

Winter leafy vegetables cultivation in association with six years old *Swietenia macrophylla* tree

M. Jahan, S.K. Sikdar, M.T. Islam, Z. Alam and M.A. Wadud

Department of Agroforestry, Bangladesh Agricultural University, Mymensingh-2202, E-mail: mousratjahan@gmail.com

Abstract An experiment was conducted at the char Kali bari situated at the side of Brahmaputra river adjacent to the Bangladesh Agricultural University, Mymensingh, in order to evaluate the growth performance of five winter crops viz. radish, red amaranth, spinach, coriander and mustard grown under 5 years old mahogoni tree saplings of 3 different treatments viz. T₀ (open field referred to as control), 1.5 m distance both in east and west direction from tree base referred to as treatment T₁ and T₂. The Experimental design was Randomized Complete Block Design with three replications in open field, east and west direction during the period from 1 November 2015 to 15 January 2016. It was found that growth and yield of mustard, radish, red amaranth, coriander, spinach were not significantly influenced by east and west direction from mahogoni tree. Highest value of different morphological parameters viz. plant height, no. of leaf, leaf length, leaf breadth, weight per plant, was in open field condition and second highest value was in east direction treatment T₁ obtained which was more or less similar with the west direction treatment. Yield of all studied winter leafy vegetable was also highest in open field condition i. e. without tree condition. Yield of radish, red amaranth, spinach, coriander and mustard were 7.67, 4.92, 13.43 and 1.89, 2.76 t/ha, respectively. Yield of these vegetable were 40.68%, 40.66%, 40.58%, 41.27%, 40.58% lower in east direction and 41.07%, 41.06%, 41.10%, 41.27%, and 40.94% lower in west direction of mahogoni in compare to control situation. These results indicate that winter leafy vegetables can be cultivated along with five years old mahogoni tree by compromising about 40% yield loss either east or west directions.

Key words: Leafy vegetables, agroforestry, *Swietenia macrophylla*, Charland.

Introduction

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 (Franis, 2001). Lundgren and Raintree (1982) stated that agroforestry is a collective name for all land use systems and technologies where woody perennials are deliberately used on the same land management units as agricultural crops and/or animals in some form of spatial arrangement or temporal sequence. In agroforestry systems, there are both ecological and economical interactions between the different components. *Acacia auriculiformis* used for fuelwood plantations as an ornamental and shade tree, quite tolerant of heat, the Australian species is widely planted in loceana and southeast Asia. The wood is also employed for making farm tools and furniture (NAS, 1983).

We have a large number of vegetables that are grown in the field. Most of them are grown in the rabi season viz. mustard and sweet gourd 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 saplings of timber species in their cropland, homestead, and other fallow lands at block plantations, row plantation, woodlot plantation, and scattered plantations (Haque, 1996). Initially the saplings 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 *Swietenia mahagoni*. But it does not do so harm to agricultural crops and vegetables. During this early period of tree establishment farmers can produce annual crops (like vegetables) at the base area and surrounding area of the saplings. Cultivation of vegetables can ensure optimizing use of our land resources and ultimately increases total yield. The competition between crop and sapling for growth resources such as light, water and nutrients are minimum at the early stages of tree establishment. Traditionally, farmers grow shade loving

species and vegetables under different trees in their cropland, homesteads and surrounding areas.

Therefore, the present study was undertaken to observe the morphological growth and yield performance of selected winter leafy vegetables in association with five years old mahogoni tree, to observe the effect of mahogoni tree on the growth and yield of different winter leafy vegetables in east and west direction of mahogoni tree.

Materials and Methods

Location and time of the study: The experiment was carried out at char Kalibari which is situated by the side of Brahmaputra river adjacent to the Bangladesh Agricultural University, Mymensingh, during the period from 1 November 2015 to 15 January 2016. The place is geographically located at about 24°75' North latitude and 90°50' East longitude.

