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PERFORMANCE OF WHEAT (*Triticum aestivum* L. cv. BARI GOM-25) UNDER MANGO-BASED AGROFORESTRY SYSTEM

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ABSTRACT

A field experiment was carried out to evaluate the performance of wheat (BARI GOM-25) under mango (Amrapali variety) based agroforestry system following three different spacing. Wheat seeds were sown in lines at three different spacing viz. 15, 20 and 25cm as sole cropping and under mango tree as agroforestry system. Plant height of wheat was found significantly higher under mango based production system (99.67 cm) compared to wheat sole cropping (83.83 cm). On the other hand plant height did not vary significantly in different spacing. Higher yield (ha^{-1}) of wheat was found in mango based (3.41 tons) agroforestry system compared to sole cropping (3.34 tons) but there was no statistical variation of yield due to different spacing. The yield per hectare also varied significantly among the interaction treatments.

Key words: agroforestry system, mango tree, spacing, wheat

INTRODUCTION

Bangladesh is one of the most densely populated countries of the world having agro based economy. The country is totally dependent on agriculture for the supply of food and fiber. Bangladesh has varied agro-ecological regions including high mountainous valleys and irrigated plains. The environmental factors such as temperature, fertility status, soil characteristics and rainfall play an important role in the varietal performance (Asif *et al*., 2003). Agroforestry, the combination of woody perennials with crops and/or animals on the same unit of land management, is an age-old practice in Bangladesh. Wheat (*Triticum astivum* L.) is one of the most important cereal crops of the world as well as in Bangladesh. It supplies carbohydrate, protein, minerals and vitamin (BARI, 1997) and preferable to rice for its higher seed protein content It contributes about 60 per cent of daily protein requirement and more calories to world human diet than any other food crops (Mattern *et al.*, 1970). Wheat variety "BARI GOM-25" is heat tolerant and high yielding. It was released in 2005. The variety can be cultivated in any part of Bangladesh and is suitable for optimum and late planting conditions. Plant height may attain 90-96 cm, number of tillers may be 4-5, leaves are wide and deep green, maturity time is 102-110 days, grain weight may be 27-30 g per 1000 grain. This variety is suitable for quality bread-making due to strong gluten. Yield under favorable conditions may be 3-3.5 t ha^{-1}. Mango plays an important part in the diet and cuisine of many diverse cultures. This delicious fruit is particularly rich in nutrients such as protein, Vitamin A, fiber, thiamine, ascorbic acid etc.

Considering the current research was carried out in the Amrapali mango orchard to observe the performance of wheat under mango based agroforestry system.

MATERIALS AND METHODS

The field experiment was conducted at the Agroforestry Research Farm, Hajee Mohammad Danesh Science and Technology University, Dinajpur. The geographical location of the site is between 25º 13' latitude and 88º 23' longitude, and about 37.5 m above the sea level during December 2013 to March 2014. The experimental plot was in a medium high land belonging to the old Himalayan Piedmont Plain area (AEZ - 01) comprising sandy loam texture with pH 5.1. The site is characterized by tropical climate characterized by heavy rainfall from July to August and scanty rainfall the rest period of the year. 80 to 90% is received between June and September. The remaining 10 to 20% rainfall is received during wheat-growing season November to April (IWFM, 2014). Wheat seeds (BARI GOM-25) were collected from Wheat Research Centre, Nashipur, Dinajpur. Wheat was cultivated as sole wheat and with mango field maintaining three different line to line spacing as S1 =15 cm, S2 = 20 cm, S3 = 25 cm. Land Preparation, seed sowing was done

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followed by standard procedures. Intercultural operations were done when needed. The plants were harvested on 3rd March 2014. The harvested crop of each plot was bundled and then threshing, cleaning, winnowing and drying of seeds were done carefully. Five plants were randomly selected from each plot & data were recorded. The recorded growth and yield data were wheat plant height, leaf number, spikelet length & number, tiller number, 1000-grain weight and yield ha^{-1}. Plant height, leaf number and tiller number were recorded 4 times viz. 30, 45, 60 and 75 days after sowing. The statistical analysis ANOVA was done following RCBD design with the help of MSTAT-C programme. The means were adjusted by Duncan's New Multiple Range Test (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Plant height (cm): Plant height of wheat was found significantly higher after 45, 60 and 75 days in mango based system than sole cropping (open field) but it did not vary significantly in spacing treatments. In case of interaction between production system and spacing, plant height was significantly higher in mango-wheat intercropping system comparing with wheat sole cropping (Table 1) as there was no effect of spacing on plant height. After 75 days, highest plant height of wheat was recorded as 99.67 cm in mango tree intercropping system compared to 83.83 cm in sole cropping. The higher plant height of wheat in mango based agroforestry system may be due to moisture variation and competition for solar radiation between the component crops (Chaudhry, 2003).

