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CROP PRODUCTIVITY IN SOIL AS AFFECTED BY INTERCROPPING WITH WHEAT

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ABSTRACT

Khatun S, Azad AK, Bala P (2012) Crop productivity in soil as affected by intercropping with wheat. *J. Soil Nature* 6(1), 22-25.

A field experiment was conducted during November 2009 to April 2010 on intercropping of soybean, potato and lentil with wheat crop at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh to evaluate the crop productivity of different intercrop combinations compared to their respective sole cropping. The experiment was laid out in a randomized complete block design with three intercrops and four sole crops treatment combinations assigned in three replications. Crop characteristics and yield of wheat reduced in intercropping treatments as compared to sole cropping of wheat. Among the intercropping treatments, the highest grain yield was found (1.736 t ha^{-1}) in wheat + lentil and the lowest grain yield (1.463 t ha^{-1}) was found in wheat + soybean intercropping treatments. The seed yield of component crops reduced in intercropping treatments as compared to their sole crops. All the intercropping treatments gave higher wheat equivalent yield than their respective sole crops except potato and lentil.

Key words: *crop productivity, wheat, intercropping*

INTRODUCTION

Growing of two or more crops simultaneously in the same piece of land in alternating rows or in set of rows is called intercropping. Intercropping has been recognized as a potentially beneficial system of crop production and evidences suggest that intercropping can provide substantial yield advantage compared to sole programming (Singh *et al*. 1992). It gives higher cash returns and total production per hectare than growing one crop alone (Grimes *et al.* 1983; Kurata 1986). Yield of intercropping are often higher than in sole cropping systems (Dahmardeh *et al.* 2009). The reasons are mainly that resources such as water, light and nutrients can be utilized more efficiently than in the respective sole cropping systems. Intercropping also gives higher resource use efficiency such as higher nutrient retention (Lithourgidis *et al.* 2011) and enhanced water-use efficiency (Gao *et al.* 2009). 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 nutrient build up of the soil (Sharma and Choubey, 1991). It also helps in utilization of soil moisture from the soil layer. In intercropping system if the needed crops can be grown successfully without any appreciable loss or no loss of the main crops, it will provide an opportunity to the farmers for an additional source of income.

Productivity is a function of the production potential of the existing resources and the efficiency with which this potential is actually used. Potential productivity is mainly dependent on soil properties and water availability, while efficiency is primarily a function of land use intensity. In Bangladesh, there is a great possibility to practice intercropping in the Rabi season. Wheat is grown in Bangladesh during the winter season mostly under rain fed condition. The average yield of rainfed wheat is generally low. Scope exists, therefore, to improve and stabilize the productivity and profitability from wheat cultivation through proper choice of intercrops. Wheat, lentil, potato and soybean are the most important crops to be included in intercropping practices under dry land ecosystem. Therefore, the present study on intercropping of wheat and other three crops was undertaken to investigate the yield performance of wheat in intercropping pattern compared to its sole crop and observe the yield performance of the selected component crops as sole and intercrops with wheat.

MATERIALS AND METHODS

The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during the period from November 2009 to April 2010. Four types of crops having dissimilar growth habits were used in the experiment. The crops were wheat (*Tricticum aestivum* var. Kanchan), potato (*Solanum tuberosum* var. Cardinal), Lentil (*Lens culinaris* var. BARI Mashur 4), and soybean (*Glycine max* var. PB-1). Among them wheat was grown as the principal crop and other as component or secondary crops. Seeds of wheat and lentil were collected from the Regional Research Station, BARI, Barisal. Potato tubers were collected from BADC, Jamalpur and soybean seeds from the Department of Genetics and Plant Breeding, BAU, Mymensingh. Four treatments were used in this experiment such as wheat -soybean, wheat-potato, wheat-lentil and wheat sole. The experiment was laid out in a randomized complete block design with three replications. The treatments were randomly assigned within each block. The size of unit plot was 4.0m × 2.5m and each plot was separated by 0.5m wide bund. The blocks were separated by 1.0m. There were 21 plots in the experiment. The land was first opened with two cross ploughing given by country plough. Weeds and stubble were removed from the field and visible larger clods were broken into small pieces by using wooden hammer. The layout of the experiment in the field was done according to the experimental design adopted.

