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Vegetative and Reproductive Parameters of Carrot Influenced by Tree Fresh Leaf Biomass Application as a Source of Organic Matter

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Abstract: Bangladesh's soil organic matter is quite low. To replenish biodegradable materials, it is important to investigate the best organic amendment for enhanced crop production. A field study was carried out at the Agroforestry Field Laboratory of Bangladesh Agricultural University in Mymensingh from December 2019 to March 2020 to assess the influence of different tree leaf biomass applications on vegetative characters, yield contributing characters and yield of carrot. In this research, six experimental treatments were imposed, T_0= represents the Control (recommended fertilizer dose), T_1= Mander (*Erythrina orientalis*) tree leaf biomass, T_2= Ipil-Ipil (*Leucaena leucocephala*) tree leaf biomass, T_3= Minjiri (*Cassia siamea*) tree leaf biomass, T_4= Jhau *(Casuarina equisetifolia*), T_5= Sissoo (*Dalbergia sissoo*) tree leaf biomass, the experiment was conducted in a Randomized Complete Block Design (RCBD) with three replications. The results revealed that the tree fresh leaf biomasses significantly influenced the growth, yield and yield contributing parameters of carrots viz. plant height (cm), the number of leaves per plant, leaf length (cm), leaf breadth (cm), length of root (cm), diameter of root (cm), fresh weight of root (gm), dry weight of root (%) and yield of carrot (t/ha) at different days after seed sowing. The highest (28.72 t ha^{-1}) root yield of carrot was obtained in the recommended fertilizer dose followed by the treatments of T_2, T_1, T_3, T_4 (23.98, 21.98, 21.26, 20.22 t ha^{-1}) respectively, while the lowest (18.29 t ha^{-1}) root yield was produced in the T_5 treatment. When it came to root yield, the ipil-ipil tree outperformed the other tree leaf biomasses because it was closest to the appropriate fertilizer dose. The sissoo tree leaf biomass produced the lowest output in this situation. However, the green leaf biomass of ipil-ipil tree might be substituted for or applied in conjunction with inorganic fertilizer. In the agroforestry system, tree leaves can be used as a source of organic matter. This would greatly reduce the amount of chemical fertilizer needed to grow carrots in Bangladesh.

Keywords: Agroforestry; tree leaf biomass; organic matter; yield.

INTRODUCTION

The popular winter root crop known as the carrot (*Daucus carota*) is planted all over the world because of its nutrient-rich roots Carrots contain large amounts of fiber and beta-carotene, a precursor to vitamin A. (Handelman, 2001). Additionally, it contains minerals including salt, fiber, carbs, and protein (Ahmad *et al.*, 2004). The roots of carrots are cooked or steamed in a variety of vegetable dishes as well as used to salads and soups (Amjad *et al.*, 2005). Due to a number of alleged pharmacological properties, carrots can be used for a variety of medical conditions in addition to their nutritional advantages (Rossi *et al.*, 2007). Carrots are becoming increasingly popular in Bangladesh, particularly among urban residents, due to its excellent nutritional content and potential for a variety of uses in the preparation of appealing dishes. It now occupies around 2.17 thousand hectares of land and produces 20.99 thousand metric tons (BBS, 2020). It is consumed both fresh and cooked in curries. Carrot is also used to make pickles and sweet meals.

However, due to the farmers' usage of minimal or no fertilizer inputs in their fields, the crop does not provide a promising yield. This is due, in part, to the unreasonably high prices of inorganic fertilizers, as well as a lack of scientific and application understanding regarding alternative nutrition sources. Organic matter, which is vital for long-term soil fertility and agricultural production, is the life of the soil. The most significant advantage of organic matter cycling and recycling in soils is an overall improvement in soil environment; plant nutrients, namely N, P, K, and S, are stored in organic matter, which also inhibits nutrient leaching. Organic matter is being lost from Bangladeshi soils on a daily basis. The rapidly decreasing organic matter content in our soil causes nutritional imbalance, notably vitamin deficiency. Tree leaf biomasses like Mahogoni, Ipil-ipil, Akashmoni, and Eucalyptus are rich sources of organic matter and can assist boost soil fertility by providing nutrients like N, P, K, and S (Aziz, 2014).

