Performance of mustard along the north-south direction of a five years old strip plantation of akashmoni tree

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Abstract: An experiment was conducted at the experimental farm, Department of Agroforestry, Bangladesh Agricultural University, Mymensingh, during November 2013 to March 2014 in order to evaluate the growth performance of mustard under five years old Akashmoni tree. Four different treatments were used in this experiment viz. 0-1.5m, 1.5-3m and 3-4.5m distance both in north and south direction from tree bases and in open field condition referred as control. The experimental design was laid out in a Randomized Complete Block Design with three replications in north and south directions. Mustard was cultivated in north and south directions in association with five years old Akashmoni tree (*Acacia auriculiformis)* which was established in the boundary (ail) of the field. It was found that growth and yield of mustard were significantly influenced by different distance from Akashmoni tree. Growth and yield of mustard in association with Akashmoni tree was remarkably increased with increasing distance from the tree base. The highest value of different morphological parameters of mustard viz. plant height, no. of leaf, leaf length, leaf breadth, rachis length, branch per rachis, no. of flower, no. of branch, siliqua per plant, siliqua length, seed per siliqua, thousand seed weight was in open field condition which was almost similar with the treatment T_3 i.e. 3-4.5m distance from tree base .However, morphological parameters in treatment T_1 i.e. 0-1.5m and T_2 i.e. 1.5-3.0m distance from tree base were significantly lower compared to control condition. Yield of mustard also highest in control condition which was almost similar with treatment T_3 i.e. (3-4.5m distance area from tree base). On the contrary, yield of mustard was significantly lower in treatment T_1 i.e. 0-1.5m (70.82%) and treatment T_2 i.e. 1.5-3m (49.68%). Yield of mustard was relatively lower in north direction compare to south direction in the treatment T_1 (70%) and T_2 (72.6%) may be due to shade effect. From this study it may be concluded that mustard can be successfully cultivated along the north-south oriented strip planted akashmoni tree beyond 3m distance from the strip of akashmoni tree.

Key words: Mustard, *Acacia auriculiformis*, strip plantation, agroforestry.

Introduction

Bangladesh is the eighth most populated country in the world with a population of over 150 million people. The annual population growth rate is about 1.6 percent. It is estimated that by 2020, the population of Bangladesh will be around 167 million people. Even with a slowing down of the population growth rate, the size of the population will continue to grow because of the young age structure of the population. As a result of the population momentum, the total population size will almost double in the next four to five decades. With about 147,570 sq. km, Bangladesh is the most densely populated country of the world struggling hard to feed those peoples. The current forest land of Bangladesh is 1442 hectares which is 17.08% of total land area (FAO, 2011). And the main point is that, this forest land cannot fulfill the demand of people for food, fuel, fodder, timber etc. Consequently, poverty has become a serious issue. About 31.60% of the gross domestic product of Bangladesh is contributed from agriculture. Of the total agricultural product about 22.80% comes from various crops, 3.2% from livestock, 3.27 from fishes and 2.32% from forests (BBS, 2008). Forest plays an important role in maintaining environmental equilibrium and socio-economic development of the people. Though agroforestry is an age old practice in Bangladesh, further development may be brought for harvesting maximum benefit by identification of appropriate tree-crop combination. To maintain the environmental equilibrium and rate of socio-economic development sound environment is needed and at least 25% area of a country should be covered with forest. In Bangladesh, the total forest area covers about 13.36% of the total land area (BBS, 2008). But the actual tree covered area is estimated at around 5.4%, which is decreasing at an alarming rate (Hossain and Bari, 1996). To meet the domestic requirement of timber and fuel wood, there is no other way for expansion of natural forest but there is only way to increase the plantation forest. For example, one component may produce branch and creates more shade; another may develop root more deeply than its companion species and so obtain a greater share of available water and perhaps nutrients.

