

# Performance of radish along with mango tree in charland based agroforestry farming system

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**Abstract:** An experiment was conducted at the Char Kalibari which is situated by the side of Brahmaputra river adjacent to the Bangladesh Agricultural University, Mymensingh, during the period from October 2013 to March 2014 to observe the performance of radish cultivation in association with mango. This experiment was conducted following a Randomized Complete Block Design (RCBD) with four replications. Different distance from tree base was treated as different treatment. Three different distance like <1.5 feet, 1.5-3.0 feet, and 3.0-4.5 feet from tree base were the three different treatment of the experiment. There was a control treatment i.e. Radish was cultivated in the open field condition (without tree), so the four treatment of the experiment were T<sub>0</sub> (open field condition referred as control), T<sub>1</sub> (<1.5 feet distance from the tree base), T<sub>2</sub> (1.5-3.0 feet distance from the tree base), T<sub>3</sub> (3.0-4.5 feet distance from the tree base). Growth of mango tree also observed during radish growing period. The result showed that radish as vegetables and seed production was gradually increased with increasing distance from the tree base. Yield of radish as vegetables and seeds was highest in open field condition. However, radish as vegetables in association with mango reduced by 11.20%, 27.23% and 50.50% and as seed yield reduced by 12%, 40% and 68% respectively in 3.0-4.5 feet, 1.5-3.0 feet and <1.5 feet distance from tree base. Growth of Mango fruit trees was observed as height and girth increment. Height and girth increment of Mango tree was little bit higher under control (without radish) condition.

**Key words:** Radish, mango, charland, agroforestry.

## Introduction

Agroforestry, the integration of tree and crop or vegetable on the same area of land is a promising production system for maximizing yield and maintaining friendly environment (Nair, 1990). In agroforestry systems, trees or shrubs are intentionally used within agricultural systems, or non-timber forest products are cultured in forest settings. Knowledge, careful selection of species and good management of trees and crops are needed to optimize the production and positive effects within the system and to minimize negative competitive effects. Bangladesh is one of the most densely populated countries of the world struggling hard to feed her more than 150 million peoples. The current population growth rate is 1.3% and the density of human population is 1020 per sq. (UNFPA, 2011). If the current population growth rate (1.3%) continues, the population will increase to 180 million by the year 2025, and the country will face enormous problem for nursing her population. The current forest land area of Bangladesh is 1442 hectares which is 17.08% of total land area (BBS, 2011). Radish (*Raphanus sativus*) is a cool season root crop. The crop is grown for its young tender roots which are eaten raw as salad or cooked as vegetables. The young leaves of radish are also cooked as vegetables. The fleshy root is the main edible portion of radish. Rashid (1999), mentioned that a hundred gram of edible root contains 1% protein, 4% carbohydrate, little fat, 15 calories, negligible vitamin A, 0.03 mg thiamine, 0.03 mg riboflavin, 0.30 mg niacin, 25.00 mg vitamin C, 30 mg calcium and 1.00 mg iron. Mango (*Mangifera indica* L.) belonging to the family Anacardiaceae is one of the most important and popular fruits of Bangladesh. It is being cultivated in this subcontinent since 4000 years ago (Candole, 1984). Mango originated in India subcontinent during the pre-historic times (Mukherjee, 1998). India produces approximately 86% of the world mango. Mango ranks third among the tropical fruits grown in the world with the total production of 45563 Thousand metric tons (FAO, 2010). Mango is the most popular and important fruit crop among all fruits grown in Bangladesh covering the largest area (61885 ha.) and the total production (1005164 tons) being in the 3rd position after banana and jackfruit the acreage and production of mango during the 2000- 2001

were 152125 acres and 293570 tons respectively (BBS, 2011). For identifying the compatible tree-crop combination, i.e. different crops should be screened out in terms of their adaptability and yield in association with fruit tree. For this purpose, the best way of experimentation is to grow different crops at different spacing from the tree. So, if we know the suitability of different crops in terms of growth and yield, it would be very useful information for selecting the best tree-crop combination. Therefore, it would be wise to conduct experiments under different tree crop or vegetable combination at different spacing for screening of different crops in terms of their growth and yield performance. So the present study was undertaken to observe the morphological behaviors and yield of radish as Shak vegetable and seed production in association with mango trees and to examine the effects of Mango tree on growth and yield performance of Radish in different distance from the tree base and to observe the growth of associated tree component during the vegetable/crops growing season.