Biomass transfer is a process that involves cutting and transporting or 'transferring' nutrient-rich leaves from agroforestry tree species to fertilize agricultural fields in order to produce high-value arable crops. Decomposition of tree leaf litter is an important component of biochemical nutrient cycling and floodplain food webs in agroforestry systems. The nutrients in leaf litter are transformed into accessible form for absorption by plants through decomposition, exerting a crucial constraint on vegetative productivity (Hobbie *et al.*, 2002). The release of nutrients during leaf litter decomposition is a key mechanism in nutrient flux. Nutrients can be released from leaf litter in an agroforestry system by leaching or mineralization (Bai *et al*., 2022).

Leaf litter is essential for nutrient turnover and energy transmission between plants and soil, with the source of the nutrient accumulating in the soil's uppermost layer (Horwath, 2017). The nutrients carbon, nitrogen, phosphorus, and potassium that leaf litter contributes to soil are also important indicators of ecosystem health and soil productivity. Furthermore, this leaf litter has been squandered in a variety of ways. So, if we can use these materials for the purpose of providing organic materials for crop development, we can minimize the quantity of chemical fertilizer used, such as urea. As a result, using tree leaf biomass as green manure as an alternative for green manuring crops to preserve soil fertility may be an option. Most smallholder farmers in Bangladesh do not employ leaf biomass, which would have helped to address low soil productivity caused by low nutrient levels. Keeping all of the foregoing in mind, it was done to conduct the study to investigate the effect of tree fresh leaf biomass as an organic matter source on vegetative and reproductive growth parameters of carrot. Also determine the relationship between some yield dependent parameters and yield of carrot.

MATERIALS AND METHODS

Site and soil for the experiment: The experiment was carried out at the Agroforestry Experimental Field of Bangladesh Agricultural University in Mymensingh. Geographically, the trial location was at 24°75' North latitude and 90°50' East longitude, with an elevation of 18 meters above sea level (Anon, 1989). It belongs to the Old Brahmaputra Flood Plain (AEZ 9) Debnath *et al.*, (2011). It is distinguished by dark grey, non-calcareous flood plain soil that ranges in pH from 6.5 to 6.8. It has a silty loam texture (UNDP and FAO, 1988).

Experimental Period: The experimental area is distinguished by subtropical rainfall from April to September and scattered rainfall the rest of the year. Carrot is a winter vegetable. From sowing to harvest, 100-120 days are required depending on variety and weather conditions (Banglapedia, 2014).

Experiment layout: In this study, the Japanese variety New Kuroda of carrot (*Daucus carrota*) was selected as a test crop for the study. Using a Randomized Complete Block Design (RCBD) with three replications, the experiment was carried out (Figure 1). The total number of plots was 18, with a unit plot size of 1.5 m × 1.5 m.

Experimental treatment: In this study, five tree fresh leaf biomass, viz. T_1= Mander (*Erythrina orientalis*), T_2= Ipil-Ipil (*Leucaena leucocephala*), T_3= Minjiri (*Cassia siamea),* T_4= Jhau (*Casuarina equisetifolia),* and T_5= Sissoo (*Dalbergia sissoo*) were used and compared with control treatment T_0= Recommended fertilizer dose (RFD).

Collection and management of organic materials: These tree leaf biomasses were chopped by hand and mixed uniformly with soil during final land preparation and then left to decompose for two weeks. The leaf biomass was collected from the selected trees on the Bangladesh Agricultural University Campus in Mymensingh. The selected tree green leaf biomass was added to the experimental plots at 20 t/ha and 4.5 kg/plot.