Acacia auriculiformis used for fuel wood plantations as an ornamental and shade tree, quite tolerant of heat, the Australian species is widely planted in Oceania and southeast Asia. The wood is also employed for making farm tools and furniture (NAS, 1983). Recent Australian test suggest that 10-year old trees can be pulped readily by the sulfate process, giving high pulp yields, with good strength properties. Also produces high quality pulp by the neutral sulfite semi-chemical process. The tannin produces good 3 quality leather, inclined to redden upon exposure to sunlight (NAS, 1983). Mustard (*Brassica spp*.) is one of the most important oil crops of the world after Soybean and Groundnut (FAO, 2011) and it tops the list among the oilseed crops grown in Bangladesh in respect of both production and acreage. Bangladesh has been in short 65-70% of the demand of the edible oil. For obtaining the full benefits from these two components by maximizing beneficial effects and minimizing negative effects, it is essential to observe the effects of the tree on the growth and yield of mustard.

Materials and Methods

Location and time of the study: The experiment was carried out at the experimental farm, Department of Agroforestry, Bangladesh Agricultural University, Mymensingh, during the period from November 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 Brahamaputra Floodplain Agro-Ecological Zone-9 (UNDP, 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: Tree species of this study was Akashmoni (*Acacia auriculiformis*) which was planted in the Boundary (ail) of crop field maintaining plant to plant distance 1.0m during the year 2011. Mustard (*Brassica oleracea*) was collected from BRAC seed centre and broadcastly both north and south side of the row of Akashmoni tree.

Experimental design and treatment combination: The experiment was laid out following a two factorial Randomized Complete Block Design (RCBD) with three replications. Factor A: Orientation viz. North, South. Factor B: Distance from tree bases viz, T_0 = Open field referred to as control, T_1= 0-1.5m distance from tree base,T_2= 1.5-3.0m distance from tree base,T_3= 3.0-4.5m distance from tree base.

Land preparation: The experimental land was first opened on 25th November, 2014 and the operation was done by spade. Then the land was fallow for few days. All crop residues and weeds were removed from the field and finally the land was properly leveled.

Crop establishment and management: Mustard seeds were directly sown in the experimental plot on 10th December 2014. The seeds were sown through broadcasting methods. After emergence mustard were thinned out maintaining l cm to 2 cm distance from plant to plant. Overall experimental view is shown in plate-1.Only recommended dose of well decomposed cow dung were applied for the all crop species. No chemical fertilizers were applied considering the suitable fertility status of the soil. Full amount of well decomposed cow dung was incorporated during the final land preparation. Different management practices viz. fertilization, irrigation and weeding, thinning out and earthing-up were done for better growth of Mustard.

Method of data collection: Plant samples of mustard were collected randomly from the respective plots. Ten mustard plants were selected from each plot for data collection. The parameters under study were as plant height (cm), no. of leaves/plant, leaf length (cm), leaf breadth, Average length of floral rachis, Average no. of branches/plant, Average no. of siliqua/plant, Average length of siliqua, no. of seed/siliqua , weight of 1000 seeds.

Data analysis: Data were analyzed statistically by ANOVA to examine the treatment effects were significant (Gomez and Gomez, 1984) or non significant. Mean value were compared by DMRT (Duncan's Multiple Range Test). The software package, WASP was used for statistical analysis.

Results and Discussion

Morphological parameters:

Plant height: The result showed that plant height of mustard grown under different distance from the Akashmoni tree base was influenced significantly (Tables 1- 2). Plant height decreased gradually with the increasing of distance from tree base. Among the four distance levels in south and north direction the shortest plant (30.76cm and 29.43cm respectively) was produced within T_1 (0-1.5m distance from the tree) and the tallest plant (72.33cm) within T_4 (open field referred as control) which was statistically similar within treatment T_3 (71.86cm and 71.73cm respectively) followed by treatment T_2 (49.53 cm and 47.40cm respectively). Similar to this crop higher plant height under reduced light levels were observed in bitter gourd in association with three fruit trees during winter season by Momtaz *et al*. (2014).

