Wheat cultivation along the north-south orientation of a five years old strip plantation of Acacia auriculiformis tree

M.N. Huq, M.A. Wadud and G.M.M. Rahman
Department of Agroforestry, Bangladesh Agricultural University, Mymensingh-2202, E-Mail: sakib5646@gmail.com

Abstract: An experiment was conducted at the field laboratory, Department of Agroforestry, Bangladesh Agricultural University, Mymensingh, during December 2014 to March 2015 to evaluate the growth performance of wheat under five years old akashmoni (Acacia auriculiformis) tree planted across the ails in east-west orientation. Four different treatments were used in this experiment viz. 0.0-1.5m, 1.5-3.0 m and 3.0-4.5m distance both in south and north direction from tree bases and in open field condition referred as control. The experimental design was laid out in a Randomized Complete Block Design (RCBD) with three replications separately for south and north direction under prune and unprune condition. Wheat was cultivated in south and north directions with prune and unprune condition in association with five years old akashmoni tree which was established in the boundary (ail) of the field. It was found that growth and yield of wheat were significantly influenced by different distance from akashmoni tree under prune and unprune condition. In both directions under prune and unprune condition, it was found that growth and yield of wheat was gradually decreased towards the akashmoni tree base. Results showed that optimum values of all the growth parameters of wheat were the highest in shade free area (T0) compare to all other conditions. Among the different treatments growth and yield of wheat in association with akashmoni tree in both (south and north) direction under prune and unprune condition was remarkably increased with increasing distance from the tree. Yield of wheat was bit better (9.8%) under prune condition compare to unprune condition. It also found that yield of wheat relatively higher (6.9%) in south direction compare to north direction. Yield of wheat under control condition was 2.04 t/ha and in different distant from akashmoni tree (0.0-1.5 m, 1.5-3.0 m and 3.0-4.5 m) in south and north directions under prune condition were 0.81, 1.34 & 1.97 and 0.71, 1.23 & 1.91 t/ha, respectively. However, in unprune conditions wheat yield were 0.56, 1.21 & 1.94 and 0.53, 1.05 &1.88 t/ha, respectively. So, higher yield of wheat under prune condition might be due to the effect of pruning before the wheat cultivation and lower yield in north direction under prune and unprune conditions may be due to more shade cast in north direction during winter season.

Key words: Wheat, agroforestry, Acacia auriculiformis, strip plantation.

Introduction
Bangladesh is a Next Eleven emerging economy country located in the north-eastern part of South Asia. The central region where the population density is the highest, has the least forest resources substantial depletion of forest resources has occurred in the last few decades, and now it is reduced to less than 0.02 ha per person, one of the lowest ratio in the world (BBS, 2006). Under these alarming situations, agricultural production as well as forest resources must be increased by using modern or new techniques.

A proverb says, “Farming without tree culture is incomplete”. There has been a practice of growing one or the other tree species with agricultural crop for multipurpose uses. Farmers from time immemorial are in the habit of planting various economic tree species on the field bunds, corners of field or sporadically or zonally or sequentially for fuel, fodder, fruits, fertilizers (manure), finance and timber. A rigorous selection has been imposed by the farmers in the past as regards to their suitability in respect of supplementary / complimentary efforts or competitive nature. This is kind of growing economic trees zonally or sequentially is termed as “Agro-forestry”.

The trees in agroforestry practices generally fulfill multiple purposes, involving the protection of the soil or improvement of its fertility, as well as production of more products. In plant mixtures, each kind of plants modifies its environment in different ways. Acacia auriculiformis used for fuel wood plantations as an ornamental and shade tree, quite tolerant of heat. The wood is also employed for making farm tools and furniture (NAS, 1983) and 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 three quality leather, inclined to redden upon exposure to sunlight (NAS, 1980).

Wheat (Triticum aestivum) is a cereal grain, originally from the Levant region of the Near East but now cultivated worldwide. Wheat was a key factor enabling the emergence of city based societies at the start of civilization because it was one of the first crops that could be easily cultivated on a large scale and had the additional advantage of yielding a harvest that provides long-term storage of food. Wheat grain is a staple food used to make flour for leavened, flat and steamed breads, biscuits, cookies, cakes, breakfast cereal, pasta, noodles, couscous and for fermentation to make beer, other alcoholic beverages and bio-fuel. Wheat is planted to a limited extent as a forage crop for livestock, although the straw cannot be used as feed.