Fertilizer application and land preparation: The recommended dose of fertilizers applied according to Ahmad *et al.*, (2014) was Cowdung-Urea-TSP-MoP @ 10000-150-125-200 $kgha^{-1}$ or 2.25-33.75-28.13-45 gm/plot. The experimental land was then initially prepared using a power tiller. For the cultivation of commercial crops, the soil was properly prepared and had good tilth. With a spade, the experimental field's ground was plowed. Later, the area was ploughed three times and then laddered to get the desired tilth. Larger clods were divided into more manageable pieces, and the land's corners were dug out with a shovel. After plowing and laddering, all the stubble and uprooted weeds were removed and the ground was then prepared. Before the final plowed, the chosen tree leaf biomass was applied. The soaked seeds at 3 kg/ha (Rikabdar, 2000) were sown after two weeks of tree leaf biomass incorporation. Shallow furrows with a 1.5 cm depth were made at a distance of 15 cm along the rows spaced at a distance of 25 cm. There were 60 holes in each unit plot, and 4 to 10 seeds were placed in each hole and immediately covered by loose soil with the help of a hand. Weeds were controlled by uprooting and removing them from the field. Different types of inter-culture operations like viz. thinning, weeding, irrigation, insect pest and disease control were done.

Data collection and recording: Data on vegetative growth parameters, root yield, and yield contributing characteristics of carrot viz. plant height (cm), the number of leaves per plant, leaf length (cm), leaf breadth (cm), length of root (cm), diameter of root (cm), fresh weight of root (gm), dry weight of root (%), and root yield of carrot (t/ha) were collected from 10 randomly selected carrot plants in each plot at 30

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and 60 days after sowing (DAS) and before harvesting of carrot root. Roots were carefully washed with water after harvesting, and they were then dried by air. Then, a sample was obtained from numerous roots, chopped into small pieces, and sun-dried for three days before being dried in an oven for 72 hours at a temperature of 70°–80°C. The samples were weighted using an electronic balance after oven drying, and the dry matter content was determined using the method below:

$$\text{\% Dry matter of root} = \frac{\text{Constant dry weight of root}}{\text{Fresh weight of root}}$$

Analysis of data: The collected data was analyzed statistically with the help of the STATIX10 program. The mean differences were adjusted by the Least Significant Different (LSD) test and the treatment means were separated by Duncan's New Multiple Range Test (DMRT) at 5% and 1% levels of significance for the interpretation of the results.