Tree and plant materials: Tree species of this study was Mahagoni (*Swietenia mahagoni*) which was planted in the ail of crop field maintaining plant to plant distance 1.0m during the year 2011. Crop species was mustard, radish, spinach, red amaranth, coriander which was collected from BRAC seed centre and broadcastly both east and west side of the row of Mahagoni tree.

Experimental design and treatment combination: The experiment was laid out following a Randomized Complete Block Design (RCBD) with three replications. Treatments of this study were T₀ = Open field referred to as control, T₁ = East, and T₂ = West.

Land preparation: The experimental land was first opened on 1st November, 2015 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 (Plate -1).

Crop establishment and management: Mustard, coiander, radish, spinach, and red amaranth seeds were directly sown in the experimental plot on 22th October, 2015. The seeds were sown by broadcasting. After emergence mustard, radish, and spinach were thinned out maintaining 1 cm to 2 cm distance from plant to plant. Red amaranth and Coriander were thinned out maintaining 1 cm distance.



Plate 1. Land preparation under mahogany tree

Method of data collection: Plant samples of radish, mustard, red amaranth, coriander and spinach were collected randomly from the respective plots. The parameters under study were as plant height (cm), leaf number, leaf length, leaf breadth, weight / plant, yield plot/kg and yield t/ha.

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

Table 1. Morphological characteristics of radish in association with mahogoni tree

Treatments	Morphological characteristics of mustard				
	Plant height (cm)	No. of leaves/plant	Leaf size		Weight per plant (g)
			Leaf length (cm)	Leaf breadth (cm)	
East	23.65b	4.00b	7.00b	2.74b	3.88b
west	24.80b	3.87b	7.26b	2.83b	3.94b
Control	27.86a	4.73a	8.49a	3.43a	7.40a
CV(%)	2.899	2.175	2.917	6.604	3.274
LSD(0.05)	1.662	0.209	0.508	0.449	0.373
LSD(0.01)	2.768	0.341	0.837	..	0.621
Level of significance	**	**	**	*	**

Mean in column followed by the different letter are significantly different by DMRT at $P \leq 0.05$.

Tallest plant of radish was found in control condition (27.86cm) and significantly shorter plant was found in east orientation (24.80cm) of mahogany tree which was statistically similar with the plant height in west orientation (23.65cm) but it was numerically bit lower compare to east orientation (Table 1). Maximum number leaves per plant of radish was found in control condition (4.73) and significantly less number leaves per plant was found in east orientation (4.00) of mahogany tree which was statistically similar with the number leaves per plant in west orientation (3.87) but it was numerically bit lower compare to east orientation (Table 1). Highest leaf length of radish was found in control condition (8.49cm) and significantly shorter leaf length was found in east orientation (7.26cm) of mahogany tree which was

Results and Discussion
The research results obtained from radish, mustard, red amaranth, coriander, spinach (Plate 2) was observed as morphological characteristics and yield separately and these are as:



Plate 1. Winter leafy vegetables under mahogany tree

Morphological characteristics:

Radish: Different morphological parameters of radish viz. plant height, no. of leaves per plant, leaf length (cm), leaf breadth, weight/ plant of tree were significantly varied with mahogoni but orientation effect was not significant (Table 1).

statistically similar with the leaf length in west orientation (7.00) but it was numerically bit lower compare to east orientation. Highest leaf breadth of radish was found in control condition (3.43cm) and significantly shorter leaf breadth was found in east orientation (2.83cm) of mahogany tree which was statistically similar with the leaf breadth in west orientation (2.74cm) but it was numerically bit lower compare to east orientation. Maximum weight per plant of radish was found in control condition (7.40g) and significantly minimum weight per plant was found in east orientation (3.94g) of mahogany tree which was statistically similar with the weight per plant in west orientation (3.88g) but it was numerically a bit lower compare to that of east orientation (Table 1).

Hossain *et al.* (2014) found similar type results in lettuce in association with lohakat tree.

Mustard: Different morphological parameters of mustard viz. plant height, no. of leaves per plant, leaf length (cm), leaf breadth, weight/ plant of tree were significantly varied

with mahogoni but orientation effect was not significant (Table 2). Like radish effect of mahogony was almost similar which are shown in Table 2. Parvej *et al.* (2014) found similar type results in chilli when grown in association with akashmoni tree.

