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Performance of three winter vegetables in association with Telsur (*Hopea odorata*)

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Abstract: The experiment was carried out at the Agroforestry Farm, Department of Agroforestry, Bangladesh Agricultural University, Mymensingh, during November 2008 to March 2009 to evaluate the performance of three winter vegetables grown under *Hopea odorata* at different distances. The vegetables were stem amaranth (*Amaranthus lividus*), red amaranth (A*maranthus gangeticus*) and coriander (*Coriandrum sativum*). Each vegetable were laid out using the Randomized Complete Block Design (RCBD) with three replications as separate experiment. In each experiment vegetables are grown at different distance from tree base which were treated as different treatment. Performance of winter vegetables in terms of morphological parameters as well as fresh and dry yield was affected significantly by distance from the tree. The result showed that vegetable production was the highest in control (without tree) which was significantly similar with 2, 3 and 4 feet distance from the tree base and the lowest was observed under 1 feet distance. Among the different morphological characteristics of winter vegetable, standard leaf length, standard leaf diameter, stem girth, fresh weight and dry weight decreased consistently with the decrease of distance from the tree where the best result was obtained under 4 feet distance from *Hopea odorata*. The growth characteristics of *Hopea odorata* was significantly influenced by all the three winter vegetables. The highest growth was recorded in control condition which was statistically similar with red amaranth and coriander combination. The lowest tree growth was found under the combination of tree-stem amaranth, which is different from other.
Key words: *Hopea odorata*, winter vegetables, Agroforestry, interactions

Introduction

Agroforestry combines agriculture and forestry technologies to create more integrated, diverse, productive, profitable, healthy and sustainable land-use systems. Due to increasing population, land holdings are being fragmented and area devoted to small scale agriculture is decreasing. Small scale agriculture plays an important role in Bangladesh economy. It provides nearly 50% of cash flow to the rural poor (Leuscher and Khaleque, 1987; Haque, 1996). It is important that small scale agriculture be maintained, so that sustainable local vegetable production is continued in Bangladesh. Forest plays an important role in maintaining environmental equilibrium and socio-economic upliftment of the people. Agroforestry can provide a sound ecological basis for increased crop and animal productivity, more dependable economic returns, and greater diversity in social benefits on a sustained basis (Rahim, 1997). Agroforestry can help to overcome shortcomings of traditional agriculture that are often characterized by low output, relatively high investment and a deterioration of the environment.

In our country, almost every year timber scarcity is a common phenomenon. In Bangladesh, supply and demand of timber products is as 1472m^3 and 5148m^3 in 1998, and in 2003 it was 1580m^3 and 5612m^3 (BBS, 2003). To solve this problem, planting of timber trees such as Telsur, Garjon, Lohakat etc. in agroforestry and we getting benefited both crop and tree products.

In Bangladesh, a large number of vegetables are grown in the field. Red amaranth, stem amaranth and coriander are very common, popular and quick growing vegetables having high nutritional value and grow easily. Our limited cultivable land and natural resources is the main constraint for increasing vegetable production. On the other hand to meet up farmer's timber and fuel wood demand they plant large number of trees of timber species in their cropland, homestead, and other fallow lands at block plantations, row plantation, woodlot plantation, and scattered plantations. Initially the trees are small and it requires wider spacing and it takes many years to generate income. Farmers do not get immediate return from the monoculture area of *Hopea odorata*. During this early period of tree establishment, farmers get more crops (vegetables) at the base area and surrounding area of the trees. Cultivation of these vegetables can ensure optimizing use of our land resources and ultimately increases our total yield. The competition between vegetable and tree for growth resources such as light, water and nutrients are minimum at the early years of tree establishment. So, the present study was undertaken to observe the morphological behaviors and evaluate yield and yield attributes of the selected vegetables are grown under *Hopea odorata* for selecting suitable winter vegetables in agroforestry system.