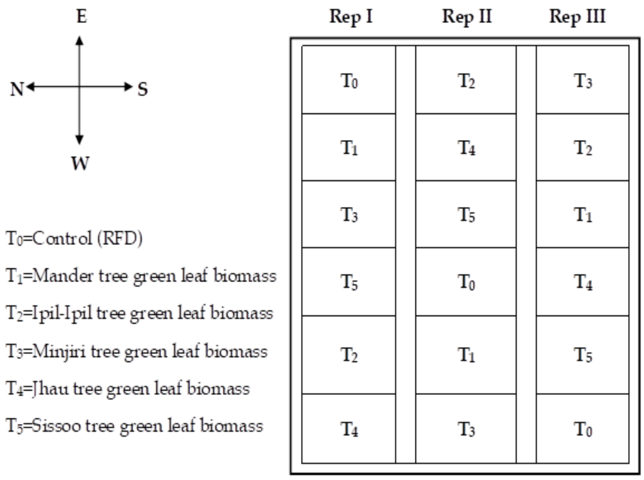

Figure 1. Layout of the experiment

Results and Discussion

Effect of tree fresh leaf biomass on carrot vegetative parameters

Plant height (cm): The yield and yield contributing characters of carrot cv. New Kuroda such as plant height, number of leaves per plant, average leaf length (cm), average leaf breadth (cm) was significantly influenced due to the application of different tree leaf biomasses. The carrot plant height was measured at 30 and 60 days after sowing (DAS) at various stages of growth (Table 1). According to the findings, the plant height of the carrot varied significantly due to the application of tree leaf biomasses (Table 1). At 30 DAS, the control treatment T_0 (recommended fertilizer dose) produced the tallest carrot plant (40.43 cm), while the T_5 treatment (Sissoo tree leaf biomass @ 20 t/ha) produced the shortest plant (24.97 cm) (Table 1). When Ipil-Ipil tree leaf biomass @ 20 t/ha was used, the maximum (33.83 cm) plant height of carrot was observed in the T_2 treatment, which was statistically comparable to the treatments of T_1 (Mander tree leaf biomass @ 20 t/ha) and T_4 (Jhau tree leaf biomass @ 20 t/ha). The smallest carrot plant height was recorded in the T_5 treatment (24.97 cm), which statistically matched the T3 (Minjiri tree leaf biomass @ 20 t/ha) condition (Table 1).At 60 DAS, the carrot plant reached its maximum height (59.56 cm) in the control (recommended fertilizer dose) (T_0) treatment, while the lowest plant height (42.95 cm) of carrot in the T_5 (Sissoo tree leaf biomass @ 20 t/ha) treatment (Table 1). The treatment T_1 (Mander tree leaf biomass @ 20 t/ha) had the highest plant height (53.88cm) among the tree leaf biomass treatments followed by T_2 (Ipil-Ipil tree leaf biomass @ 20 t/ha) was 49.44 cm and T_3 (Minjiri tree leaf biomass @ 20 t/ha) was 46.86 cm. While the T_5 (Sissoo tree leaf biomass @ 20 t/ha) treatment had the lowest plant height (42.95cm), which was statistically similar to the treatment of T_4 at 60 DAS.

According to the findings, the carrot plant height at harvest time ranged from 58.51 cm to 70.74 cm, and the treatment T_0 (recommended fertilizer dose), which was statistically equivalent to T_2, produced the tallest plant. The treatment T_5 yielded the smallest plant height (58.51 cm), which was statistically comparable to the treatment T_3 and T_4 (Table 1). The T_2 treatment had the tallest plant height (65.93 cm) while considering the treatment of tree fresh leaf biomasses. The T_1 treatment had the second-highest plant height (62.61 cm), which was statistically comparable to the T_3 treatment (Table 1). Silva *et al.* (2018) reported that the highest plant height 64.48 cm were found in the treatment where the highest amount of rooster tree green manure was added to the soil (55 t/ha) on the carrot as an intercropping system in Brazil which was very much supportive to the present study result.

Number of leaves per plant: The amount of leaves carrot plant produced decreased significantly when tree leaf biomass was used (Table 1). Specifically, 30 and 60 days after seeding, the number of leaves per plant were counted. At 30 days after seeding, the treatment T_0 (Control) had the most leaves (7.0), which was statistically comparable to the T_2 (6.7) treatment. The treatment T_5 that applied Sissoo tree leaf biomass @ 20 t/ha produced the bare minimum number of leaves (5.3). (Table 1). Among the tree leaf biomasses, the maximum number of leaves per plant (6.7) was observed from the T_2 treatment and the minimum number of leaves per plant (5.3) was found under the T_5 treatment at 30 DAS. In the case of treatment T_1, the number of leaves per plant of carrot was 6.4 which was statistically similarity with T_2 and T_4 treatments (Table 1).

At 60 DAS, the application of tree green leaf biomass influences the number of leaves per plant significantly (Table 2). From the results, the highest number of leaves per plant (10.5) was observed in the T_0 (control; recommended dose) treatment. While the lowest number of leaves per plant (7.7) was found under T_5 treatment. Among the tree leaf biomasses, the highest number (9.4) of leaves per plant was obtained from T_1 and the lowest number (7.7 cm) of leaves per plant was found in the T_5 treatment. The number of leaves (8.4) obtained in the T_3 treatment was statistically similar to T_2 and T_4 treatments (Table 1).