Plant height of BARI GOM- 25 increased over time in both mango-based and open field (control) production system. Plant height was found significantly higher under mango based system compared to open field. On the other hand, in the spacing treatments, generally plant height did not vary significantly over time due to spacing. The higher plant height of wheat in mango based Agroforestry system as compared to open field condition is the indicative of competition for solar radiation between the component crops (Chaudhry, 2003). Significant effect of plant height between the mango based agroforestry systems as compared to open field condition is also indicative of the fact that early stages of mango trees during wheat growth periods benefit the wheat crop. These findings are in agreement with (Sharma and Singh, 1992), who observed that the plant height of wheat is higher near the tree. (Evans *et al.*, 1976) reported that the light plays an important role in controlling the growth of plants besides other environmental factors.

Leaf number: Leaf number of wheat increased up to a certain period (e.g. after 60 days) but it did not vary significantly between the production systems and spacing treatments (Table 2). Average leaf number ranged from 4 to 6.67 in different treatments upto 60 days. After that period leaf number decreased due to maturity of the plant and leaf shedding.

Number of Tiller: Tiller number of wheat per plant did not differ significantly in different growing periods of wheat between mango based and open field system (Figure 1a). Similar result was recorded in different spacing treatments also (Figure 1b). In our experiment, as Amrapali mango tree was four years old and its canopy size was small, there was not much shade effect on the wheat crop. That is why wheat tiller number was not affected by intercropping practice. Similar result was obtained by some researchers such as Chaudhry, 2003; Sharma *et al.*, 1996.

Spikelet length and Number: Spikelet length varied significantly among the interaction treatments of the two factors (i.e. production system and spacing). The highest spikelet length (14.00 cm) was found in sole cropping of wheat in association with the spacing S1 that was statistically similar to 13.33 cm was recorded in S2 spacing of sole cropping of wheat. On the other hand the lowest spikelet length 12.00 cm was observed in S2 spacing of mango based wheat cultivation. The number of effective spikelet was found statistically non significant (Table 3).

Grain weight and yield: 1000-grain weight of wheat variety BARI GOM-25 was found statistically different in both mango based and open field systems (Table 4). Higher grain weight per 1000 grains was found in mango based system than open field. No statistical variation was found among the three different spacing in both systems. Similarly, yield of wheat per hectare also varied significantly among the different treatments. Highest yield was found in S2 and S3 spacing of mango based system than in open field (Table 4).

In this experiment we recorded 1000- grain weight that was statistically different in both mango based and open field systems. But they were insignificant due to spacing treatments of wheat varieties. Previous studies showed that 1000-grain weight is not controlled genetically alone but it is the environmental conditions, which have main effects on the expression of this trait (Halverson and Zelany, 1988). Similarly, (Butt *et al.*, 1997) have reported the variation in 1000-grain weight, occurred due to differences in crop years. The yield per hectare of wheat was found statistically significant due to production systems. Higher yield

Table 1. Plant height of wheat under mango tree and sole condition

Production System	Spacing	Plant height (cm)			
		30days	45 days	60 days	75 days
Sole	S_1	36.67 b	50 cd	67.67 abc	87.50 bc
	S_2	36.83 b	49.33 d	64.83 bc	83.83 c
	S_3	36.33 b	49.5 d	61.67 c	88.00 bc
Mango based	S_1	38.67 ab	52.93 bc	73.50 a	95.17 ab
	S_2	36.67 b	54 ab	74.33 a	99.67 a
	S_3	43.00 a	56.83 a	70.50 ab	96.50 ab
LSD value (0.05)		5.099	3.115	7.953	9.075
CV %		7.37	3.29	6.36	5.43

Note: S1=15 cm, S2=20 cm and S3=25 cm

Table 2. Leaf number of wheat under mango tree and sole condition

Production Systems	Spacing	Leaf number			
		30 days	45 days	60 days	75 days
Sole	S1	4.00a	5.00a	6.33a	5.33a
	S2	4.00a	5.00a	6.33a	6.00a
	S3	4.33a	5.00a	6.33a	5.67a
Mango based	S1	4.33a	5.00a	6.00a	3.67a
	S2	4.67a	4.67a	6.00a	5.67a
	S3	4.00a	5.00a	6.67a	4.33a
LSD value (0.05)		0.719	0.431	0.791	2.772
CV %		9.34	4.77	6.92	29.82

(Note: S1=15 cm, S2=20 cm and S3=25 cm; same letter in a column indicate statistically non- significant at $P \leq 0.05$)

Table 3. Spikelet length and effective spikelet number of wheat under mango tree and sole condition.