Considering the above facts, present study investigate the growth and yield of wheat along the north-south orientation of a five years old strip plantation of Acacia auriculiformis tree.

Materials and Methods
Experimental site and season: The experiment was carried out at the experimental farm in the field under Department of Agroforestry in Bangladesh Agricultural University, Mymensingh during the period from December 2014 to March 2015.

Planting material: 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. Wheat (Triticum aestivum) was collected from BRAC seed centre and broadcastly both south and north side of the row of Akashmoni tree.

Experimental design, layout and treatment combination: Wheat seeds were sown in association with
Akashmoni tree under prune and unprune condition at south and north direction. Different distance from tree base i.e. 0.0-1.5 m, 1.5-3.0 m and 3.0-4.5 m were considered treatments T₁, T₂ and T₃. Wheat seeds were sown in these treatments following Randomized Complete Block Design (RCBD) with three replication separately for south and north direction under prune and unprune condition.

**Tree Pruning:** The experimental plots were 15 m prune area and 15 m unprune area. These prune area was pruning in 29th November 2014 and pruning 5-6 branches of tree stem from the ground level of experimental plots.

**Land Preparation:** The experimental land was first opened on first week of December 2014 by using appropriate tillage implements. In the plots, several times spading were done for making the weeds and debris and then left exposed to natural weather for several days before the land was finally prepared for sowing seeds of Wheat.

**Crop establishment:** Wheat seeds of the variety prodhip were directly sown in the experimental plot on the 2nd week of December 2014. The seeds were sown by broadcasting method. Over all experimental view of this study is shown in Plate 1 at vegetative stage of wheat.

**Sampling and Data collection:** Different morphological data were collected at vegetative, flowering and harvesting period of the study. Yield and yield attributes of wheat were recorded after harvesting. Each data collection period representative wheat plant samples were collected from different treatments of the study. Growth and yield parameters of wheat viz. plant height, tiller/plant, leaves/tiller, leaf length, spike/plant, spike length, grain/spike, grain/plant, 1000 seed wt. (gm.) etc. were recorded from selected wheat plant samples.

**Statistical analysis:** The recorded data were compiled and analyzed by RCBD design to find out the statistical significance of experimental results. The means for all recorded data were calculated and analyzed statistically by using wasp2 software package to find out the statistical significance of the experimental results for all the characters were performed. The mean differences were evaluated by Duncan’s Multiple Range Test (DMRT) (Gomez and Gomez, 1984) at 5% level of significance and also by Least Significance Difference (LSD) test.

**Results and Discussion**

**Morphological features:** Morphological parameters of wheat in this study were observed at harvesting stage in south and north direction under prune and unprune condition with akashmoni tree (Plate 2). Results regarding plant height (cm), tiller/plant, spike/pant, spike length (cm), grain/spike, grain/plant, 1000 seed weight (g) are as follows:

**Plant height (cm):** In prune harvesting stage, there some significant differences were seen among the values of different parameters displayed in Tables 1 and 2. It was observed that at this stage, highest plant height 96.26 cm was found in treatment T₀ (control or shade free area) which is statistically similar to the treatment T₃ (3.0-4.5 m from the base of tree row) of south direction and the third highest plant height (95.58 cm) in T₃ (3.0-4.5 m from the base of tree row) of north direction. In unprune condition, it was observed that highest plant height 95.28 cm was found in treatment T₀ (control or without shade) which is statistically similar to the treatment T₃ (3.0-4.5 m from the base of tree row) of south direction and lowest plant height (81.26 cm) was recorded in treatment T₁ (0.1.5 m from the base of tree row) of north direction. Similar result was also recorded by Singha et al. (2015), 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.
Tiller per Plant: It was noted that no. of tiller per plant of wheat was meaningfully enlarged with the rise of distance from akashmoni tree both south and north direction (Tables 1 and 2). In prune condition, the result showed that highest 5.20 was found in the treatment T₀ (open field referred as control). Next highest was 4.60 and 4.46 recorded in treatment T₁ (3.0-4.5 m distance from the tree row). The lowest no. of tiller per plant were recorded both in south and north direction (3.0 and 2.40 respectively) with in treatment T₁ (0.0-1.5 m distance from tree base). In unprune condition, highest no. of tiller per plant was 5.05 when plants grown under treatment T₀ (open field referred as control) and the lowest was recorded in south and north direction 2.76 and 2.12 under treatment T₁ (0-1.5 m distance from the tree base). Second highest (4.35 and 4.18 respectively) under treatment T₁ (3.0-4.5 m distance from tree row).