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Table 1. Vegetative characters of carrot influenced by tree green leaf biomasses

Treatment	Plant height (cm)			Number of leaves/plants			Leaf length (cm)			Leaf breadth (cm)		
	30 DAS	60 DAS	During Harvest	30 DAS	60 DAS	During Harvest	30 DAS	60 DAS	During Harvest	30 DAS	60 DAS	During Harvest
T_0	40.43a	59.56a	70.74a	7.00a	10.45a	13.90a	15.93a	42.10a	66.47a	11.94a	18.06a	24.17a
T_1	31.23b	53.88b	62.61bc	6.40bc	9.35b	11.23b	12.37b	35.81b	53.46bc	9.22b	13.57b	17.15b
T_2	33.83b	49.44c	65.93ab	6.70ab	8.82c	12.00ab	13.33b	33.92c	56.29b	9.99b	13.19b	17.15b
T_3	26.27cd	46.86c	59.56bc	5.73d	8.43cd	10.99b	10.35cd	31.05d	49.75bc	9.10bc	11.16c	14.51bc
T_4	30.83bc	46.19cd	58.94c	6.23c	8.36d	10.63b	12.14bc	28.45e	44.77c	7.76cd	10.45d	11.80c
T_5	24.97d	42.95d	58.51c	5.26e	7.68e	10.10b	9.83d	26.85f	43.87c	7.37d	8.66e	9.94c
Level of sig.	*	**	*	**	**	*	*	**	*	*	**	**
CV (%)	8.15	2.91	5.65	2.85	1.87	9.47	8.15	0.72	10.63	8.17	1.28	11.82

Note: Figures in the column having the same letters (s) do not differ significantly; *= significant at 5% level of probability; **= significant at 1% level of probability; sig.= significance; T_0= Recommended fertilizer dose; T_1= Mander tree green leaf biomass; T_2= Ipil-Ipil tree green leaf biomass; T_3= Minjiri tree green leaf biomass; T_4= Jhau tree green leaf biomass; T_5= Sissoo tree green leaf biomass

The highest (13.9) leaf number was found during harvest from T_0 (recommended dose) which was statistically similar to the treatment T_2 that produced 12 numbers of leaves per plant. The treatment T_1 produced 11.2 leaf numbers per plant which were statistically similar with T_3, T_4 and T_5 treatments (Table 1). The minimum leaf number 10.10 was found in T_5 treatment (Table 2). Ahmed *et al.* (2014) reported that the highest (17.26) number of leaves per plant was found in the treatment where (20 t/ha) farmyard manure was added to the soil as the response of Farmyard Manure and inorganic fertilizers for sustainable growth of carrot (*Daucus carota* L.) in Kadawa, Nigeria which was strongly supportive of the current study's findings that organic manure has a good response to carrot plant production.

Average leaf length (cm): The length of the leaf had a substantial impact on the integration of tree leaf biomasses in the growing of carrots (Table 1). The maximum leaf length at 30 DAS was 15.9 cm in the treatment T_0 (recommended dosage), and the shortest leaf length (13.7 cm) was attained in the treatment T_5. The greatest (13.3 cm) leaf length of carrot was found in the tree leaf biomass from the T_2 treatment, which was statistically comparable to the T_1 treatment. The T_5 treatment, which was statistically close to the T_3 treatment and had the smallest carrot leaf length, was reported (Table 1). At 60 DAS, the T_0 (recommended dosage) treatment produced leaves with an average length of 42.1 cm, whereas the T_5 treatment produced leaves with an average length of 26.85 cm (Table 1). Among the tree leaf biomasses, the T_1 treatment had leaves with the longest average length (35.8 cm), whereas the T_5 treatment had the shortest average length (26.9 cm) (Table 1). Under the tree leaf biomass treatments at 60 DAS, the leaf length of T_2 (Ipil-Ipil tree green leaf biomass @ 20 t/ha), T_3 (Minjiri tree leaf biomass @ 20 t/ha) and T_4 (Jhau tree green leaf biomass @ 20 t/ha) respectively was 33.9 cm, 31.1 cm and 28.5 cm (Table 1).

