

Effect of six years old *Xylia dolabriformis* tree on the growth and yield of soybean and mustard

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Abstract: A field experiment was conducted at the farm field of the Department of Agroforestry of Bangladesh Agricultural University, Mymensingh, during the period of November 2013 to April 2014 with the aim of evaluating the growth and yield performance of soybean (*Glycine max*) and mustard (*Brassica campestris*) grown in combination with six years old lohakat (*Xylia dolabriformis*) trees. The experimental design was followed by Randomized Complete Block Design (RCBD) with three replications. Different distances from tree base viz. 0-0.5 m, 0.5-1.0 m and 1.0-1.5 m were treatments of this study. There was a control treatment i.e., without tree condition or open field. The individual plot size was “6 m x 2 m” and each plot contains two lohakat trees maintain 3 m distance from one another. In this study growth and yield of soybean and mustard was observed as seed production purposes. Growth and yield of soybean and mustard in association with lohakat tree was remarkably decreased with decreasing distance towards the tree base and the variation was very wide near the lohakat tree base compared to open field condition. In case of soybean, morphological characteristics such as plant height, no. of leaves plant⁻¹, leaf size, no. of flower plant⁻¹, no. of pod plant⁻¹, pod length, no. of seed per pod was less vigorous near the lohakat tree base. The highest plant height 40.5, leaf size 19.76 cm², pod length 3.2 cm, no. of pod plant⁻¹ 16.3, seed weight per hundred 8.4 g was in open field condition. Highest yield 1.34 ton per hectare obtained from open condition. Yield of soybean seed produced in 1.0-1.5 m, 0.5-1.0 m and 0-0.5 m distance from lohakat tree base was 12.68%, 25.0% and 39.13% (east) and 13.1%, 26.2% and 40.7% (west) lower compared to open field condition, respectively. In case of mustard, highest plant height 68.4 cm, length of floral rachis 46.5 cm, no. of primary branch plant⁻¹ 12.3, no. of siliqua plant⁻¹ 165.3, length of siliqua 4.7 cm and no. of seed per siliqua 28.3, thousand seed weight 4.1 g of mustard were found in open field condition. Lowest data regarding above parameters were recorded in 0-0.5 m distance from tree base. As evident from results the highest seed yield of mustard 2.06 ton per hectare was observed in open field condition i.e., without lohakat tree combination. Yield of mustard seed produced in 1.0-1.5 m, 0.5-1.0 m and 0-0.5 m distance from lohakat tree base was 11.48%, 23.51% and 30.58% (east) and 12.32%, 24.87% and 32.63% (west) lower compared to open field condition, respectively.

Key words: Mustard, Soybean, Lohakat, Agroforestry.

Introduction

Agroforestry is neither an invention nor a new concept. The concept of agroforestry probably originated from the realization that trees play an important role in protecting the long range interests of agriculture economically viable. The emergence of agroforestry was influenced by the need to maximize the utilization of soil resources through the marriage of forestry and agriculture the basic concept of inter cropping has been extended to agroforestry system. However, agroforestry as a new applied science is a matter of discussion of the contemporary time. With the increase of human beings in the geometrical progression and the land area remaining infinite, there is no other alternative but to grow food, fuel, fodder and fiber in an integrated manner in the same unit of land. Trees play an important role in ecosystem in all terrestrials and provide a range of products and services to rural and urban people. As natural vegetation is cut for agriculture and other types of development, the benefits that trees provide are best sustained by integrating trees into agricultural system—a practice known as agro forestry. Of the total agricultural products about 15.52% come from the various crops and 1.71% from forest products (BBS, 2011). Agroforestry means many things to different people. It is often applied to the integration of trees, typically one species grown for timber, with pasture; but it may also include more complex systems that include trees with a variety of crops, both annual and perennial species, and animals. Now a days Bangladesh contains about 6.7% forest area (FAO, 2010) but for sustainable ecology a country needs 25% forest coverage of its total area.