Spike per Plant: In prune condition, the result revealed that significant difference was seen among the values of different parameters of wheat for the treatments (Table 5 and Table 6). It was observed that at this stage highest no. of spike per plant 4.40 was found in treatment T₀ (control or without shade). Second highest was 3.66 in treatment T₁ (3.0-4.5 m from the base of tree row) of south direction. The lowest no. of spike per plant 3.78 was found in treatment T₁ (0-1.5 m from the base of tree row) of north direction. In unprune condition, it was observed that highest no. of spike per plant 3.78 was found in treatment T₀ (open field referred as control) which is comparatively similar to the spike 3.58 in treatment T₁ (3.0-4.5 m from the base of tree row) of south direction. The lowest no. of spike 0.94 was found in treatment T₁ (0-0.5 m from the base of tree row) of north direction. In both south and north direction no. of spike per plant remarkably lower near to the Akashmoni tree base may be due to severe competition for nutrients and moisture. Similar type of results also observed by Mallick et al. (2013) in strawberry along with lohakat tree.

Table 1. Morphological characteristics of wheat under prune and unprune condition in north direction of akashmoni tree

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Prune condition</th>
<th>Morphological characteristics of wheat</th>
<th>Unprune condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant height (cm)</td>
<td>Tillers per plant (plant⁻¹)</td>
<td>Spike length (cm)</td>
<td>Grain spike (plant⁻¹)</td>
</tr>
<tr>
<td>T₀</td>
<td>83.72a</td>
<td>2.40c</td>
<td>1.58c</td>
</tr>
<tr>
<td>T₁</td>
<td>89.82b</td>
<td>3.64ab</td>
<td>2.76ab</td>
</tr>
<tr>
<td>T₂</td>
<td>95.58a</td>
<td>4.46ab</td>
<td>3.06ab</td>
</tr>
<tr>
<td>T₃</td>
<td>96.26a</td>
<td>5.20ab</td>
<td>4.40a</td>
</tr>
</tbody>
</table>

C.V (%): 2.07 20.78 21.71 11.48 2.14 4.32 6.1 2.93 17.43 20.32 14.0 2.83 5.44 7.95
LSD (0.05): 2.12 0.92 1.26 0.62 0.37 0.93 0.55 2.63 2.13 2.16 4.72
LSD (0.01): 1.57 1.29 2.27 1.29 3.17 0.56 0.78 3.68 2.98 3.08 6.64
Level of Sig.: *  **  **  **  **  **  **  **  **  **  **  **

Means in column followed by the different letter are significantly different by DMRT at P ≤ 0.05 and P ≤ 0.01.

Table 2. Morphological characteristics of wheat under prune and unprune condition in south direction of akashmoni tree

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Prune condition</th>
<th>Morphological characteristics of wheat</th>
<th>Unprune condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant height (cm)</td>
<td>Tillers per plant (plant⁻¹)</td>
<td>Spike length (cm)</td>
<td>Grain spike (plant⁻¹)</td>
</tr>
<tr>
<td>T₀</td>
<td>84.52a</td>
<td>3.00c</td>
<td>2.06c</td>
</tr>
<tr>
<td>T₁</td>
<td>91.26b</td>
<td>3.80bc</td>
<td>2.80bc</td>
</tr>
<tr>
<td>T₂</td>
<td>95.78a</td>
<td>4.60ab</td>
<td>3.60ab</td>
</tr>
<tr>
<td>T₃</td>
<td>96.26a</td>
<td>5.20ab</td>
<td>4.40a</td>
</tr>
</tbody>
</table>

C.V (%): 2.07 2.07 2.07 11.48 2.14 4.32 6.1 2.93 17.43 20.32 14.0 2.83 5.44 7.95
LSD (0.05): 2.12 0.92 1.26 0.62 0.37 0.93 0.55 2.63 2.13 2.16 4.72
LSD (0.01): 1.57 1.29 2.27 1.29 3.17 0.56 0.78 3.68 2.98 3.08 6.64
Level of Sig.: *  **  **  **  **  **  **  **  **  **  **  **

Means in column followed by the different letter are significantly different by DMRT at P ≤ 0.05 and P ≤ 0.01.