## Materials and Methods

**Experimental site:** The experiment was carried out at the experimental farm in the project field Kalibari Char, Mymensingh, Department of Agroforestry, Bangladesh Agricultural University, Mymensingh, during the period from October 2013 to March 2014. The place is geographically located at about 24°75" north latitude and 90°50' east longitudes.

**Soil Characteristics:** The topography of the field was medium high land above flood level belonging to the old Brahmaputra flood plain agro-ecological zone-9 (FAO, 1988). It is characterized by non calcareous dark grey flood plain soil having pH value from 6.5 to 6.8 and the soil texture is silty loam. It appeared cold but readily broken when pulverized.

**Climate and Weather:** The climate of the location was characterized by relatively high temperature and heavy rainfall during kharif or summer season (April to October) and low temperature and little rainfall during Rabi or winter season (November to March).

**Tree and plant materials:** In this study, previously

established 2.5 years old mango, guava and lemon were used as tree components. The seeds of radish variety BARI MULA-1 (Tasaki Mula) were used as plant materials in this study.

**Experimental Design and Treatment of Study:** The experiment was laid out following the Randomized Complete Block Design (RCBD) design with single factorial three replications. Different treatments of this study were T<sub>0</sub> (open field referred as control), T<sub>1</sub> (<1.5 feet distance from the tree), T<sub>2</sub> (1.5-3.0 feet distance from the tree), T<sub>3</sub> (3.0- 4.5 feet distance from the tree).

**Sampling Procedure and Data Collection of Radish:** Plant samples of Radish were collected randomly from all of the respective plots. Ten plants of Radish were selected from each plot for data collection. The parameter such as plant height, numbers of leaves, length of leaves, leaves size, weight per plant, length of floral rachis, number of primary branches per plant, length of primary branches, number of secondary branches per primary branch, number of pod per plant, seed per pod, seed per plant, length of secondary branch, were considered for data collection. Dry yield was calculated using the following formula: Total dry weight =  $\frac{\text{(sub sample oven dry weight)}}{\text{(sub sample fresh weight)}} \times \text{Total fresh weight}$ .

**Data Analysis:** The data were collected from the experiment at different stages of various growths, and analyzed statistically by using MASTATC software package to find out the statistical significance of the experimental results. The means for all the treatments and analysis of variance of yields of the summer vegetables was calculated by Duncan's Multiple Range Test (DMRT). The mean differences were evaluated by Duncan's New Multiple Range Test (DMRT) (Gomez and Gomez, 1984) and also by Least Significant Difference (LSD) test.

### Results and Discussion

Performance of radish was observed as shak vegetable and seed production purpose. Effect of the mango tree on radish are presented here separately as shak vegetable and seed production purpose.

#### Radish as shak vegetable with Mango tree

**Growth and yield contributing characters of radish as shak vegetable:** Growth and yield contributing characteristics radish as shak vegetable like plant height, number of leaves plant<sup>-1</sup>, leaf size, weight plant<sup>-1</sup> was significantly influenced by mango tree (Table 1). Effect of mango tree on the morphological behavior of Radish was as follows:

**Plant height:** It was observed that the plant height of radish grown under different distance from the mango tree base was influenced significantly (Table 1). Plant height increases, gradually with the increasing of distance from

tree base. The highest plant height (34cm) was observed within T<sub>0</sub> (open field referred as control) and the lowest plant height (20cm) was found within T<sub>1</sub> (< 1.5 feet from tree base). The second maximum plant height (32cm) was verified within T<sub>3</sub> (3.0-4.5 feet from tree base) another highest plant height (31cm) was observed under T<sub>2</sub> (1.5-3.0 feet from tree base) (Table 1). Light is an essential factor on plant growth and development. The major light factors affecting plant growth are light quality, light intensity, photoperiod and day/night cycle (Goto, 2003).

**Number of leaves Plant<sup>-1</sup>:** The result shows from the trees (Table 1). It was observed that highest number of leaves 10 was noted under T<sub>0</sub> (open field referred as control). The next highest number of leaves 9 was observed within T<sub>3</sub> (3.0-4.5 feet from tree base) and the lowest number of leaves 6 was found under T<sub>1</sub> (<1.5 feet from tree base ) (Table 1) another no. of leaves per plant 8 was observed under T<sub>2</sub> (1.5-3.0 feet from tree base) (Table 2). Number of leaves per plant was reduced near the near base may be due to competition for nutrients between the roots of strawberry and Lohakat tree. Similar type of assumption was also opined by Habib *et al.*, (2012) for okra and amaranth along with *Xylia dolabriformis* tree.

