

EFFECTS OF DIFFERENT TREE LEAF LITTERS ON GROWTH AND YIELD OF OKRA IN MODHUPUR FOREST SOIL

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ABSTRACT

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A pot experiment was conducted in the open net house of the department of Agricultural chemistry, Bangladesh Agricultural University, during 20th March to 15th July 2006, to study the effects of different tree leaf litters and chemical fertilizer on the growth and yield of Okra in Modhupur soil. The experiment was laid out in Complete Randomized Design (CRD) with three replications and twelve treatments viz. T₁: Acacia (*Acacia auriculiformis*), T₂: Bohera (*Terminalia bellirica*), T₃: Gamer (*Gmelina arborea*), T₄: Chemical fertilizer, T₅: Sal (*Shorea robusta*) and T₆: Control (No leaf litter i.e. soil only) and also two varieties were V₁: Local dherosh and V₂: BARI dherosh-1. All the leaf litters were applied @ 20 ton per hectare and recommended dose (N₆₉ P₃₀ K₆₀ S₂₀ kg ha⁻¹) of chemical fertilizers. Different leaf litter had significant effect on the growth and yield of Okra. The performance of BARI dherosh-1 was better than local variety. Among the treatments fertilizer gave highest (13.08) yield and the lowest (5.79 t ha⁻¹) in control treatment. Considering the interaction effect T_FV₂ gave highest yield (14.78) and the lowest (5.76 t ha⁻¹) in T_AV₁ treatment.

Keywords: Tree leaf litters, growth, yield and Okra

INTRODUCTION

Bangladesh occupies 17.5% forest areas of the total land and Modhupur is one of the largest forest covering 0.12 m ha have great scope to increase soil health by using different tree leaf litters which fall much amount every day. Litter plays a fundamental role in the nutrient turnover and in the transfer of energy between plants and soil, the source of the nutrient being accumulated in the upper most layers of the soil (Singh, 1971). Through decomposition, the nutrients within leaf litter are converted into a form available for uptake by vegetation and thereby exercising a critical control on vegetation productivity (Mitch and Gosselink, 1993; Groffman et al., 1996). Modhupur evergreen forest which located in Madhupur plays an important role in both ecological and economic terms of Bangladesh. This forest helps us to restore the productivity of the area and to reduce the weed populations after the agricultural use of the site. They are also source of a variety of products, which vary from edible plants to plants used for handicrafts. These forests are usually located close to human settlements and are particularly suitable for the extraction of forest products. Sal, Teak, Acacia, Gorgon, Eucalyptus, Koroi, Mahogany etc. are the major tree species in tropical deciduous Sal forest in Bangladesh. A lot of leaf litters, twigs are fallen on the ground of this forest soil every year which play a vital role to enrich the forest soil with organic matter content and are naturally decomposed and released nutrients for forest plants. These forest tree leaf litters contain higher amount of organic mater, N, P, K, Ca, Mg, S and other trace element can be applied for the production of agricultural crops in the surrounding areas of the forest.

Okra (*Abelmoschus esculentus*.) is one of the most important pod vegetables in sub-tropical and tropical regions belonging to the family of Malvaceae. It plays an important role in vegetable market during summer season when the supply of vegetable is acute. But unfortunately the production of this popular vegetable is very low according to our demand. So the production of this vegetable should be increased to meet up our increasing demand. The decomposed leaf litters are considered as the promising alternative of nutrient source of cowdung for successful crop production in the concerned areas. The decomposition of Sal, Bohera, Gamer, and Acacia tree leaf litters need more delving research attention and by using this asset can be compensated different organic and chemical fertilizers. Unfortunately very little work has been done in the past on our forest and the effect of leaf litter on the growth, yield and quality of crops. Considering above facts in mind, an experiment was conducted on Okra to see the performance of some tree leaf litters and to observe the effects of different forest tree leaf litter and chemical fertilizer on the growth and yield of Okra at Modhupur forest in Modhupur soil.