Table 2. Morphological characteristics of mustard in association with mahogoni tree at harvesting stage

Treatments	Morphological characteristics of mustard				
	Plant height (cm)	No. of leaves/plant	Leaf size		Weight per plant (g)
			Leaf length (cm)	Leaf breadth (cm)	
East	19.69b	5.62b	4.40b	1.83b	1.57b
west	19.18b	5.80b	4.56b	1.86b	1.60b
Control	23.92a	7.36a	6.21a	3.14a	3.00a
CV(%)	2.916	4.918	5.222	7.454	3.341
LSD(0.05)	1.385	0.698	0.59	0.388	0.256
LSD(0.01)	2.292	1.156	0.994	0.633	0.159
Level of significance	**	**	**	**	**

Mean in column followed by the different letter are significantly different by DMRTat $P \leq 0.05$.

Red amaranth: Different morphological parameters of red amaranth viz. plant height, no. of leaves per plant, leaf length (cm), leaf breadth, weight/ plant of tree were significantly varied with mahogoni but orientation effect was not significant (Table 3). Like radish and mustard

almost emilar influce of mahogony tree was also recorded in red amaranth which are presented in Table 3. Kundu *et al.* (2014) found similar type results in soybean when grown in association with *Xylia* tree.

Table 3. Morphological characteristics of red amaranth in association with mahogoni tree at harvesting stage

Treatments	Morphological characteristics of red amaranth				
	Plant height (cm)	No. of leaves/plant	Leaf size		Weight per plant (g)
			Leaf length (cm)	Leaf breadth (cm)	
East	1.28b	7.82b	4.41b	2.10b	2.00b
West	1.30b	8.05b	4.94b	2.14b	2.03b
Control	2.44a	10.22a	6.79a	3.64a	3.42a
CV(%)	3.371	4.899	5.153	7.354	3.245
LSD(0.05)	0.121	0.963	0.644	0.437	0.194
LSD(0.01)	0.214	1.601	1.074	0.726	0.312
Level of significance	**	**	**	**	**

Mean in column followed by the different letter are significantly different by DMRTat $P \leq 0.05$.

Coriander: Different morphological parameters coriander viz. plant height, no. of leaves per plant, leaf length (cm), leaf breadth, weight/ plant of tree were significantly varied with mahogoni but orientation effect was not significant

(Table 4). Effct of *Swietenia macrophylla* on coriander are shown in Table 4. Habib *et al.* (2012) found similar results in okra in association with Lohakat tree.

Table 4. Morphological characteristics of coriander in association with mahogoni tree

Treatments	Morphological characteristics of coriander				
	Plant height (cm)	No. of leaves/plant	Leaf size		Weight per plant (g)
			Leaf length (cm)	Leaf breadth (cm)	
East	11.10b	3.78b	4.15b	1.47b	0.71b
west	10.41b	3.90b	4.30b	1.50b	0.72b
Control	13.50a	4.95a	5.86a	2.53a	1.37a
CV(%)	2.912	4.925	5.203	7.384	2.928
LSD(0.05)	0.077	0.468	0.565	0.307	0.064
LSD(0.01)	1.292	0.773	0.933	0.506	0.105
Level of significance	**	**	**	**	**

Mean in column followed by the different letter are significantly different by DMRTat $P \leq 0.05$.

Table 5. Morphological characteristics of spinach in association with mahogoni tree

Treatments	Morphological characteristics of spinach				
	Plant height (cm)	No. of leaves/plant	Leaf size		Weight per plant (g)
			Leaf length (cm)	Leaf breadth (cm)	
East	19.30b	4.50b	15.04b	4.92b	5.55b
west	20.24b	4.35b	15.63b	5.089b	5.62b
Control	22.76a	5.32a	18.28a	6.17	10.58a
CV(%)	2.895	2.207	2.927	6.595	3.263
LSD(0.05)	1.369	0.23	1.087	0.809	0.534
LSD(0.01)	2.268	0.394	1.79		0.886
Level of significance	**	**	**	*	**

Mean in column followed by the different letter are significantly different by DMRTat $P \leq 0.05$.