Mustard and Soybean are two important oil seed crop in Bangladesh and all over the world. Planting soybean in rows ensures easy intercultural operations and helps to attain in higher yield. In agroforestry system both of these

crops may be suitable. For identifying the compatible tree-crop combination particularly understory species different crops should be screened out in terms of their adaptability and yield in association with tree. For this purpose one of the best ways of experimentation is to grow different crops at different distances from the tree. So, best tree-crop combination can be easily selected if we know the suitability of different crop. Considering the facts and potentiality a study was undertaken with the broad objective to observe the morphological behavior and yield performance of soybean and mustard in lohakat tree based agroforestry system.

Materials and Methods

Study site and location: The experiment was carried out at the experimental field, Department of Agroforestry, Bangladesh Agricultural University, Mymensingh.

Associated plants: Plant materials of this study were lohakat (*Xylia dolabriformis*) as tree, soybean (*Glycine max*) and mustard (*Brassica campestris*) as herbaceous crops.

Tree establishment and management: Lohakat trees planted along the field boundary of the agroforestry farm were used as the test plants in the study. During the study period lohakat trees as planted during the year 2008 were well established and average height and girth of lohakat trees were 7.29 m and 0.32 m, respectively. Before final land preparation tree pruning enhances the plants to get the sunlight directly to grow well.

Experimental design, layout and treatment combination: The experiment was laid out following a randomized complete block design (RCBD) with three replications. For both soybean and mustard in each replication two lohakat trees were included in a “6 m × 2 m” size plot. Soybean was planted in 18 rows surrounding

the lohakat trees. Mustard seeds were broadcasted surrounding the lohakat trees as shown in the. Total four treatments of this study were as: T₀ = Open field referred to as control, T₁ = up to 0.5 meter distance from the tree base, T₂ = 0.5 to 1.0 meter distance from the tree base and, T₃ = 1.0 to 1.5 meter distance from the tree base

Harvesting: Soybean was harvested in 3rd April, 2014 when the crops became fully matured. For the purpose of seed production, mustard was harvested when more than 80% of the pods become straw color.

Data collection: data were recorded for morphological parameters and yield attributes to measure yield. Data were collected randomly from all rows of respective plots. The yield of soybean was collected as tha⁻¹. In case of mustard data were collected at vegetative stage, flowering and harvesting stages Mustard seeds were weighted for yield to tha⁻¹.

Statistical analysis: The recorded data were compiled and analyzed by RCBD design to find out the statistical significance of the experimental results. The means for all recorded data, the analyses of variance for all the

characters and Least Significant Difference (LSD) test were performed using statistical package programmed MSTAC-C and WASP 2 software. Mean comparisons were done by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984) and also by Least Significant Difference (LSD) test.

Results and Discussion

Soybean

Morphological characteristics:

Plant height: Plant height of soybean grown under different distance from the lohakat tree base was significantly influenced. Plant height decreased gradually with the decreasing of distance from tree base. Among the four distance levels, the shortest plant 29.0 cm (east) and 27.0 cm (west) was produced within T₁ and tallest plant 40.5 cm within T₀. Plant height of soybean grown up to 0.5-1.0 m and 1.0-1.5 m from lohakat tree base was 34.5 cm and 37.2 cm (east) and 34.3 cm and 38.3 cm (west) respectively (Table 1). Similar observation also found in Akter *et al.* (2013).