Materials and Methods

The experiment was carried out at the experimental farm, Department of Agroforestry, Bangladesh Agricultural University, Mymensingh during the period from November, 2008 to March, 2009. The experimental site is geographically located at about 24º75´ North latitude and 90º50´ East longitudes (Khan, 1997). In this study three winter vegetables, such as: Red amaranth *(Amaranthus gangeticus)* Stem amaranth *(Amaranthus lividus)*, Coriander *(Coriandrum sativum)* were grown in association with 8 months old Telsur (*Hopea odorata)* saplings. Each vegetable were laid using the Randomized Complete Block Design (RCBD) with three replications as separate experiment. Individual plot size was 9ft x 2ft. In each experiment vegetables are grown at different distance from tree base which were treated as treatment. For each experiment treatments were as; T_0 = Open field (without trees) - control; T_1 = 1 feet distance from the tree; T_2 = 2 feet distance from the tree; T_3 = 3 feet distance from the tree; T_4 = 4 feet distance from the tree. *Hopea odorata* Saplings also grown without vegetables association as control.

After land preparation red amaranth & stem amaranth seeds were directly sown in the experimental plot on 20th November 2008. Coriander seeds were sown in the experimental plot on 27th November 2008 by line sowing method at a depth of 0.03-0.05 ft maintaining the spacing of 0.02 x0.02 ft from plant to plant. Necessary cultural operations were done for all vegetables. Plant samples of red amaranth, stem amaranth & coriander were collected

randomly from the respective plots. Twenty plants of red amaranth, ten plants of stem amaranth & twenty plant samples of coriander were selected from each plot for data collection. Plant height (cm), stem girth (cm), no. of leaves per plant, leaf length (cm) and fresh weight plant^{-1} (g) were recorded from selected plnats of respective vegetables. Yields of all vegetables calculated from the fresh weight per plants as t/ha. Height (cm), girth (cm), leaf size (cm^2) and number of leaves per *Hopea odorata* saplings also measured during the harvesting period of vegetables.

Data regarding various parameters under study from the experiment were statistically analyzed by the computer using statistical package programme MSTAT-C (Russell, 1986). Mean comparisons were done by DMRT (Duncan's Multiple Range Test) at 5% level of significance.

Results and Discussion

Effect of *Hopea odorata* saplings on the growth and yield of red amaranth, stem amaranth and coriander:

Growth parameters

Different growth parameters of red amaranth, stem amaranth and coriander were significantly influenced by *Hopea odorata* saplings (Fig. 1) these were as:

Fig. 1. (a) Red amaranth, (b) stem amaranth and (c) coriander in association with *Hopea odorata*

Plant height

Plant height of all tested vegetables was significantly influenced with increasing distance from tree base (Table 1). In all vegetables highest plant height was observed under control condition which was statistically similar with the plant height observed at 3 and 4 feet distance from saplings base (Table 1). Lowest plant height was found at 1 feet distance from sapling base which is statistically similar with the plant height recorded at 2 feet distance from sapling base (Table 1). It was found that plant height within the 1-2 feet from sapling base was relatively shorter as compared with control condition other treatments i.e. more than 2 feet distance from tree base. This may be due to the competition for moisture and nutrients between the roots of *Hopea odorata* saplings and vegetables because saplings age was only eight months, within one year, tree root can spread only 1-2 feet distance. Similar type results were also observed by Dhukia *et al.* (1988) who found that closer plant from tree base has severely affected by root competition.

Stem girth

Stem girth of red amaranth and stem amaranth were also significantly influenced with increasing distance from tree base (Table 1). Like plant height similar trend variation was observed in case of stem girth where highest stem girth recorded under control condition and lowest at 1 feet distance from saplings base. Stem girth of red amaranth and stem amaranth at 2-4 feet distance from saplings base were statistically similar with control condition. Near the saplings base i.e. closest to the saplings there was a competition for moisture and nutrients between the roots amaranths and *Hopea odorata* as a results stem girth within 1-2 feet from sapling base was thin compare to 3-4 feet distance. Similar result was also reported by Ali *et al.* (1998) who reported that the leaf production gradually increased with increasing distance from the trees.

No. of leaves per plant and leaf length

Number of leaves plant^{-1} and leaf length of red amaranth, stem amaranth and coriander were gradually increased with increasing distance from sapling base (Table 1). Among the different distance category highest numbers of leaves were recorded at 4 feet distance and lowest at 1 feet distance (Table 1). Number of leaves plant^{-1} at 2 and 3 feet distance from tree base and under control condition were statistically similar with 4 feet distant plants. Like number of leaves plant^{-1}, almost similar result also observed in case of leaf length. Similar result was also reported by Ali *et al.* (1998) who reported that the leaf production gradually increased with increasing distance from the trees.