Table 1. Morphological characteristics of mustard in association with akashmoni tree at harvesting stage in north direction

Treatment	Morphological Characteristics of mustard					
	Plant height (cm)	No.of branch	Siliqua/plant	Siliqua length (cm)	seed/siliqua	1000 seed wt.(g)
T_1	29.43c	1.39c	15.10c	2.68c	3.93c	0.72c
T_2	47.40b	2.42b	24.16b	4.42b	7.23b	1.37b
T_3	71.73a	3.52a	35.46a	6.06a	13.38a	2.03a
T_4	72.33a	3.55a	35.75a	6.10a	13.50a	2.05a
LSD (0.01)	3.707	0.440	2.344	0.451	1.253	0.118
level of sign.	**	**	**	**	**	**

Means in column followed by the different letter are significantly different by DMRT at $P \leq 0.05$, T_1= 0-1.5m distance , T_2= 1.5 - 3.0 m distance , T_3= 3.0-4.5 m distance and T_4 = Control (without tree)

In both north and south direction plant height remarkably lower near to the Akashmoni tree base may be due to severe competition for nutrients and moisture. Bithi *et al*. (2014) found shortest brinjal and chilli plant when grown very near to tree base of Lohakat tree. Relatively tallest plant was recorded in all treatments at north direction, this may be due to more shade effect in north direction compare to south direction. Shade condidition results tallest plant due to apical dominance.

Number of branches: At the harvesting stage it was noted that no. of branch of mustard grown under different distance from the Akashmoni tree base was influenced significantly (Tables 1-2). No. of branches decreased gradually with the increasing of distance from tree base but relatively highest no. of branches were found in south and north direction (Tables 1- 2) from tree base. Among the four distance levels at both south and north direction lowest no. of branches (1.46 cm and 1.39 cm respectively) was produced within treatment T_1 (0-1.5m distance from the tree) and highest no. of branches (3.55 cm and 3.55 cm respectively) were recorded in treatment T_4 (open field referred as control) which was statistically similar with

treatment T_3 (3.58 cm and 3.52 cm respectively) followed by treatment T_2 (2.24cm and 2.13cm respectively). In both north and south direction no. of branches remarkably lower near to the Akashmoni tree base may be due to severe competition for nutrients and moisture. Shade condidition results highest no. of branches due to apical dominance (Hillman, 1984). Similar type of results also observed by Mallick *et al.* (2013) in strawberry along with lohakat.

Table 2. Morphological characteristics of mustard in association with akashmoni tree at harvesting stage in south direction

Treatment	Morphological Characteristics of mustard					
	Plant height (cm)	No.of branch	Siliqua/plant	Siliqua length (cm)	seed/siliqua	1000 seed wt.(g)
T_1	30.76c	1.46c	15.92c	2.83c	4.17c	0.76c
T_2	49.53b	2.53b	25.47b	4.64b	7.66b	1.45b
T_3	71.86a	3.58a	35.80a	6.09a	13.45a	2.06a
T_4	72.33a	3.55a	35.75a	6.10a	13.50a	2.05a
LSD (0.01)	3.958	0.350	2.127	0.513	1.206	0.188
level of sign.	**	**	**	**	**	**

Means in column followed by the different letter are significantly different by DMRT at $P \leq 0.05$, T_1= 0-1.5m distance , T_2= 1.5 - 3.0 m distance , T_3= 3.0-4.5 m distance and T_4 = Control (without tree)

Siliqua/plant: It was observed that the highest no. of siliqua/plant of Mustard was meaningfully infuenced by different treatments. In both south and north direction the result showed that the highest no. of siliqua/plant (35.75cm) was noted in T_4 (open field referred as control). The next maximum no. of siliqua (35.80 cm and 33.46cm respectively) was shaped under T_3 (1.5-3m distance) (Table 1 and Table 2). The lowest no. of siliqua (15.92 cm and 15.10cm respectively) was shaped under T_1 (0-1.5m distance). It was probably due to the poor photosynthetic capacity and nutrients competition between tree and crops. Das *et al*. (2014) also showed the same result of sweet gourd in association with three timber tree species.