MATERIALS AND METHODS

A pot experiment was carried out on Okra 20th March to 15th July 2006, in the open net house of the Department of Agro-Forestry, Bangladesh Agricultural University (BAU) Mymensingh. The experiment was laid out in Complete Randomized Design (CRD) with three replications. Twelve treatment combinations were used in this experiment. The treatments were T₁: Acacia (*Acacia auriculiformis*), T₂: Bohera (*Terminalia bellirica*), T₃: Gamer (*Gmelina arborea*), T₄: Chemical fertilizer, T₅: Sal (*Shorea robusta*) and T₆: Control (No leaf litter i.e. soil only). Varieties were V₁: Local dherosh and V₂: BARI dherosh-1. All the leaf litters were applied @ 20 ton per hectare and chemical fertilizers were applied @ recommended (N₆₉ P₃₀ K₆₀ S₂₀ kg ha⁻¹) dose.

In order to conduct the study, Modhupur Sal forest, Talky, Modhupur was selected. The soil used in this experiment was collected from a selected area of the concern forest. The initial surface soils of 0-15 cm depth were collected from there on 10th March of 2007. The land was fallow when soil samples were collected. The soil samples were put into bags and were taken to the laboratory. The collected soils were air dried, sun dried for several days, ground, plant residues and other extraneous materials were removed and were sieved through 10-mesh sieve and mixed thoroughly. This whole process was done several times until adequate amount of soil was prepared for the experiment. Acacia (*Acacia auriculiformis*), Bohera (*Terminalia bellirica*), and Gamer (*Gmelina arborea*), Sal (*Shorea robusta*) leaf litter were collected from different locations of Modhupur Sal forest. The samples were then brought to the laboratory of the department of Agricultural Chemistry. The composite samples were washed and dried under open sunlight followed by oven drying at 60°C for 48 hours and ground in a steel grinding mill containing a fine sieve. Prepared samples were stored in a desiccators before using. To conduct the experiment BARI Derosh-1 and Local variety were selected and seeds were collected from the Bangladesh Agricultural Research Institute (BARI), Joydevpur and (12 x 12 inch²) earthen pots were collected and each pot was poured with 8 kg finely ground sieved soil. The ground leaf litter were added to the pot and mixed with the soil very well and then the soil was saturated with water and allowed to keep for 15 days for the well decomposition of the leaf litter. After 15 days 3 seeds were sown uniformly in each pot. The chemical fertilizers were mixed with soil in the previous day of sowing. The urea fertilizer was applied at two installments. Thinning was done at 7 DAS and finally one healthy plant was kept in each pot. Irrigation and other intercultural operations were done if when necessary.

Table 1. Chemistry of different leaf litter and Initial soil status of Madhupur

| Sample No. | pH | OM% | Ca | Mg | K | Total N% | P | S | Cu | Fe | Mn | Zn |
|--------------|-----|------|----------|------|------|----------|------|------|------|-----|------|-----|
| | | | Meq/100g | | | | | | | | | |
| Sal | - | 5.92 | 0.78 | 0.35 | 0.66 | 0.98 | 0.05 | 0.08 | 24 | 630 | 360 | 62 |
| Bohera | - | 8.98 | 3.42 | 0.50 | 0.78 | 1.12 | 0.13 | 0.12 | 15 | 330 | 159 | 38 |
| Acacia | - | 7.87 | 1.32 | 0.28 | 0.72 | 1.96 | 0.04 | 0.12 | 12 | 450 | 135 | 34 |
| Gamar | - | 6.63 | 1.82 | 0.34 | 0.72 | 1.68 | 0.14 | 0.14 | 12 | 510 | 116 | 75 |
| Initial soil | 4.7 | 1.54 | 2.1 | 1.2 | 0.35 | 0.082 | 20.0 | 25.0 | 0.28 | 422 | 60.0 | 2.0 |

Data were collected on plant height (cm), number of branch Plant⁻¹, date of first harvest (DAS), fruit length (cm), fruit Diameter (cm), total number of fruit plant⁻¹, weight of individual fruit (g), yield (t ha⁻¹), and total biomass (t ha⁻¹). The harvesting was done during 80 to 145 days after sowing. The collected data viz. yields parameters were statistically analyzed by F-test to examine the treatment effects and the mean differences were adjudged by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984). The software package MSTAT was followed for statistical analysis.