Table 1: Morphological characters of red amaranth, stem amaranth and coriander in association with *Hopea odorat* a

Treatments	Vegetables										
	Red amaranth				Stem amaranth				Coriander		
	Plant height (cm)	Stem girth (cm)	No. of leaves per plant	Leaf length (cm)	Plant height (cm)	Stem girth (cm)	No. of leaves per plant	Leaf length (cm)	Plant height (cm)	No. of leaves per plant	Leaf length (cm)
T_0	16.78a	2.02a	14.00a	8.49a	58.37a	3.84 a	24.00a	15.63a	21.59a	14.62a	17.00a
T_1	13.37bc	1.70b	12.00bc	6.75c	54.38b	3.54b	21.00c	11.43bc	18.49c	12.35b	14.00c
T_2	14.35b	1.86ab	13.00ab	7.41ab	55.40b	3.63ab	22.00bc	12.43b	19.19bc	13.85ab	15.07ab
T_3	15.64a	1.987a	13.76ab	7.95a	57.24a	3.72a	24.00a	14.04ab	20.92a	14.15ab	16.00a
T_4	16.75a	2.02a	14.00a	8.49a	58.33a	3.84 a	24.00a	15.63a	21.54a	14.62a	17.00a
Level of significance	**	**	**	**	**	**	**	**	**	**	**
LSD	1.134	0.084	1.945	0.54	1.811	0.103	2.063	1.09	1.756	0.85	1.684

In a column, figures having common letter(s) do not differ significantly as per DMRT, ** significant 1% level of probability

Yield

Yield of red amaranth, stem amaranth and coriander were significantly influenced by *Hopea odorata* saplings at closer distance from the base (Fig. 2). Lowest yield of red amaranth, stem amaranth and coriander were recorded at 1 feet distant area from the base of the sapling which were only 9, 14, and 15%, respectively lower compared with control condition. Yield at 2, 3 and 4 feet distance from sapling base were statistically similar with control condition (Fig. 2). During the early stage of plantation i.e. sapling stage, competition for growth resources is occur only in closest to the basal areas of sapling. For this reason some yield reduction of all three vegetables were observed near the basal area (1-2 feet distance) *Hopea odorata*.