#### Leaf size (length of leaves and breath of leaves plant<sup>-1</sup>)

**Length of leaves of plant:** The length of leaf was varied significantly due to the effect of different distance from the tree base (Table 1). The maximum length of the leaves (25 cm) was obtained from T<sub>0</sub> (open field referred as control) and the lowest length of leaves (23 cm) was obtained within T<sub>1</sub> (<1.5 feet from tree base) and T<sub>2</sub> ( 1.5-3.0 feet from tree base) and the second highest length of the leaves ( 24cm) was found within T<sub>3</sub> (3.0-4.5 feet from tree base) (Table 1). It has been reported that shading reduced leaf number, leaf area and thickness of dry bean (Crookston *et al.*, 1975). They also reported 38% decrease in photosynthesis per unit area of shaded leaves.

**Breadth of leaves of plant:** Leaf breath exhibited significant variation with the different distance from tree base (Table 1). The maximum breadth of leaves (11.40cm) was found in T<sub>0</sub> (open field referred as control) and the lowest breath of leaves (9.20cm) was found T<sub>1</sub> (<1.5 feet from tree base). The next maximum breadth of leaves (11.30cm) was obtained under T<sub>3</sub> (3.0-4.5 feet from tree base) (Table 1).

**Fresh weight plant<sup>-1</sup>:** It was observed that fresh weight plant<sup>-1</sup> of radish was difference from the different distance from the mango tree base was influenced significantly (Table 1). The highest fresh yield of plant<sup>-1</sup> of radish (31.60g) was obtained from T<sub>0</sub> (open field referred as control). On the other hand, the lowest fresh yield of plant<sup>-1</sup> radish (15.40g) was found from T<sub>1</sub> (<1.5 feet from tree base) and second highest fresh yield of plant<sup>-1</sup> of radish (30.50g) was observed from T<sub>3</sub> (3.0-4.5 feet from tree base) (Table 1).

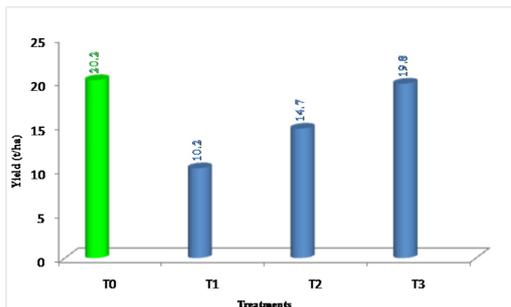
**Table 1.** Growth and yield contributing characters of radish as shak vegetable along with Mango tree

| Treatment      | Plant height (cm) | No. of leaves/plant | Leaf size   |             | Weight /plant (g) |            |
|----------------|-------------------|---------------------|-------------|-------------|-------------------|------------|
|                |                   |                     | Length (cm) | Breath (cm) | Fresh weight      | Dry weight |
| T <sup>1</sup> | 34a               | 10a                 | 27a         | 11.90a      | 31.66a            | 2.62a      |
| T <sup>2</sup> | 20c               | 7d                  | 24c         | 9.60b       | 15.87c            | 1.31c      |
| T <sup>3</sup> | 31b               | 8c                  | 24c         | 10.00b      | 22.69b            | 1.88b      |
| T              | 32b               | 9b                  | 25bc        | 11.50a      | 30.56a            | 2.53a      |

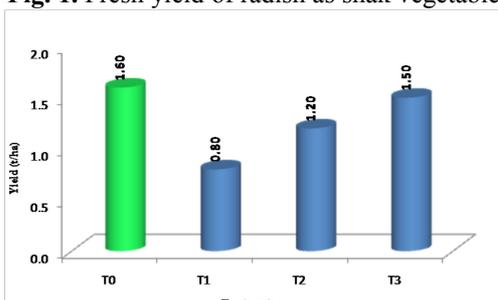
Means in column followed by the different letter are significantly different by DMRT at  $P \leq 0.05$ , T =Control, T<sub>1</sub> =<1.5 feet from tree base, T<sub>2</sub> =1.5-3 feet from tree base, T<sub>3</sub> =3-4.5 feet from tree base

**Dry weight plant<sup>-1</sup>:** The variation in dry weight Plant<sup>-1</sup> of radish in different treatments was found to be significant (Table 1). The results, showed that the highest dry weight plant<sup>-1</sup> of radish (2.61g) was created from T<sub>0</sub> (open field referred as control). On the other hand, the lowest dry weight plant<sup>-1</sup> of Radish (1.30g) was found under T<sub>1</sub> (<1.5 feet from tree base). The second highest dry weight plant<sup>-1</sup> of Radish (2.51g) was obtained from T<sub>3</sub> (3.0-4.5 feet from tree base) (Table 1).

