equivalent yield, land equivalent ratio, benefit cost ratio

INTRODUCTION

Bananas and plantains (*Musa* sp.) are the most widely consumed fruit and its annual production is estimated to be approximately 88 mt (Anonymous, 1999), making them one of the largest food crops in the world after rice, maize and wheat (Anonymous, 1997). It is the most important starch rich horticultural crop of Bangladesh cultivated over an area of more than 105835 acres with annual production of 606100 mt (Anonymous, 2001).

Potato [*Solanum tuberosum* L.] is a winter tuber vegetables which ranks first in respect of use and production in almost all parts of Bangladesh. Mustard [*Brassica napus* L.] is a major oil seed crop of Bangladesh. It covers 59.6% of the total oil seed area and produces 60% of the total oil seed production of the country (Anonymous, 2001).

Intercropping or mixed cropping farms is a cropping practice where total production from a unit area of land in a farming year is achieved through growing two or more crops simultaneously in the same land area, particularly in tropics (Andrews and Kassam, 1976) and in densely populated countries, sole crop in sequence or a combinations of mixed and sole crops in sequence. Intercropping gives a greater stability of yield over monoculture (Willey and Reddy, 1981). Besides, it often provides higher economic and monetary return and total productions per hectare compared to monoculture (Grimes *et al*., 1983; Kurata, 1986) and ensures greater resources use efficiency (Herrara and Harwood, 1974; Pathick and Malla, 1979). It has been reported from many countries viz., Bangladesh, India, China, Taiwan, Sri Lanka, Vietnam, Africa and Latin America (Beets, 1977).

Rajshahi is the very potential area for production banana, potato and mustard. Traditionally, the farmers of Rajshahi area cultivate long duration banana as well as short duration potato and mustard as a mono crop. The farmers don't know how to produce more production from per unit area, how to cultivate banana, potato and mustard simultaneously. Indeed, such type of investigation in banana, potato and mustard is scants. Therefore, the present study was under taken to find out yield, cost and net return of the intercropping system in order to select the best banana based one.

MATERIALS AND METHODS

The experiment was conducted at the research field of Institute of Biological Sciences of Rajshahi University, Rajshahi-6205 in the North-west region of Bangladesh during the period of Rabi season of 2003-2004 in Randomized Complete Block Design with three dispersed replications for selecting responds. The unit plot size was 6×4 m. Banana spacing (plant to plant 2×2 m apart) was maintained to accommodate potato and mustard per unit plot. Two genotypes of banana, namely Ranginsagar (AAA; 3n = 33) and Sabari (AAB, 3n = 33) were collected from the farmers field and potato and mustard seeds were from BADC form Nowdapara. Totally eight different

Corresponding Author: M.Z. Rahman, Institute of Biological Sciences, University of Rajshahi, Rajshahi-6205, Bangladesh

treatments were taken in the study, such as sole Ranginsagar, sole Sabari, sole potato, sole mustard, Ranginsagar + potato, Ranginsagar + mustard, Sabari + potato and Sabari + mustard. The land of the experimental site was medium high and the soil was silty loam with pH 6.0 to 7.0, 45 to 50 days old banana seedlings were transplanted into the respective pits on first weeks of November in both the year. The seeds of potato and mustard were planted as sole and intercrop between the two rows after planting the banana in both the year. The land was prepared to fine tilth and fertilizers were applied as shown in Table 1.

All the fertilizers except urea were applied during the final land preparation in sole banana but in sole potato, mustard as well as in intercropping combinations 40% urea and MP, entire quantity of TSP, gypsum and Zn were broadcast at the time of final land preparation and the remaining urea and MP were applied into equal splits at 35 days and 55 days after transplanting. Necessary intercultural operations were done to facilitate the growth and development of the crop. Marketable potato, mustard and banana were harvested at 100-110, 90-100, 300-310 (Ranginsagar) 375-380 (Sabari) days, respectively after transplanting.

Collected data were analyzed by following standard statistical methods (Equivalent yield, LER and BCR etc.) and significant text was computed from F test and LSD (0.05) technique.