Table 1. Morphological characteristics of soybean

Direction	Treatments	Plant height (cm)	No. of leaves plant ⁻¹	No. of pod	Pod length	Seed per pod	Wt. of 100 seed
East	T ₀	40.5	11.0	16.3	3.2	2.3	8.4
	T ₁	29.0	8.0	8.7	2.4	1.5	4.6
	T ₂	34.5	9.0	11.3	2.4	1.6	5.5
	T ₃	37.2	5.7	13.7	2.6	1.7	7.0
West	T ₁	27.7	3.3	7.3	2.1	1.4	4.4
	T ₂	34.3	7.7	9.7	2.5	1.6	5.4
	T ₃	38.3	14.3	13.3	2.5	1.8	6.8

T₀= Control, T₁= 0.5 m from the tree base, T₂= 0.5-1.0 m from tree base, T₃= 1.0-1.5 m from tree base

No. of leaves plant⁻¹: The result revealed that the highest no. of leaves per plant was 14.3 produced by T₃ (west). The second highest no. of leaves per plant was 11.0 produced under T₀ and the lowest leaves number was 3.3 observed at T₁ i.e., 0.5 m distance from the tree in west direction and the second lowest leaves was 8.0 in T₁ in east (Table 1). Tanni *et al.* (2010) for Radish and Lettuce along with 4 years old *Xylia dolabriformis* tree.

Number of pod plant⁻¹: The number of pod per plant is the most yield contributing character, which was also significantly influenced by different distance from the tree. The top pod number plant⁻¹ 16.3 was logged in the open field condition treatment (Table 1). The number of pod was recorded in 1.0-1.5 m distance level 13.7 (east) and 13.3 (west). Number of soybean pod per plant in 0-0.5 m and 0.5-1.0m distance from lohakat tree base was 8.7 and 11.3 (east) and 7.3 and 9.7 (west) respectively. 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.

Average Length of Pod: The length of pod was highly influenced by different distance from trees. The longest pod length 3.2 cm was obtained at open filed condition and the smallest pod length 2.1 cm (west) and 2.4 cm (east) was observed in 0-0.5m distance from lohakat tree base. The second and the third lowest pod length 2.5 cm (west) and 2.6 cm (east) were produced by the treatments 0.5-1.0 m and 1.0-1.5 m distance from lohakat tree base

respectively (Table 1). Rahman *et al.* (2013) also found less size of Sweet gourd fruits very near Akahmoni tree.

No. of seed pod⁻¹: The number of seed was highly influenced by distance from tree base. The highest seed no. was in control treatment T₀ that is control treatment which was 2.3 and the lowest under treatment T₁ i.e., up to 0.5 m distance from tree base in west direction which was 1.4 (west). Second highest no. of seeds per pod was 1.6 in both direction produced under 0.5-1.0 m from tree base and next highest no. of seeds was 1.7 (east) and 1.8 (west) produced by T₃ treatment in west direction (Table 1).

Weight of hundred seed: Weight of hundred seed is influenced by different distance of growing soybean plant from the tree. The maximum weight of hundred seed was 8.4g was observed at T₀. The lowest hundred seed weight was 4.4 g (west) and 4.6 g (east) found under T₁ and 5.5 g (east) and 5.4 g (west) was observed at T₂. 7.0 g (east) and 6.8 g (west) was produced by T₃ (Table 1). Farhana *et al.* (2013) also found same result in spinach cultivation with lohakat tree.

Yield: Seed yield of soybean was recorded as ton per hectare both in east and west direction. Highest amount of seed yield of soybean per hectare was 1.34 ton which was found from treatment T₀ i.e., open field referred to as control. 1.22 ton and 1.13 ton seed yield of soybean was found from 1-1.5 m distance and 0.5-1.0 m distance from the lohakat tree base. Lowest amount seed yield was

recorded under 0-0.5 m distance from the lohakat tree base which was 0.97 t/ha (Fig. 1) in east direction.

Yield of soybean seed in different treatments showed considerable variation (Fig. 1). As evident from results the seed yield obtained from 1.0-1.5 m distance area 1.17 ton hectare⁻¹ from tree base in west direction. Seed yield of soybean was remarkably reduced with reducing distance from tree base. Seed yield of soybean produced in 0.5-1.0 m and 0-0.5 m distance area from lohakat tree base in west direction was 1.09 ton and 0.94 ton per hectare respectively (Fig. 1).