Spinach: Different morphological parameters of spinach viz. plant height, no. of leaves per plant, leaf length (cm), leaf breadth, weight/ plant of tree were significantly varied with mahogoni but orientation effect was not significant (Table 5). Like above others leafy vegetables similar variation was also found in spinach which are shown Table 5. Ali *et al.* (2007) observed similar type of results in case of carrot when cultivate with goraneem tree.

Yield: Yield of all different winter leafy vegetables were significantly varied with mahogoni but orientation effect was not significant (Table 1). Maximum yield of radish, mustard, red amaranth, coriander and spinach were found in control condition and the values were 7.67, 2.76, 4.92, 1.89 and 13.43 t/ha, respectively, Yield of these leafy vegetable significantly lower in both east and west orientation of mahogony tree. Yield of radish, mustard, red amaranth, coriander and spinach in east direction were 4.55, 1.64, 2.92, 1.11 and 7.98 t/ha, respectively. Yield of radish, mustard, red amaranth, coriander and spinach were numerically bit lower compare to east orientation and the values were 4.52, 1.63, 2.90, 1.11 and 7.91 t/ha, respectively (Fig. 1). Average yield reduction of radish, mustard, red amaranth, coriander and spinach in association with were 33.19, 38.72, 40.85, 34.32 and 42.52%, respectively (Fig. 2).

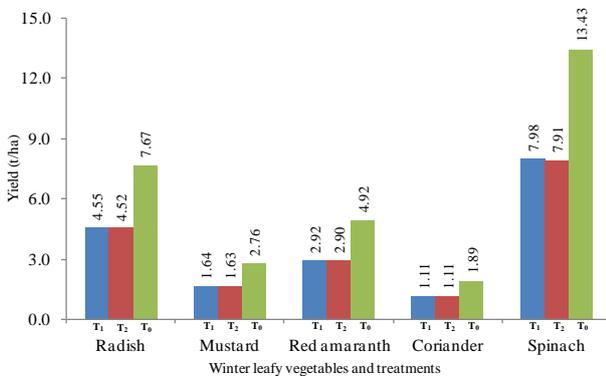


Fig. 1. Yield of different winter leafy vegetables with mahogony tree

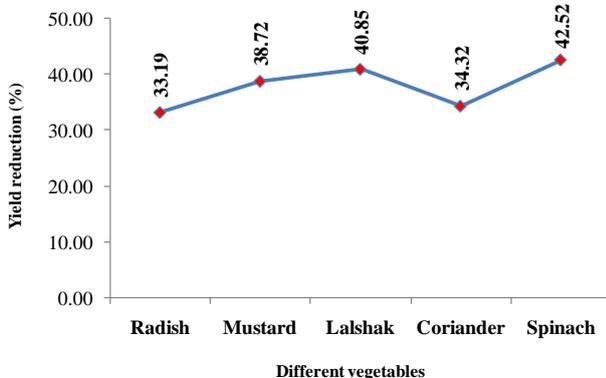


Fig. 2. Yield reduction of different winter leafy vegetables with mahogony tree

It is mentionable that, mahogony as a timber trees, it is fast growing and broad leaved which indicates that these trees are high water demanding (Rao, *et al.*, 1998, Costa and Chandrapala, 2000). Another fact is that mahogony tree is

not a leguminous as a result leaves of this tree is not easily decomposed which indicates that its leaf biomass is not so capable for adding organic matter or nutrients to the soil (Szott *et al.*, 1991). Due to above reasons, associated mahogony trees of this study remarkably suppressed the yield (33.19-42.52%) of all studied winter leafy vegetables. Hossain *et al.* 2014, Kundu *et al.* 2014 and Bithi *et al.* 2014 opined that growth and yield of bitter gourd, mustard and chilli were remarkably reduced with *Swietenia mahogony* and *Xylia dolabriformis*.

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