According to the findings, the average carrot leaf length at harvest ranged from 43.9 cm in treatment T_5 to 66.5 cm in treatment T_0. The treatment T_2 generated leaves that were the longest (56.3 cm), the most among the treatments for tree leaf biomass (Table 1). The leaf lengths produced by treatments T_1, T_3 and T_4 were statistically equal at 53.5 cm, 49.8 cm, and 44.8 cm (Table 1). According to Maharudrappa *et al.* (2000), using litter improved nutritional availability. The kind of litter had an impact on the pace of decomposition and the release of nutrients. Leaf litter breakdown rates were in the following order: teak, acacia, eucalyptus, and casuarina. The release of N from the litter followed the similar order. That was very supportive of the current study's findings.

Average leaf width (cm): The breadth of carrot leaf was significantly affected by the application of tree leaf biomass (Table 1). At various development phases, the breadth of carrot plants' leaves was counted after 30 and 60 days after seeding. The treatment T_0 (recommended dosage) had the widest leaf (11.9 cm), whereas the treatment T_5, which was statistically identical to the treatment T_4 at 30 DAS, had the narrowest leaf (7.4 cm) (Table 1). The treatment T_2 generated the biggest (10 cm) leaf width among the tree leaf biomasses, statistically comparable to the T_1 and T_3 treatments (Table 1). The recommended dose (T_0) treatment had leaves that were the widest (42.1 cm) per plant at 60 DAS, whereas the T_5 treatment had the narrowest leaves (26.9 cm per plant) (Table 1). According to the findings, treatment T_1 produced the widest leaf (13.6 cm), which was statistically comparable to treatment T_2, among the tree leaf biomasses (Table 1). Under the green leaf biomasses at 60 DAS, T_3, T_4 and T_5 treatments had leaves that were, respectively, 11.2 cm, 10.5 cm, and 8.7 cm wide (Table 1).

The experimental results revealed that the application of green leaf biomass had a substantial influence on the leaf width of carrots at the harvesting stage (Table 1). During

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harvest, the largest (24.2 cm) leaf width of carrot was recorded in treatment T_0 and the lowest value (9.9 cm) was observed in treatment T_5. Treatments T_1 and T_2 generated the most leaf width (17.2 cm) among the tree leaf biomasses, which was statistically equivalent to treatment T_3 (Table 1). Tanzi *et al.* (2012) investigate the effect of varied leaf biomass treatments on yield contributing features and yield of rice cv. BRRI (Mukta) and shown that green leaf biomass has a considerable influence on the yield contributing features, viz. Plant height, panicle length, number of tillers hill^{-1}, number of leaves hill^{-1}, leaf size, number of panicles hill^{-1}, number of effective tillers hill^{-1}, number of non-effective tillers hill^{-1}, number of spikelet's panicle^{-1}, 1000-grain weight are all identical to this study.

Effect of tree leaf biomass on carrot reproductive parameters

Length of root (cm): The length of the root varied significantly as a result of the influence of tree leaf biomass assimilation in soil (Table 2). The largest carrot root (13.9 cm) was obtained from the control treatment (recommended dosage), which was statistically equal to the treatments T_1, T_2 and T_3, and the smallest (9.7 cm) was produced from the treatment T_5 (Table 2). Among the tree leaf biomasses, the Ipil-Ipil tree green leaf biomass treatment produced the longest root length (12.7 cm), which was statistically equal to the T_1 and T_3 treatments (Table 2). In an experiment to determine the impact of various Ipil-Ipil (*Leucaena leucocephala*) tree green leaf biomass doses on rice yield and soil chemical properties, Paul *et al.* (2015) found that, with the exception of grain yield, Ipil-Ipil tree green leaf biomass performed better than recommended fertilizer dose. This is consistent with the findings of the current study