**Yield:** Both fresh and dry yield of radish shak as vegetables was highest in the open field condition and these were 20.20 t/ha (Fig. 1) and 1.60 t/ha (Fig. 2) respectively, which were statistically similar with treatment T<sub>3</sub> i.e. 3.0-4.5 feet distance from the tree base and lowest yield both fresh and dry radish shak as vegetable was 10.20 t/ha and 0.80 t/ha within T<sub>1</sub> (<1.5 feet from tree base) respectively in association with mango tree.



**Fig. 1.** Fresh yield of radish as shak vegetable



**Fig. 2.** Dry yield of radish as shak vegetable

Among the different distance groups in association with mango yield of radish shak as vegetable was found which were ranking as T<sub>3</sub> > T<sub>2</sub> > T<sub>1</sub> i.e. 3.0-4.5 feet > 1.5-3.0 feet > (<1.5 feet distance from tree base). Total fresh radish shak as vegetables along with mango in T<sub>3</sub>, T<sub>2</sub>, and T<sub>1</sub> were 19.80 t/ha, 14.70 t/ha and 10.20 t/ha respectively. Radish shak as vegetables was gradually increased with increasing distance from tree base.

Considering this result it is clear that two and a half years old mango tree negatively affect the yield of associated crops/vegetables up to 3.0 feet distance from the tree base. Similar result also observed by Tanni *et al.*, (2010) and Habib *et al.*, (2012) in different winter and summer vegetable grown in association with Lohakat (*Zylia dolabiformis*) tree.

**Radish cultivation for seed production purpose:**

**Morphological characters:**

**Plant height:** It is observed that from the results (Table 2). The highest plant height (145cm) was recorded within T<sub>0</sub> (open field referred as control) and the lowest plant height of (94cm) was found under T<sub>1</sub> (<1.5feet from t tree base). Other lowest plant height (113cm) was created in T<sub>2</sub> (1.5-3.0feet from t tree) (Table 2).

**Length of floral rachis:** The result revealed that the highest of floral rachis (65.50cm) was produced under T<sub>0</sub> (open field referred as control). The next highest floral rachis (60.10cm) was observed under T<sub>3</sub> (3.0-4.5feet from tree base) and the lowest result (42.00cm) was observed at T<sub>1</sub> (<1.5 feet from tree base) and 2<sup>nd</sup> lowest result (50.70cm) was found at T<sub>2</sub> (1.5-3.0feet from tree base) (Table 2).

**Number of primary branches plant<sup>-1</sup>:** The highest number of primary branches plant<sup>-1</sup> of 9 was found in T<sub>0</sub> (open field referred as control) and the lowest average number of primary branches plant<sup>-1</sup> 6 was produced in T<sub>1</sub> (<1.5 feet distance from the tree). Other lowest average number of primary branches plant<sup>-1</sup> 7 was found in T<sub>2</sub> (1.5-3.0 feet distance from the tree) (Table 2).

**Number of secondary branches per primary branch:** The highest number of secondary branches per primary branches 5 was found in T<sub>0</sub> (open field referred as control) and T<sub>3</sub> (3.0-4.5 feet from tree base) and the lowest number of secondary branches per primary branches 3 was produced within T<sub>1</sub> (<1.5 feet from tree base). The next maximum number of secondary branches per primary branches 4 was found within T<sub>2</sub> (1.5-3.0 feet from tree base) (Table 2).

**Number of pod plant<sup>-1</sup>:** The highest number of pod plant<sup>-1</sup> 43.00 was produced under T<sub>0</sub> (Open field referred as control) and the minimum number of pod plant<sup>-1</sup> 25.50 was observed within T<sub>1</sub> (<1.5 feet from tree base). The second lowest number of pod plant<sup>-1</sup> 34.50 was showed under T<sub>2</sub> (1.5-3.0 feet from tree base) (Table 2). Basak *et al.*, (2009) also showed that the yield contributing characters of the vegetables increased gradually with the increase of planting distance from the tree. Khatun *et al.*, (2009) also showed the similar results.