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The sole intercropped wheat was fertilized as per recommendation. The fertilizer doses (kg/ha) were as follows:

Crop	Cow dung	Urea	TSP	MP	Gypsum	Zinc Oxide
Wheat	-	200	180	50	120	-
Potato	10,000	276	185	322	-	-
Lentil	-	45	85	35	-	5
Soybean	-	60	175	120	100	-

One third of total urea and full doses of TSP, MP and gypsum were applied during final land preparation in sole and intercropped wheat treatments. The rest two-thirds of urea were top dressed in two equal splits given at 21 days after sowing (DAS) and 55 DAS. In case of sole soybean, and lentil fertilizers were applied during final land preparation, on the other hand, half of urea and full doses of other fertilizers and manure were applied at the same time (final land preparation) in sole potato and the rest of urea was top dressed at 50 DAS.

The seed rates of all the crops were equal for both sole and intercropping which were as follows: Wheat @ 120 kg ha^{-1}, Lentil @ 30 kg ha^{-1}, Potato @ 1.5 ton ha^{-1} and Soybean @ 80 kg ha^{-1}. Seeds of all crops were sown on 15 November 2009 by hand. In intercropping treatments the seeds of companion crops except potato were sown in between the rows of wheat. However, potato was planted after every two rows of wheat. The row to row distances for wheat, lentil and soybean were 30 cm in intercropping. The line to line distance of wheat was 25 cm and potato was 60 cm. Thinning and weeding were done on 4 and 30 December 2009. Urea fertilizer was applied as top dressing on the dates previously mentioned. The experimental plots were irrigated properly. Potato and soybean were attacked by blight disease, soybean hairy caterpillar, aphid and pod borer insect, respectively. Dithane M-45, Dimecron-100EC, Diazinon 60 EC and ripcord 50 EC were applied at proper rates to control them. Potato was harvested on 18 February 2010 after full maturity. Soybean and lentil were harvested on 4 March 2010, wheat on 26 march. After harvest, all crops except potato were sun dried for a few days and then threshed. Seeds were cleaned and sun dried and weighed plot wise to record the seed yield. Before harvesting five plants of each crop were selected randomly from each unit plot carefully. The data on yield and crop characters of all crops such as no. of effective tillers $plant^{-1}$, grain $plant^{-1}$, grain weight $plant^{-1}$, straw weight $plant^{-1}$, grain yield (t ha^{-1}), straw yield (t ha^{-1}), biological yield (t ha^{-1}) and harvest index (%) were collected.

Grain yield and straw yield are combined regarded as biological yield. The biological yield was calculated using the following formula:

Biological yield = Grain/seed yield/tuber yield + straw/haulm yield

Harvest index is the per cent expression of seed and biological yield. Harvest index was calculated with the help of the following formula:

$$\text{Harvest index (\%)} = \frac{seed/tuber}{\text{biological yield}} x\ 100$$

Data of different yield contributing characters were compiled and appropriate statistical analysis was made following the ANOVA technique. The mean differences among the treatments were adjudged by the Duncan's New multiple range tests (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

The present study was undertaken to evaluate the productivity of wheat with soybean, potato and lentil. The results of the present study have been presented in Table l and 2.

Number of effective tillers $plant^{-1}$ was not significantly affected by the treatments.

Number of grains $plant^{-1}$

The number of grains $plant^{-1}$ was significantly influenced by intercropping. The highest number of grains (92.71) $plant^{-1}$ was obtained in wheat sole crop and the lowest number of grains $plant^{-1}$ was observed in wheat + soybean (79.65).

Grain and straw weight $plant^{-1}$

Grain and straw weight $plant^{-1}$ was significantly affected by intercropping the highest grain weight $plant^{-1}$ was found (3.90g) in wheat sole and the lowest grain weight $plant^{-1}$ was produced (3.27g) in wheat + soybean. The highest straw weight $plant^{-1}$ was found in wheat sole crop (5.899g) and the lowest straw weight $plant^{-1}$ was 4.74 (g) in wheat + Soybean.

Grain yield

The grain yield of wheat was significantly influenced by intercropping (Table 1). The significantly highest grain yield (2.011 t ha^{-1}) was obtained from wheat sole. The highest grain yield in wheat sole might have resulted due to the highest plant population m^{-2}, highest number of effective tillers $plant^{-1}$ and highest number of grains $plant^{-1}$. This result was in agreement with that of Lal *et al*. (1998) who reported that yield of wheat, lentil, linseed, mustard and peas were decreased by intercropping. Tomar *et al*. (1997) also stated that seed/grain yields of all

crops were decreased by wheat + legumes intercropping. The lowest grain yield (1.463 t ha^{-1}) was recorded in wheat + soybean. In intercropping system the yield reduction of wheat comparing to its sole might be due to higher competition for light, nutrient, water, and other growth requirement by component crops. Results indicate that among the intercrops wheat + lentil was the best and wheat + soybean was the worst in respect of grain yield in wheat. This result was in partial agreement that of Mallick *et al*. (1993).