Length of Spike (cm): In prune condition, the result showed that the length of spike 16.72 cm was increased in treatment T₀ (control or without shade) which is statistically higher than the treatment T₁ (3.0-4.5 m from the base of tree row) of south direction i.e. 15.36 cm (Table 2). The lowest length of spike 11.58 cm was recorded under treatment T₀ (0-1.5 m from the base of tree row) of north direction (Table 1). In unprune condition, the result revealed that the highest length of spike was 15.80cm under treatment T₀ (control or without shade) and second highest was 15.08 cm under the treatment T₁ (3.0-4.5 m from the base of tree row) of south direction (Table 2). The lowest length of spike was recorded in T₃ (0-1.5 m from the base of tree) i.e. 10.44 cm (Table 1). Length of spike 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.

Grain per Spike: In prune condition, different treatments had significant effect on total no. of grain per spike (Table 1 and Table 2). The result revealed that the highest no. of grain 62.60 per spikewas produced by treatment T₀ (control or shade free condition). The second highest no. of grain 58.76 per spike was found under treatment T₃ (3.0-4.5 m from the base of tree row) of south direction and the lowest result 45.40 was observed at T₁ (0-0.5 m from the base of tree row) of north direction. In unprune condition, the result revealed that the highest no. of grain 62.40 per spike was produced by treatment T₀ (control or shade free condition). The second highest no. of grain 58.40 per spike was found under treatment T₁ (3.0-4.5 m from the base of tree row) of south direction and the lowest result 41.80 was observed at T₁ (0-0.15 m from the base of tree row) of north direction. Similar type of effect was observed by Bithi et al. (2014), in an agroforestry practice with Brinjal and Chilli cultivation along with Lohakat (Xyilia dolabriformis).

Grain per Plant: In prune condition, the result exhibited that grains per plant varied significantly due to different distance of shade. Higher grains per plant 1046.32 were...
produced in treatment T0 (control or shade free area) which was statistically higher than result 902.50 to the treatment T1 (3.0-4.5 m from the base of tree row) of south direction. Shade free condition provided sufficient sunshine intensity for assimilation, transfer assimilates to grain which lead good filling. In non-shaded area, wheat produced lower grains per plant 525.73 in treatment T1 (0.0-1.5 m from the base of tree row) of north direction. The second lowest amount of grains 544.10 was produced in treatment T1 (0.0-1.5 m from the base of tree row) of south direction. In unprune condition, higher grains per plant 985.92 were produced in treatment T0 (control or shade free area) which was statistically higher than result 785.67 to the treatment T1 (3.0-4.5 m from the base of tree row) of south direction. Shade free condition provided sufficient sunshine intensity for assimilation, transfer assimilates to grain which lead good filling. In non-shaded area, wheat produced lower grains per plant 436.77 in treatment T1 (0.0-1.5 m from the base of tree row) of north direction. The second lowest amount of grains 452.88 was produced in treatment T1 (0.0-1.5 m from the base of tree row) of south direction. Jadhav et al. (1987) reported that partial shading (45-50% of normal light) at 15 days after transplanting reduced grain yield of rice by 73% because of reduction in number of panicles per plant (51.5%), number of grain per panicle (16.7%) in 25 rice cultivars.

Weight of 1000 seeds (gm): In prune condition, 1000 seed weight was recorded beneath (0.0-1.5m, 1.5-3m, 3-4.5m) and open field referred as control from tree (Table 1 and 2). It was noticed that 1000 seed weight of wheat was affected by tree. In both south and north direction the best amount of seed weight 48.64 g were recorded in T0 (open field referred as control) (Table 5 and Table 6). The second highest no. of seed weight 45.74 g and 45.44 g respectively was produced under T1 (1.5-3m distance from tree). The lowest no. of 1000 seed weight was 42.40 g and 40.16 g respectively, observed under T1 (0.0-1.5m distance from tree). It was noticed that weight of 1000 seed of wheat was expressively augmented with the increase of distance from tree. In unprune condition, the result revealed that 1000 seed weight highest 48.04 g was produced by treatment T0 (control or shade free condition). The second highest 42.94 g was found under treatment T1 (3.0-4.5 m from the base of tree row) of south direction and the lowest result 37.74 g was observed the treatment T1 (0.0-1.5 m from the base of tree row) of north direction. 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.

So, higher yield of wheat under prune condition might be due to the effect of pruning before the wheat cultivation and lower yield in north direction under prune and unprune conditions may be due to more shade cast in north direction during winter season. Similar type of results also found by Singha et al. (2015) in rice based agroforestry system in association with akashmoni tree.

References