RESULTS AND DISCUSSION

Effect of different tree leaf litters and chemical fertilizer on the yield and yield contributing characters has given below:

Plant height (cm)

It is revealed from the result that, different tree leaf litter significantly influenced the plant height of okra (Table 2). The tallest plants (154.3 cm) were found from the application of chemical fertilizer (T_F), which is followed by Acacia leaf litter (T_A) (140.3 cm) whereas the shortest was found from Sal leaf litter (T_S) (122.7 cm). Results also showed that plant height of okra was varied significantly with variety (Table 3). Local variety (134.83 cm) was found taller than BARI Dheros-1 (127.88 cm). The results revealed that different tree leaf litter and okra variety did not interact significantly with each other in plant height (Table 4). Chemical fertilizer when applied to the local variety (T_FV_1) produced the tallest plant (156.7 cm) closely followed by fertilizer with BARI Dheros-1 (T_FV_2) (152.0 cm). The shortest plants (95.67 cm) were produced from BARI Dheros-1 when grown in control (T_0V_2). The highest dose of N might have enhanced cell division and formation of more tissues resulting in luxuriant vegetative growth and thereby increased plant height. Meyer and Anderson (2003) also reported similar results.

Table 2. Effect of different tree leaf litters on the yield and yield attributes of Okra

| Leaf litter | Plant height (cm) | Branch plant ⁻¹ (no.) | Days to 1 st harvest | Fruit length (cm) | Fruit diameter (cm) | Fruits plant ⁻¹ (no.) | Individual fruit wt. (g) | Yield pot ⁻¹ (g) | Total yield (t ha ⁻¹) | Total biomass (t ha ⁻¹) |
|-------------|-------------------|----------------------------------|---------------------------------|-------------------|---------------------|----------------------------------|--------------------------|-----------------------------|-----------------------------------|-------------------------------------|
| T_A | 140.3 | 6.33 | 68.83 | 9.16 | 1.41 | 10.17 | 12.17 | 123.3 | 5.79 | 3.75 |
| T_B | 137.0 | 6.33 | 69.00 | 11.17 | 1.60 | 13.67 | 16.50 | 200.7 | 10.20 | 4.39 |
| T_G | 134.5 | 6.33 | 69.50 | 9.16 | 1.58 | 13.33 | 15.83 | 198.8 | 9.38 | 4.30 |
| T_F | 154.3 | 7.50 | 65.67 | 13.17 | 1.68 | 16.83 | 19.50 | 278.5 | 13.08 | 4.94 |
| T_S | 122.7 | 4.16 | 75.00 | 8.17 | 1.28 | 9.00 | 11.33 | 102.8 | 4.87 | 3.80 |
| T_0 | 99.33 | 2.66 | 81.17 | 4.51 | 1.23 | 7.00 | 9.16 | 64.67 | 2.00 | 3.48 |
| LSD (0.05) | 4.097 | 1.129 | 2.836 | 1.456 | 1.1258 | 1.635 | 1.630 | 21.63 | 1.207 | 0.1258 |

Number of branches per plant

Results showed that number of branches per plant was also differed significantly by the application of different leaf litter (Table 2). Maximum number of branches (7.5) was obtained from chemical fertilizer and the second highest number of branches (6.33) was given by Acacia leaf litter which is identical with Bohera and Gamar leaf litter. The Minimum number of branches (2.66) was observed in Control treatment (T_0).

High significant variation was observed in branch number per plant due to varietal variation (Table 3). BARI Dherosh-1 produces more branches (6.33) than the local one (4.77). No significant variation was observed in interaction effect on number of branches per plant (Table 4). Maximum branches (9.0) were found in fertilizer with BARI Dherosh-1 (T_FV_2) and minimum in local variety when grown in control (T_0V_1).

Days to first harvest

The treatment subjective significantly the harvesting time of Okra (Table 2). Earliest harvest was done in the pot treated with chemical fertilizer (65.67 DAS), whereas it was identical Acacia, Bohera and Gamar leaf litter. Plants treated with Sal leaf litter took the maximum days to harvest (81.17 DAS). Earliness in harvesting was varied significantly due to varietals difference (Table 3). Early harvesting was done in BARI Dherosh-1 than local variety. Interaction effects were significant in days to first harvest (Table 4). BARI Dheros-1 with Fertilizer (T_FV_2) required the minimum days to 1st harvest (61.33 DAS), while maximum days (82.67 DAS) to first harvest was found in local variety with control (T_0V_1).