**Table 2.** Growth and yield contributing characteristics of Radish for seed production along with Mango tree

| Treatment <sub>o</sub> | Plant height (cm) | Av. length of floral rachis (cm) | Av. no. primary branches/plant | Av. no. of secondary branches/primary branch | No. of pod per plant | No. of seed per pod | No. of seed per plant | Wt. of 1000 seeds (g) |
|------------------------|-------------------|----------------------------------|--------------------------------|--|----------------------|---------------------|-----------------------|-----------------------|
| T <sup>1</sup>         | 145a              | 66.60a                           | 10.00                          | 6.00   | 44.0                 | 6.5                 | 292.5                 | 12.97                 |
| T <sup>2</sup>         | 95d               | 42.75                            | 7.00                           | 4.00   | 26.5                 | 4.0                 | 106.0                 | 7.93                  |
| T <sup>3</sup>         | 114c              | 51.30                            | 8.00                           | 5.00   | 35.5                 | 5.2                 | 184.6                 | 11.67                 |
| T                      | 135b              | 60.75b                           | 9.00                           | 6.00   | 43.5                 | 6.3                 | 274.1                 | 12.93                 |

Means in column followed by the different letter are significantly different by DMRT at  $P \leq 0.05$ , T = Control, T<sub>1</sub> = <1.5 feet from tree base, T<sub>2</sub> = 1.5-3 feet from tree base, T<sub>3</sub> = 3-4.5 feet from tree base

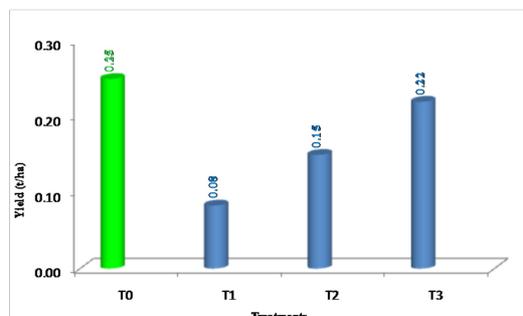
**Number of seeds pod<sup>-1</sup>:** The maximum number of seed pod<sup>-1</sup> 6.20 was showed within T<sub>0</sub> (open field referred as control) and the minimum number of seed pod<sup>-1</sup> of 3.80 was found under T<sub>1</sub> (<1.5 feet from tree base). The next maximum number of seed plant<sup>-1</sup> 6.10 was observed under T<sub>3</sub> (3.0-4.5 feet from the tree base) (Table 2).

**Number of seed plant<sup>-1</sup>:** It was observed that number of seed plant<sup>-1</sup> under different distance from the mango tree base was influenced significantly (Table 2). The highest number seed plant<sup>-1</sup> 290.50 was found in T<sub>0</sub> (open field referred as control) and the lowest number of seed plant<sup>-1</sup> 105.00 was found within T<sub>1</sub> (< 1.5 feet distance from the tree base). The second lowest number of seed plant<sup>-1</sup> 183.20 was observed under T<sub>2</sub> (1.5-3.0 feet distance from the tree base) (Table 2). Basak *et al.*, (2009) also showed that the yield contributing characters of the vegetables increased gradually with the increase of planting distance from the tree. Khatun *et al.*, (2009) also showed the similar results.

**Weight of 1000 seeds:** The maximum weight of 1000 seeds 12.50 g was produced under T<sub>0</sub> (open field referred as control) and the minimum weight of 1000 seeds 7.75 g was found within T<sub>1</sub> (<1.5 feet from tree base). The next maximum weight of 1000 seeds 12.50 g was showed in T<sub>2</sub> (3.0-4.5 feet from tree base) (Table 2). Basak *et al.*, (2009) also showed that the yield contributing characters of the vegetables increased gradually with the increase of planting distance from the tree. Khatun *et al.*, (2009) also showed the similar results.

**Seed yield of radish with Mango:** Seed yield of radish with these fruit trees significantly influenced by different distance level from tree base (Fig. 3). Highest seed yield of radish was recorded in open field condition second highest yield obtained from 3.0-4.5 feet distance area from all of these fruit trees (Fig. 3). But there was a variation of seed yield of radish among these fruit trees in the area 3.0-4.5 feet. Radish seed was produced highest 0.25 t/ha within T<sub>0</sub> (open field condition) which is statistically similar with treatment T<sub>3</sub>, i.e. 3.0-4.5 feet from tree base (Fig. 3). Radish seed was produced in T<sub>3</sub>, T<sub>2</sub> and T<sub>1</sub> was 0.22 t/ha, 0.15 t/ha and 0.08 t/ha respectively. Radish seed was gradually increased with increasing distance from mango tree base from tree base. Radish seed in different distance T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> from tree base were 68%, 40% and 12% reduced compare to open field condition.

From above the discussion it is clear that, when distances were declining, yield of radish seed was also decreased. This may be due to completion for sunlight, nutrients and water either in above or below the ground. Sayed *et al.*, (2009) recorded similar result in spinach with telsius tree.



**Fig. 3.** Seed yield of radish with mango tree

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