A substantial yield reduction of wheat due to intercropping with different crops was reported by Malik *et al*. (1998). The yield reduction of wheat compared with their pure stand was also observed by Janardan *et al*. (1990). In fine we can say, wheat + soybean and wheat + potato had similar effect on all the characters. On the other hand, the rest two treatments showed similar effect on most of the characters.

Table 1. Crop characters of wheat as influenced by various intercrop combination

Treatment	Effective tillers $plant^{-1}$ (No)	Grains $plant^{-1}$ (No)	Grain weight $plant^{-1}$ (g)	Straw weight $plant^{-1}$ (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest Index (%)
Wheat + soybean	3.19abc	79.65b	3.27bc	4.74b	1.463cd	2.359cd	3.822cd	38.28
Wheat + potato	3.26ab	83.22ab	3.46b	4.84b	1.601bc	2.553c	4.194c	38.54
Wheat + lentil	3.37a	91.56a	3.83a	5.90a	1.736b	2.987b	4.723b	36.76
Wheat sole	3.43a	92.71a	3.90a	5.89a	2.011a	3.381a	5.392a	37.29
S$\bar{x}$	0.09	3.178	0.118	0.218	0.058	0.092	0.168	2.86
CV (%)	5.15	6.83	6.17	7.43	6.66	6.28	7.16	13.75
Level of significance	0.05	0.01	0.01	0.01	0.01	0.01	0.01	NS

The figures having common letter(s) in a column are not significantly different as per DMRT
NS = Non Significant

Straw yield

Straw yield of wheat varied significantly due to intercropping with different crops. The highest straw yield (3.38 t ha^{-1}) was produced in wheat sole and the lowest wheat straw yield was found in wheat + soybean (2.359t ha^{-1}).

Biological yield

Intercropping also exerted significant effect on the biological yield of wheat. The biological yield of wheat was decreased by intercropping combination. The highest biological yield of wheat was given by the monoculture (5.392 t ha^{-1}) and the lowest biological yield was found in wheat + soybean (3.822 t ha^{-1}). The lowest biological yield was associated with high component crop competition for growth resources.

Harvest index

The harvest index of wheat was not found significantly affected by intercropping (Table 1). The highest harvest index (38.54%) was observed in wheat + potato and the lowest (36.76%) in wheat + lentil.

Productivity of intercropping

Crop productivity is a basic consideration in evaluation of intercropping system where land holding is very insufficient. For this purpose, land equivalent yield and monetary advantage ha^{-1} could be better indicators of relative advantages of different intercropping practices. The productivity parameters are presented in table 2.

Table 2. Land equivalent ratio, wheat equivalent yield and monetary advantages as influenced by various crops grown alone and intercropped

Treatment	Land equivalent ratio(LER)	Wheat equivalent yield (t ha^{-1})	Monetary advantage (Tk ha^{-1})
Wheat + soybean	1.487a	3.176d	11338.06
Wheat + potato	1.286c	9.256b	21590.44
Wheat + lentil	1.379b	4.130cd	12303.48
Wheat	1.000d	2.011e	-
Potato	1.000d	15.617a	-
Lentil	1.000d	4.637c	-
S$\bar{x}$	0.051	0.290	-
CV (%)	7.29	10.85	-
Level of significance	0.01	0.01	-

The figures having common letter(s) in a column are not significantly different as per DMRT
NS = Non Significant

Land equivalent ratio (LER)

While comparing the different intercrop combinations, wheat + soybean (1.487) was found superior for LER. This result was in partial agreement with Nag *et al*. (1996). This result agree with Zhang *et al.* (2011)who stated

that intercropping system had a substantial yield advantage when comparing to single crop systems (LER = 1.00). The lowest LER was found wheat + potato (1.286).

Wheat equivalent yield

Sole potato recorded the highest value of wheat equivalent yield (15.617 t ha^{-1}) which was significantly higher than any other treatments. The lowest wheat equivalent yield was observed in wheat sole due to its low yield. This result was in partial agreement with of Kurmvanshi *et al*. (1994).

Monetary advantage

The highest monetary advantage (21590.44 Tk ha^{-1}) was observed in wheat + potato might be due to high yields, high land equivalent ratio and high market price of the crops. This result was in agreement with that of Neupane *et al*. (1997). The lowest monetary advantage was found in wheat + soybean (11338.06 Tk ha^{-1}).

CONCLUSION

It may, therefore be concluded that sole wheat was significantly higher than that of all of the intercropping patterns and intercropping of lentil with wheat crop may produce good yield, higher LER and higher monetary advantage. Further studies are necessary for both sole and intercropping practices of wheat in different places.

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