Table 3. Effects of different variety on the yield and yield attributing characters of Okra

| Variety | Plant height (cm) | Branch plant ⁻¹ (no.) | Days to 1 st harvest | Fruit length (cm) | Fruit diameter (cm) | Fruits plant ⁻¹ (no.) | Individual fruit wt. (g) | Yield plant ⁻¹ (g) | Total yield (t ha ⁻¹) | Total biomass (t ha ⁻¹) |
|----------------|-------------------|----------------------------------|---------------------------------|-------------------|---------------------|----------------------------------|--------------------------|-------------------------------|-----------------------------------|-------------------------------------|
| V ₁ | 134.8 | 4.77 | 74.33 | 8.13 | 1.38 | 10.27 | 12.72 | 138.1 | 6.45 | 3.88 |
| V ₂ | 127.9 | 6.33 | 68.72 | 10.31 | 1.55 | 13.05 | 15.44 | 184.9 | 8.65 | 4.32 |
| LSD (0.05) | 6.483 | 0.347 | 2.161 | 0.609 | 0.155 | 3.922 | 0.718 | 14.830 | 0.319 | 1.194 |
| CV% | 5.86 | 6.75 | 4.90 | 6.48 | 7.79 | 7.95 | 8.11 | 6.39 | 6.48 | 5.21 |

Table 4. Interaction effects of different leaf litter and variety on the yield and yield contributing characteristics of Okra

| Interaction | Plant height (cm) | Branch plant ⁻¹ (no.) | Days to 1 st harvest | Fruit length (cm) | Fruit diameter (cm) | Fruits plant ⁻¹ (no.) | Individual fruit wt. (g) | Total yield (t ha ⁻¹) | Total biomass (t ha ⁻¹) |
|-------------------------------|-------------------|----------------------------------|---------------------------------|-------------------|---------------------|----------------------------------|--------------------------|-----------------------------------|-------------------------------------|
| T _A V ₁ | 144.3 | 5.33 | 71.67 | 8.33 | 1.36 | 9.00 | 11.33 | 4.76 | 3.55 |
| T _A V ₂ | 136.3 | 7.33 | 66.00 | 10.00 | 1.46 | 11.33 | 13.00 | 6.82 | 3.90 |
| T _B V ₁ | 141.3 | 5.33 | 72.67 | 10.00 | 1.50 | 12.00 | 14.00 | 8.65 | 4.18 |
| T _B V ₂ | 132.7 | 7.33 | 65.33 | 12.33 | 1.70 | 15.33 | 19.00 | 11.83 | 4.60 |
| T _G V ₁ | 138.3 | 5.67 | 73.00 | 8.00 | 1.46 | 11.67 | 14.00 | 7.94 | 4.06 |
| T _G V ₂ | 130.7 | 7.00 | 66.00 | 10.32 | 1.70 | 15.00 | 17.67 | 10.82 | 4.54 |
| T _F V ₁ | 156.7 | 6.01 | 70.00 | 11.00 | 1.60 | 15.33 | 17.33 | 11.38 | 4.67 |
| T _F V ₂ | 152.0 | 9.00 | 61.33 | 15.34 | 1.76 | 18.33 | 21.67 | 14.78 | 5.20 |
| T _S V ₁ | 125.3 | 4.03 | 76.00 | 8.00 | 1.13 | 7.66 | 10.67 | 4.07 | 3.54 |
| T _S V ₂ | 120.0 | 4.33 | 74.00 | 8.33 | 1.33 | 10.33 | 12.00 | 5.67 | 4.06 |
| T ₀ V ₁ | 103.0 | 2.34 | 82.67 | 3.50 | 1.23 | 6.00 | 9.00 | 1.98 | 3.33 |
| T ₀ V ₂ | 95.97 | 3.00 | 79.65 | 5.53 | 1.33 | 8.00 | 9.34 | 2.02 | 3.64 |
| LSD(0.05) | 5.025 | 1.101 | 1.924 | 1.613 | 0.2028 | 1.650 | 2.033 | 1.891 | 1.401 |
| CV% | 5.86 | 6.75 | 4.90 | 6.48 | 7.79 | 7.95 | 8.11 | 6.48 | 5.21 |
| Sig. Level | NS | NS | ** | ** | NS | * | ** | ** | NS |