Banana equivalent yield was calculated by converting yield of intercrops to the yield of banana on the basis of prevailing market prices of the individual crops. The formula is as follows:

$$\text{Banana equivalent yield} = Y_0 + (Y_i \times P_i)/ P_0$$

Where:
Y_0 = Yield of banana
Y_i = Yield of intercrop (potato/mustard)
P_i = Selling price of intercrop (potato/mustard)
P_0 = Selling price of banana

$$\text{Land Equivalent Ratio (LER)} = \frac{\text{Intercrop yield of banana}}{\text{Sole crop yield of banana}} + \frac{\text{Intercrop yield of potato /mustard}}{\text{sole crop yield of patato/mustard}}$$

Benefit Cost Ratio (BCR) = Gross return/Cost of cultivation

RESULTS AND DISCUSSION

Yield and yield components of banana: There were significant effects of potato and mustard on number of hands per bunch, number of finger per hand, total number of finger per bunch, finger weight (g), bunch weight (kg) and yield per plot (kg) but no significant effect was found on number of leaves per plant, finger length (cm) and finger girth (cm) (Table 2). All the intercrop combinations also performed better yield than those of sole crop but the individual yield of banana is decreased in intercrop combinations. Superior values of the above yield and yield attributes of banana were recorded from Ranginsagar + potato combination closely followed by Sabri+potato combination. On the other hand, correspondingly lowest values were obtained from Sabari + mustard combination. The yield of banana (Ranginsagar and Sabari) decreased 8-10 and 13-18%, respectively. Similar result was observed by Devos and Wilson (1979) in food crops, maize, cassava and cocoyam with plantains. The yield variation among two different banana crops (Ranginsagar and Sabari) was due to the reason of bearing habit and genetic yield potentialities. On the other hand, the reduction in intercropping situation might be the cause of facing competition with the companion crop for space, light, water and nutrients that caused reduction in number of hands, total number of fingers and finger weight (g). Maximum reduction was recorded in banana (Sabari)+ mustard. This is because, mustard is shallow irrigated crop but banana (Sabari) is a deep irrigated fruit crop. So, due the excess irrigation during intercultural operations of banana vegetative growth and grain yield decreased remarkably.

Table 1: Dosages of various fertilizers applied per hectare of land

Treatment	Cow dung (t ha^{-1})	kg ha^{-1} OL	N	P	K	S	Zn
Ranginsagar +sole	25	2.5	200	100	400	20	5
Sabari + sole	25	2.5	200	100	400	20	5
Potato + sole	25	2.5	150	60	150	20	4
Mustard + sole	25	2.5	100	80	60	40	4
Ranginsagar + potato	25	2.5	200	100	400	20	5
Ranginsagar + mustard	25	2.5	200	100	400	20	5
Sabari + potato	25	2.5	200	100	400	20	5
Sabari + mustard	25	2.5	200	100	400	20	5

Yield of potato and mustard: Yield of potato was significantly affected by different crop combinations (Table 3). The highest yield (30.50 t ha^{-1}) was observed in sole crop of potato and lowest (26.12 t ha^{-1}) in the combination of banana (Sabari) + potato. Similarly, sole mustard produced significantly higher yield (1.92 t ha^{-1}) than those in other combinations. The main reason of reduction of yield of the component crops were due to lower number of crops per unit plot as banana covered few land in intercropping combination.

Banana equivalent yield: All the intercropping situations showed higher equivalent yield than that of sole

Table 2: Yield and yield contributing characters of banana influenced by intercropping

Treatments	No. of leaf/plant	No. of hands/bunch	No. of fingers/hand	Total No. of finger/bunch	Finger length (cm)	Finger girth (cm)	Finger weight (g)	Bunch weight (kg)	Yield/ plot (kg)
Ranginsagar (sole)	10.07	8.42	14.02	118.04	14.90	13.90	132.10	15.59	187.08
Sabari (sole)	10.68	7.01	12.10	84.80	12.85	13.92	118.20	10.02	120.24
Ranginsagar+potato	9.75	8.25	13.88	114.47	14.78	13.85	128.50	14.71	176.52
Ranginsagar+mustard	9.62	8.22	13.78	113.32	14.75	13.81	127.60	14.46	173.52
Sabari+potato	10.30	6.85	11.85	81.20	12.73	13.90	116.50	9.46	113.52
Sabari+mustard	9.85	6.80	11.72	79.74	12.68	13.87	116.00	9.25	110.98
F test	NS	*	*	**	NS	NS	**	**	**
LSD (%)	NS	0.05*	0.05	0.01*	NS	NS	0.01*	0.01**	0.01*