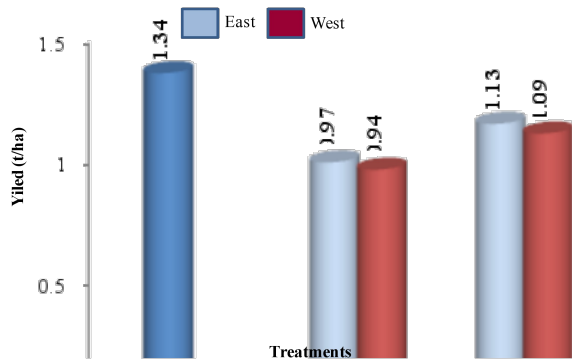


Fig. 1. Yield of soybean in association with Lohakat tree

Mustard

Morphological parameters and yield of mustard were observed at different stages. Different morphological parameters were studied separately for seed production purpose. Yield was measured from the yield contributing characters for seed production purpose. Results regarding morphological parameters obtained at mustard lohakat based agroforestry practice in different study periods were as follows:

Morphological characteristics:

Plant height (cm): It is noticed that the highest plant height of mustard was 68.4 cm found in T₀ (open field

condition) and the lowest average plant height of mustard was 37.9 cm found in T₁ (east) and 38.0 (west). Average plant height of mustard was 46.1 cm (west) and 46.3 (east) found in T₂ i.e., 0.5-1.0 m distance from the tree. Plant height was 52.3 cm (east) and 51.8 (west) which were found in T₃ i.e., 1.0-1.5 m distance from tree (Table 2). Similar result was reported by Uddin *et al.* (2013) in Carrot in association with Akashmoni tree.

Length of floral rachis: The result showed that highest length of floral rachis 46.5 cm was noted in control plant treatment and the lowest length of floral rachis 25.4 cm (east) and 24.2 (west) was shaped under 0-0.5 cm distance. Rachis length of mustard was 33.0 cm (east) found in T₂ i.e., 0.5-1.0 m distance from the tree. Second highest of plant height was 38.7 cm (east) and 37.8 (west) which was found in T₃ i.e., 1.0-1.5 m distance from tree (Table 2). Farhana *et al.* (2013) also found shorter plant of spinach very near to lohakat tree.

Length of siliqua (cm): Length of siliqua of mustard varied from distance level. Siliqua length increases with the distance level from tree base. The highest length of siliqua 4.7 cm was logged in control treatment i.e., T₀ (Table 2). The siliqua length produced in 1.0-1.5 m distance 3.8 cm (east) and 3.7 (west) from lohakat tree base (Table 2). Siliqua length in the 0-0.5 m and 0.5-1.0 m distance from lohakat tree base were 2.1 cm and 3.0 cm (east) and 2.0 cm and 3.0 cm (east) respectively. 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.

Number of siliqua plant⁻¹: It was saw that the number of siliqua of mustard was affected significantly by lohakat trees. The top siliqua number plant⁻¹ 165.3 was logged in without trees treatment T₀ (Table 2). The number of siliqua was recorded under 0-0.5 m, 0.5-1.0 m and 1.0-1.5 m distance from trees were 82, 107, 148 (east) and 83, 107, 148 (west). Khatun *et al.* (2009) showed the similar results.

Table 2. Morphological characteristics of mustard

Direction	Treatments	Plant height (cm)	No. of leaves plant ⁻¹	No. of pod	Pod length	Seed per pod	Wt. of 100 seed
East	T ₀	68.4	46.5	4.7	165.3	28.3	4.1
	T ₁	37.9	25.4	2.1	82.0	10.3	2.3
	T ₂	46.3	33.0	3.0	107.0	15.0	3.0
	T ₃	52.3	38.7	3.8	148.0	19.7	3.9
West	T ₁	38.0	24.2	2.0	83.0	9.7	2.2
	T ₂	46.1	32.9	3.0	107.3	14.0	3.0
	T ₃	51.8	37.8	3.7	146.0	18.7	3.8