Fruit length (cm)

The length of the fruit was governed by the different treatments (Table 2). The longest fruits (13.17 cm) were found in plants treated with T_F followed by Bohera leaf litter (11.17 cm). The shortest fruits (4.52 cm) were observed in the plants provided no treatment (control). The remaining other treatments gave the similar fruit length. Gupta *et al.* (1981) reported that N and P fertilization increased fruit size. The fruit length of BARI Dherosh-1 was significantly higher (10.31 cm) than the Local variety (8.13 cm) (Table 3).

The result of the interaction effects shows that significant changes happened in fruit length due to variety and treatment combination (Table 4). Maximum length (15.34 cm) was found in the combination of BARI Dherosh-1 and fertilizer (T_FV₂) followed by Dherosh-1 and Bohera leaf litter combination (T_BV₂). Minimum length (3.5 cm) was found from local variety when grown in control.

Fruit Diameter (cm)

Fruit diameter was differed significantly by the application of different leaf litters. Maximum diameter of (1.68 cm) was found in T_F which is statistically identical with T_B and T_G and the minimum diameter T_S and T₀ (Table 2). Significant variation was also found in fruit diameter among the varieties (Table 3). Maximum diameter (1.55 cm) was found in BARI Dherosh-1 followed by local variety (1.38 cm). Variation in fruit diameter of okra was found insignificant due to interaction of different tree leaf litter and okra variety (Table 4). Maximum fruit diameter (1.76 cm) was noticed in BARI Dherosh-1 and fertilizer (T_FV₂), closely followed by Dherosh-1 and Bohera Leaf litter (T_BV₂) and BARI Dherosh-1 with Gamer Leaf litter (T_GV₂) (1.7 cm). Minimum diameter (1.13 cm) was found in Local Dherosh with Sal leaf litter (T_SV₁).

Number of fruits per plant

Results revealed that the treatments have highly significant effect on number of fruits per plant of okra (Table 2). The highest number of fruits per plant (16.83) was observed in fertilizer treatment followed by T_B and T_G (13.62 and 13.33 respectively). The lowest number of fruits per plant was found in control (7.0). Anjum and Amjad (1999) also reported that different combination of N P K fertilizers increased number of fruits per plant. Fruit number per plant was also significantly differed among the two varieties (Table 3). Maximum number of fruits was yielded by BARI Dherosh-1 (13.05) whereas local variety yielded the minimum (10.27).

Interaction Effect was also significant in fruit number per plant (Table 4). Maximum fruits per plant (18.33) were obtained from BARI Dherosh-1 and fertilizer (T_FV_2). Second highest number of fruits per plant was found in T_BV_2 and T_FV_1 (15.33) which was statistically identical with T_GV_2 (15.00). Minimum number of fruits per plant (6.0) was noticed in Local variety with control (T_0V_1)

Individual fruit weight (g)

The heaviest fruits of okra were produced by fertilizer treatment (19.50 g) significantly followed by T_B (16.50g) and T_G (15.83g). The lowest fruit weight was (Table 2) obtained from control (9.16 g). Heaviest fruits were produced by BARI Dherosh-1 (15.44 g) which was significantly higher than the local variety (12.72 g) (Table 3). Significant variation was found in individual fruit weight of okra in the interaction of variety and leaf litter (Table 4). BARI Dherosh-1 in combination with fertilizer (T_FV_2) produced the heaviest individual fruits (21.67 g) followed by T_BV_2 (19.0 g). Lowest individual fruit weight (9.0 g) was marked in Local variety when grown in control. Birbal *et al.* (1995) found that application of N at the rate of 100 kg ha⁻¹ significantly improved the weight of individual fruit over control.