* = Significant at 5% level; ** = Significant at 1% level; NS = Non Significant

Table 3: Yield of banana, potato, mustard and equivalent yield of sole and intercropping system

Treatments	Banana yield (t ha^{-1})	Potato yield (t ha^{-1})	Mustard yield (t ha^{-1})	Banana equivalent yield (t ha^{-1})	LER
Ranginsagar (sole)	38.80	-	-	38.80	1
Sabari (sole)	25.02	-	-	25.02	1
Potato (sole)	-	30.50	-	30.50	1
Mustard (sole)	-	-	1.92	01.92	1
Ranginsagar + potato	36.78	26.45	-	64.72	1.68
Ranginsagar+mustrad	36.15	-	1.35	39.72	1.52
Sabari+potato	23.65	26.12	-	48.48	1.62
Sabari+mustard	23.12	-	1.32	26.24	1.42
LSD (%)	00.01**	00.01**	0.01**	00.0**	

* = Significant at 5% level, ** = Significant at 1% level

Table 4: Economic analysis of sole and intercropping combinations

Treatments	Gross return (Tk ha^{-1})	TVC (Tk ha^{-1})	RAVC (Tk ha^{-1})	BCR
Ranginsagar (sole)	440768	239418	201350	1.84
Sabari (sole)	318004	172779	145225	1.95
Potato (sole)	366000	180679	185321	2.02
Mustard (sole)	57600	16370	41230	3.52
Ranginsagar+potato	735219	375425	359794	1.95
Ranginsagar + Mustard	451219	244068	207151	1.85
Sabari+potato	616180	323145	293035	1.90
Sabari + mustard	333510	182772	150738	1.82

TVC = Total variable cost; RAVC = Return above variable cost; BCR = Benefit cost ratio

cropping. Among the intercropping combinations the highest banana equivalent yield (64.72 t ha^{-1}) was obtained from banana (Ranginsagar) intercropped with potato and lowest (26.24 t ha^{-1}) from banana (Sabari) with mustard. The equivalent yield variation was due to their yield and economic value (Table 3).

LER: Land equivalent ratio was higher in all intercropping than sole cropping. The combination of banana (Ranginsagar) + potato gave the highest LER (1.68) followed by LER (1.62) with banana (Sabri) + potato and the lowest LER (1.42) was observed with banana (Sabari) + mustard. The LER value 1.68 in banana (Ranginsagar) + potato indicated that by intercropping banana (Ranginsagar) and potato at a spacing 2×2 m for both banana (Ranginsagar and Sabari) and potato, a farmer could produce 36.78 tons of banana (Ranginsagar) and 26.45 tons of potato from one hectare of land instead of growing them separately in 1.68 ha of land to obtain the same combined yield. Kasture and Mangitear (1985) reported that in an intercropping system crop plants enter into complex interaction with each other resulting in either increasing or decreasing the total production. Similar result was observed by Qasem *et al.* (1986) in Chili + maize intercropping.

Economic analysis: All the intercropping combinations showed higher monetary return than that of in monocropping (Table 4). The highest gross return (Tk. 735219 ha^{-1}) was recorded from banana (Ranginsagar) + potato. Intercropping of banana (Sabari) with potato and with mustard did not perform well as compared to intercropping with banana (Ranginsagar) but produced higher gross return than those of the sole. Agrewal (1995) also obtained more yield and more profit from intercropping than in sole crop system. The highest net return over variable cost was obtained from banana (Ranginsagar)+potato which had the highest benefit cost ratio (1.95). The net return over variable cost and benefit cost ratio were observed in banana (Sabari) + mustard (Tk. 150738 ha^{-1}and 1.68), respectively. This is because mustard is shallow irrigated crop, which was damaged due to excess irrigation for deep irrigated banana crop. In addition, mustard is light favored crops, which was also damaged due to shading effect of banana. Another important reason is that genetically mustard is low yielding than that of another intercrop, potato. On the other hand, banana equivalent yield, LER, gross return, net return and BCR were maximum in banana (Ranginsagar)+potato followed by banana (Sabari) + potato. These might be due to the following reasons:

- Banana is deep irrigated fruit crops. During intercultural operation, being highly irrigated crop than mustard, potato utilizes the available irrigation in intercropping combination.
- Being a wide spaced row crop, potato can utilize almost same area in sole and intercropping.
- Banana have no shading effect on potato, even cool environment due to banana is beneficial to potato.

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