Siliqua length(cm): It was noted that the highest length of siliqua was meaningfully influenced with the rise of distance from Akashmoni tree both south and north direction (Tables 1-2). The result showed that highest length of siliqua were found in south and north direction (6.10 cm and 6.10 cm respectively) in the treatment T_4 (open field referred as control). Next maximum length of siliqua (6.09 cm and 6.06 cm respectively) were recorded in the treatment T_3 (3- 4.5m distance from the tree). The lowest no. of leaves were recorded both in south and north direction (2.83 cm and 2.68 cm respectively) in the treatment T_1 (0-1.5m distance from tree). It was found that length of siliqua was slightly higher in south direction compare to north direction. Length of siliqua decreased with decreasing distance towards tree base may be also due to competition for nutrients and mature in the closet area of tree base. Length of siliqua was bit higher in south direction may be due to less shade effect in this direction in winter season. Such type of results also observed by Bari *et al*. (2014) in sweet gourd in association with two years old different fruit tree species.

Seed/siliqua: The total no. of seed per siliqua was recorded beneath (0-1.5m, 1.5-3m, 3-4.5m distance and open field referred as control from tree). It was noticed that the no. of seed per siliqua of mustard was affected by tree. In south and north direction the best amount of seed per siliqua (13.50 cm and 13.50cm respectively) was recorded in T_4 treatment (Table 1 and Table 2). The second and third highest no. of seed per siliqua (13.45 cm and 13.38cm respectively) and (7.66 cm and 7.23 cm respectively) were produced under (1.5-3m and 3-4.5m distance from tree respectively). The lowest no. of seed per siliqua (4.17 cm and 3.93cm respectively) was observed under T_1 (0-1.5m distance from tree). It was noticed that no. of seed per siliqua of mustard was expressively augmented with the increase of distance from tree. It was probably due to poor photosynthetic capacity and nutrients competition between tree and crops. 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.

Weight of 1000 seeds: 1000 seed weight was recorded beneath (0-1.5m, 1.5-3m, 3-4.5m distance and open field referred as control from tree). It was noticed that 1000 seed weight of mustard was affected by tree. In both south and north direction the best amount of seed weight (2.06g and 2.05g respectively) were recorded in T_4 (open field referred as control) (Table 1 and Table 2). The second highest no. of seed weight (2.05 g and 2.03g respectively) was produced under T_3 (1.5-3m distance from tree).The lowest no. of 1000 seed weight was T_1 (0.76g and 0.72g respectively) observed under (0-1.5m distance from tree). It was noticed that weight of 1000 seed of mustard was expressively augmented with the increase of distance from tree. It was probably due to poor photosynthetic capacity and nutrients competition between tree and crops. Alam *et al*. (2014) showed the same results in seven winter vegetables along with Akashmoni tree.

Yield: Yield of mustard in association with Akashmoni tree was significantly influenced by different treatment in both south and north direction as well as total yield. It was found that yield of muatard gradually decreased with decreasing distance from Akashmoni tree base both in south and north direction. Total yield of mustard was highest (0.946 t/ha) in control condition i.e. without Akshmoni tree condition which was statistically similar with treatment T_3 i.e. 3.0-4.5m distance from tree base (0.944 t/ha) followed by treatment T_2 i.e. 1.5-3.0m distance from tree base (0. 476 t/ha) and lowest (0.276 t/ha) yield was obtained from treatment T_1 i.e. 0-1.5m distance from tree base (Fig. 1). Yield of mustard relatively lower in north direction compare to south direction from Akshmoni tree. Statistically similar yield