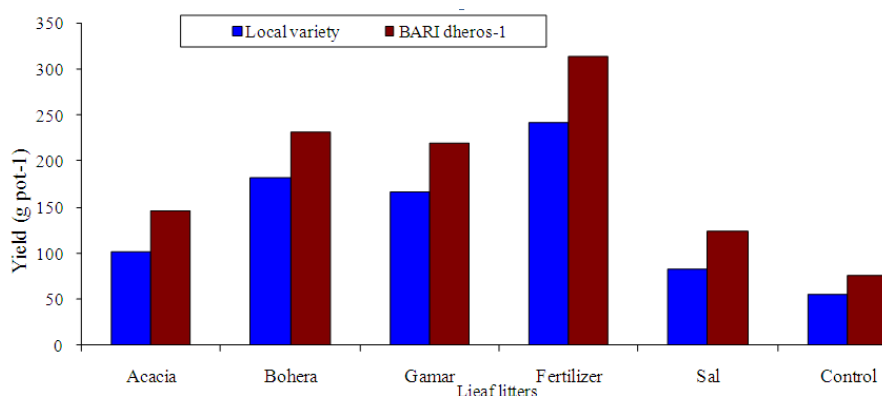


Figure 1. Effect of different leaf litters on the yield of Okra

Yield per plant (g)

The highest yield per plant was obtained from fertilizer treatment (278.5 g) followed by T_B and T_G (200.7g and 198.8g respectively), whereas the lowest fruit yield per plant (64.67 g) was observed in control (Table 2). Yield per plant shows significant differences between two varieties (Table 3). The highest yield per plant was found in BARI Dherosh-1 (184.88 g) than local variety (138.05g). Total yield per plant was varied significantly due to interaction (Fig.1). Maximum yield per plant (314.7 g) was noticed in the combination of BARI Dherosh-1 and fertilizer (T_FV_2) significantly followed by T_FV_1 (242.3 g). Minimum yield (54.67 g) was given by the combination of Local variety and control (T_0V_1). Adequate supply of nitrogen (N), phosphorus (P) and Potassium (K) are essential for maximizing the yield of Okra (Verma *et al.* 1970).

Yield ($t\ ha^{-1}$)

The results showed that tree leaf litters have significant influence on the yield of Okra on Modhupur soil (Table 2). Highest yield of okra was produced from the application of fertilizer ($13.08\ t\ ha^{-1}$) followed by T_B and T_G (10.20 and $9.38\ t\ ha^{-1}$ respectively). Yield of okra was significantly varied due to varietal difference (Table 3). BARI Dheros-1 was found high yielder ($8.65\ t\ ha^{-1}$) as compared with the local variety ($6.45\ t\ ha^{-1}$). Marked significant variation was noticed in the yield of okra due to interaction of different variety and leaf litter (Table 4). The highest yield ($14.78\ t\ ha^{-1}$) was given by the combination of BARI Dherosh-1 and fertilizer (T_FV_2). Second highest yield ($11.83\ t\ ha^{-1}$) was found in the combination of BARI Dherosh-1 and Bohera leaf litter (T_BV_2) which is statistically similar with other two combination namely, BARI Dherosh-1 and Gamer leaf litter (T_GV_2) and local variety with fertilizer (T_FV_1) whereas, lowest yield ($1.98\ t\ ha^{-1}$) was found in local variety when grown in control (T_0V_1).

Total biomass (dry)

The result showed that maximum biomass was produced by the application of fertilizer ($4.9\ t\ ha^{-1}$) and the minimum from control ($3.48\ t\ ha^{-1}$) (Table 2). Maximum biomass was also produced by BARI Dherosh-1 ($4.32\ t\ ha^{-1}$) which was significantly differ with the local variety ($3.88\ t\ ha^{-1}$) (Table 3). No significant variation was observed in total biomass production due to interaction of variety and leaf litter application (Table 4). Chauhan and Gupta (1973) reported that increased application of N P K fertilizer increased dry matter but not significantly.

CONCLUSION

From the findings of this pot experiment, it can be concluded that fertilizers shows better performance to cultivate Okra but tree leaf litters have significant influence on the growth and yield of Okra. Among the four leaf litters the performance of Bohera was better. But to sustain soil fertility for vegetables production, the people of Madhupur can be practiced these natural resources as a combination with leaf litters and fertilizers which found balance according to nutrition addition and soil health basis need.

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