T₀ = Control, T₁ = 0.5 m from the tree base, T₂ = 0.5-1.0 m from tree base, T₃ = 1.0-1.5 m from tree base

No. of seed siliqua⁻¹: The no. of seed siliqua⁻¹ was highly influenced by the distance of crops from tree base. No. of seed increase s with the distance of crops from tree base. The number of seed was highest in control treatment T₀ i.e., control which was 28.3 and the no. of seed under treatment T₁ i.e., up to 0.5 m distance from tree base which was 10.3 (east) and 9.7 (west). Second highest no. of seeds per siliqua was 15 (east) and 14 (west) produced under 0.5-1.0 m distance from tree base and next highest no. of

seeds was 19.7 (east) and 18.7 (west) produced by T₃ treatment (Table 2). Control produces the best.

Weight of thousand seed: Seed weight of mustard influenced with the distance of crops from tree base. Higher the distance results higher the seed weight. The maximum weight of thousand seed was 4.1 g was observed at T₀. The lower thousand seed weight was 2.3 g (east) and 2.2 (west) found under close contact of the tree condition referred as T₁ (0-0.5 m distance from the tree) and 2nd lowest result 3.0 g was observed at T₂ i.e., 0.5 to

1.0 m distance from the tree in both direction. Second highest weight of thousand seed 3.9 g (east) and 3.8 (west) was produced by T₃ i.e., 1-1.5 m distance from the tree (Table 2). Shah (2013) also found lesser seed weight of Mustard near tree base grown along with Akashmoni tree.

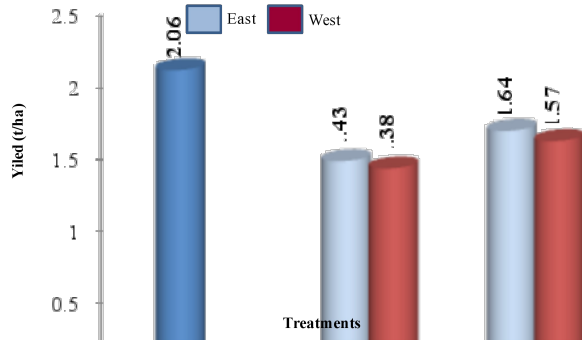


Fig. 2. Yield of mustard in association with Lohakat tree

Yield: At first seed yield of mustard was recorded as ton per hectare. Highest amount of seed yield of mustard was 2.06 ton which was found from treatment T₀ i.e., open field referred to as control. 1.87 ton and 1.64 ton seed yield of mustard was found from 1-1.5 m distance and 0.5-1.0 m distance from the lohakat tree base. Lowest amount seed yield was recorded under 0-0.5 m distance from the lohakat tree base which was 1.43 ton per hectare in east direction (Fig. 2). Yield of mustard seed (ton per hectare) in different treatments showed considerable variation in west direction (Fig. 2). As evident from results, the seed yield obtained from 1.0-1.5 m distance area (1.82 ton) from tree base. Seed yield of mustard was remarkably reduced with reducing distance from tree base. Seed yield of mustard produced in, 0.5-1.0 m and 0-0.5 m distance area from lohakat tree base were, 1.57 ton and 1.38 ton respectively (Fig. 2) in west direction.

Sybean and Mustard seed yield in combination with lohakat tree as agroforestry system was remarkably decreased with increasing distance from tree base. These results indicate very close to the tree base (within 1 m) seed yield of mustard decreased due to competition for nutrients and moisture in the belowground and shade effect in the above ground. But seed yield of mustard in the distant area (> 1 m) from tree base was almost similar

with open field condition which indicates negative interaction by lohakat tree both above and below ground was minimum in this area. So, in combination with six years old lohakat tree and mustard i.e., as agroforestry system seed production of mustard can be done without significant yield loss beyond 1.0m distance from lohakat tree base.

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