was obtained from control condition (0.946 t/ha) and treatment T_3 i.e. 3.0-4.5m distance from tree base (0.943 t/ha) followed by treatment T_2 i.e. 1.5-3.0m distance from tree base (0. 460 t/ha) and lowest (0.266 t/ha) yield was obtained from treatment T_1 i.e. 0-1.5m distance from tree base in north direction (Fig. 2). Statistically similar yield was also obtained from control condition (0.946 t/ha) and treatment T_3 i.e. 3.0-4.5m distance from tree base (0.945 t/ha) followed by treatment T_2 i.e. 1.5-3.0m distance from tree base (0. 496 t/ha) and lowest (0.286 t/ha) yield was obtained from treatment T_1 i.e. 0-1.5m distance from tree base in south direction (Fig. 3).

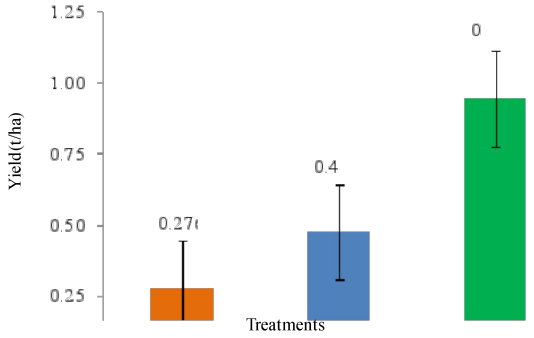

Fig.1. Total yield of mustard in association with Akashmoni tree.

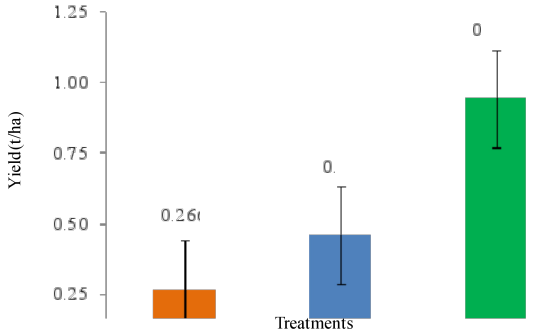

Fig. 2. Yield of mustard at north direction in association with Akashmoni tree.

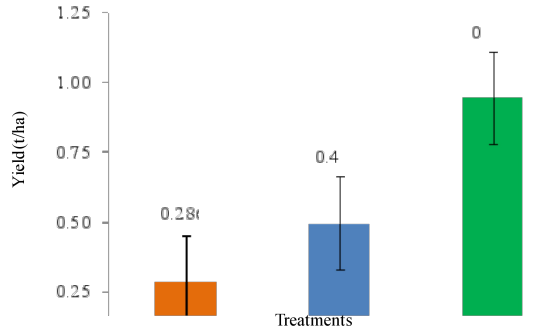

Fig. 3. Yield of mustard at south direction in association with Akashmoni tree.

In both north and south direction yield of mustard was remarkably lower near to the Akashmoni tree i.e. in the treatment T_1 (0-1.5m distance from tree base) and T_2 (1.5-3.0m distance from tree base. Yield reduction in north direction at treatments T_1 and T_2 were 71.88 and 51.37%, respectively but this reduction was in south direction at treatments T_1 and T_2 were 69.77 and 47.57%, respectively. Yield reduction of mustard in closer distance from Akshmoni tree was may be due to severe competition for different nutrients elements and moisture between the root system of these tree and crop species. Das *et al*., (2014) and Uddin *et al*., (2013) found lower yield of sweet gourd and carrot when cultivate very near the base of Mahogoni and Akshmoni, tree. Relatively lower yield (5-10%) was recorded in north direction compare to south direction may be due to partial shade effect in north side during winter season. Similar type of yield reduction also reported by Sayed *et al*., (2009) in spinach when grown in association with *Hopea odorata* tree in north and west direction.

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