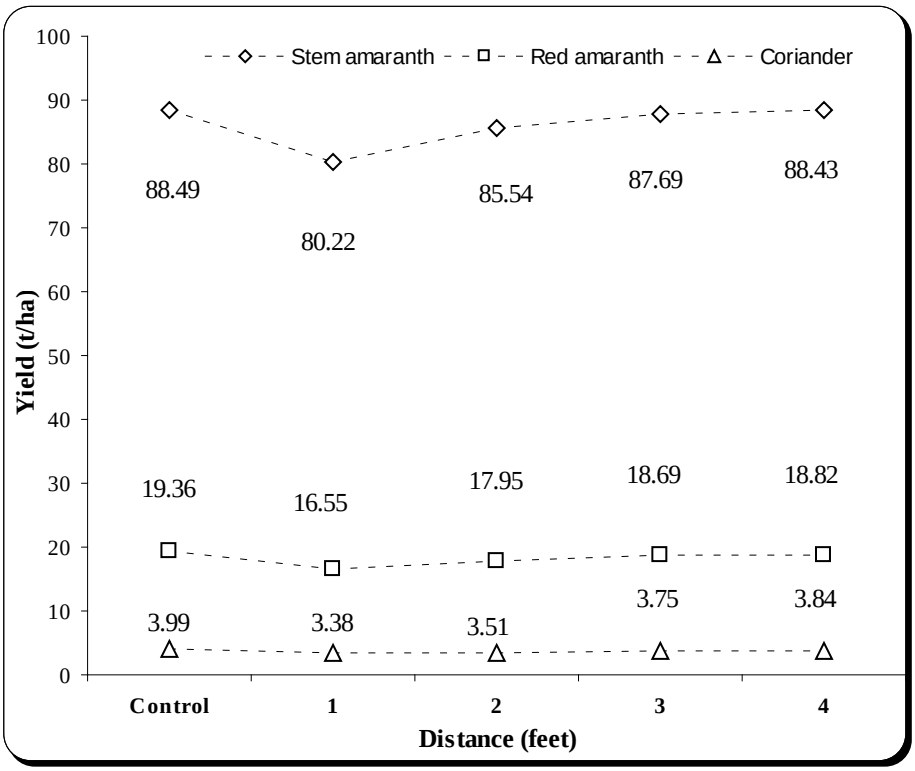
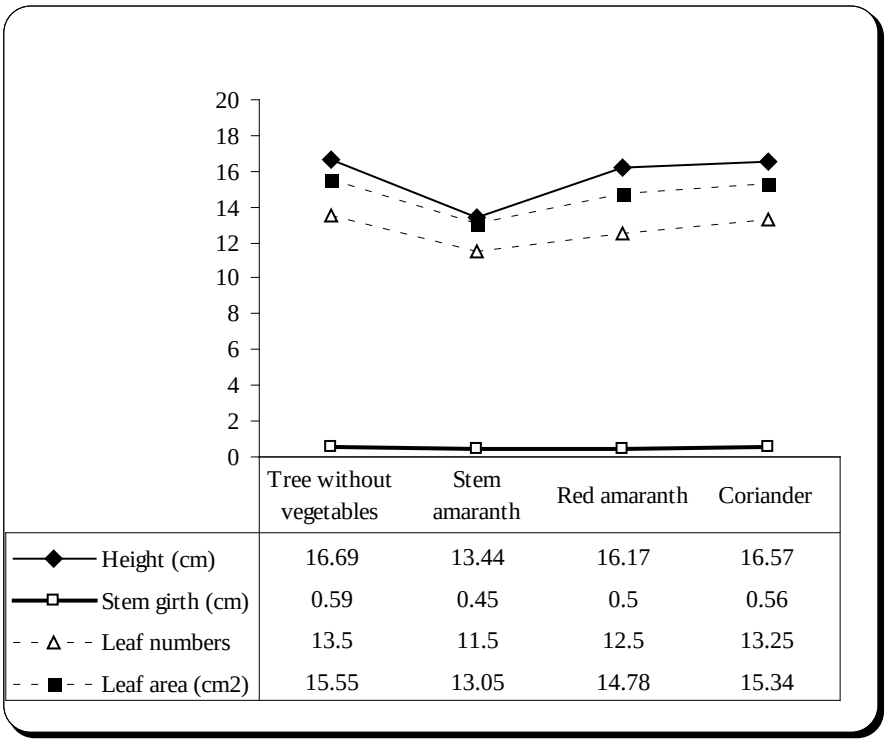


Fig. 2. Yield of red amaranth, stem amaranth and coriander in association with *Hopea odorata*

Effect of red amaranth, stem amaranth and coriander on the growth characteristics of *Hopea odorata*:

The growth characteristics such as plant height, stem girth, leaf numbers and leaf area of *Hopea odorata* significantly influenced by the interaction of stem amaranth (Fig. 3). Height, stem girth, leaf numbers and leaf area of *Hopea*

odorata were significantly when it was in association with stem amaranth (Fig. 3). Among the three vegetables stem amaranth is the long time durable as well as large size vegetable and its root volume also large. For this reason competition may be dominant between *Hopea odorata* saplings and stem amaranth roots for growth resources especially for nutrients and moisture as a result *Hopea odorata* was suppressed. On the other hand, red amaranth and coriander were short durable, lower volumes both shoot and root system where *Hopea odorata* growth was almost similar with control condition during the early establishment period of *Hopea odorata* tree species.



	Tree without vegetables	Stem amaranth	Red amaranth	Coriander
Height (cm)	16.69	13.44	16.17	16.57
Stem girth (cm)	0.59	0.45	0.5	0.56
Leaf numbers	13.5	11.5	12.5	13.25
Leaf area (cm2)	15.55	13.05	14.78	15.34

Fig. 3. Effect of red amaranth, stem amaranth and coriander on the growth characteristics of *Hopea odorata*

Yield of all vegetables were significantly lower with in the 1-2 feet distance from tree base i. e., during the first year of *Hopea odorata* plantation all three vegetables can be grown successfully more than 2 feet distance from tree base. *Hopea odorata* growth was comparatively lower in association with stem amaranth than others i. e., red amaranth and coriander can be successfully grown in association with *Hopea odorata* plantation during early establishment period.

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