Production System	Spacing	Spikelet	
		Length (cm)	Effective number
Sole	S1	13.33ab	37.67a
	S2	14.00a	46.00a
	S3	12.33b	39.33a
Mango based	S1	12.50b	44.67a
	S2	12.00b	36.67a
	S3	12.50b	42.33a
LSD value (0.05)		1.366	18.09
CV %		5.88	24.19

Table 4. Grain weight and yield of wheat under mango tree and sole condition

Production system	Spacing	1000-grain weight (g)	Yield t ha^{-1}
Sole	S1	27.80b	3.34 b
	S2	27.83b	3.34 b
	S3	27.90b	3.34 b
Mango based	S1	29.00a	3.39 ab
	S2	29.07a	3.41 a
	S3	28.83a	3.41 a
LSD value (0.05)		0.419	0.057
CV %		0.81	0.36

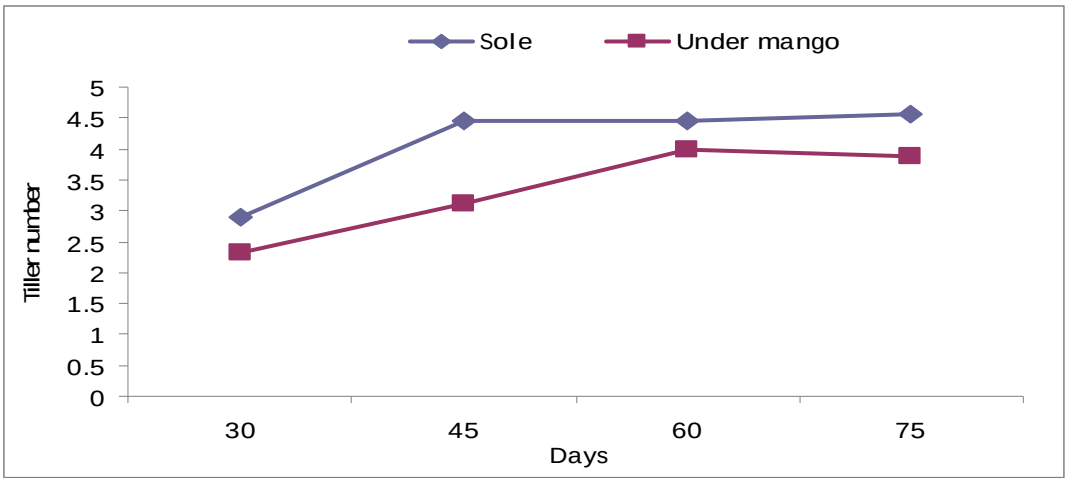

Figure 1a. Tiller number of wheat under mango tree and sole condition

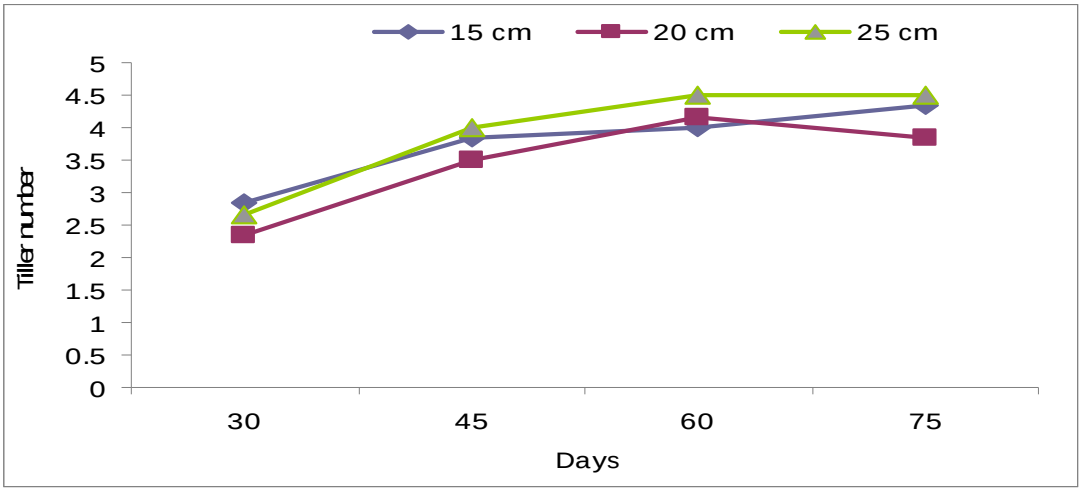

Figure 1b. Tiller number of wheat in different wheat spacing

was found in mango based system than open field. On the other hand, there was no statistical variation of wheat yield due to different spacing among the wheat varieties. The crop growth is mainly affected by light and nutrient availability. Leaf litter inputs from agro-forestry trees could provide sufficient nutrients and organic matter to sustain crop growth that may improve crop yield. Similar results were observed by (Lehmann *et al.,* 2002; Bhardwaj *et al.,* 2005; Sarvade *et al*., 2014).

CONCLUSIONS

The findings of the present investigation indicates that diversification of farming system and growing wheat as ground layer crop in Amrapali mango tree orchard is a viable option for increasing income of farmers. Wheat grain yield was not significant among the three different spacing i.e. 15 cm, 20 cm and 25 cm. Agroforestry is preferable than the sole culture to get higher total yield of wheat and mango.

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