Table 2. Effect of tree green leaf biomass on yield contributing characters of carrot plant at harvesting stage

Treatment	Length of root (cm)	Diameter of root (cm)	Fresh weight of root (gm)	Dry weight of root (gm)	Yield of root (t/ha)
T_0	13.89a	12.96a	107.72a	13.21a	28.72a
T_1	11.98abc	11.76ab	82.43bc	9.62bc	21.98bc
T_2	12.65ab	11.88ab	89.95ab	10.90ab	23.98ab
T_3	11.95abc	10.83bc	79.72bc	9.30bc	21.26bc
T_4	10.73bc	10.18bc	75.83bc	8.86bc	20.22bc
T_5	9.69c	9.51c	68.60c	7.39c	18.29c
Level of sig.	*	*	*	*	*
CV (%)	11.12	9.53	12.86	15.09	12.86

Note: Figures in the column having the same letters (s) do not differ significantly; *= significant at 5% level of probability

Diameter of root (cm): Application of tree green leaf biomasses had a substantial impact on the diameter of the carrot root (Table 2). According to the findings, the control treatment (T_0), which was statistically equivalent to the T_1 and T_2 treatments, produced the largest (12.96 cm) root diameter. While the treatment T_5 gave the lowest (9.51 cm) root diameter which was statistically identical to the T_4 treatment (Table 2). Among the tree leaf biomass treatment, the maximum root diameter of 11.88 cm was obtained from T_2 (Ipil-Ipil tree green leaf biomass @ 20 t/ha) which was statistically identical to T_1 and T_3 treatments. The Sissoo tree green leaf biomass treatment @ 20 t/ha performed worst (9.51 cm) among the tree green leaf biomass treatment (Table 2). Das and Chaturvedi (2003) performed a field experiment in many Indian states to examine how four distinct types of tree litter *Eucalyptus tereticornis*, *Dalbergia sissoo*, *Sesbania grandiflora* and *Leucaena leucocephala* decompose and release nutrients. *Leucaena leucocephala*, *Sesbania grandiflora*, *Dalbergia sissoo* and *Eucalyptus tereticornis* had the highest rate of decomposition of the species under study in their leaf litter. *Leucaena leucocephala* had the greatest initial leaf litter content (%) of N, P, and K, which increases fertility and supports the current study's conclusions.

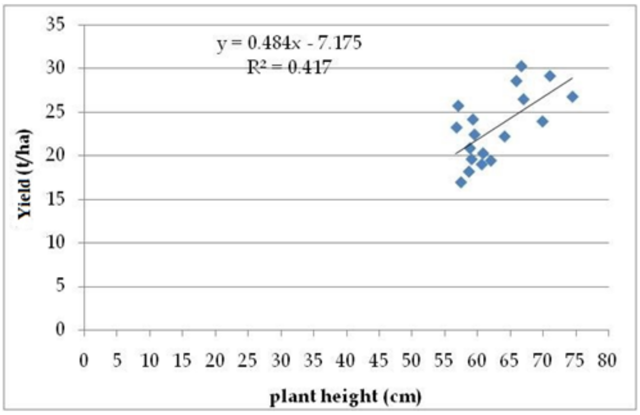

Figure 2. Correlation between plant height (cm) with root yield (t/ha)

Fresh weight of root (gm): The addition of tree leaf biomasses to the soil had a substantial impact on how much fresh carrot root each plant produced (Table 2). The Sissoo tree's green leaf biomass at 20 t/ha treatment (T_5) produced the lowest (68.60 gm) fresh weight of root, whereas the control treatment (T_0) acquired the maximum fresh weight of root (107.72 gm) (Table 2). The maximum root weight (89.95 gm) of T_2 (Ipil-Ipil tree green leaf biomass @ 20 t/ha), which was substantially different from T_5 (Sissoo tree green

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leaf biomass @ 20 t/ha) treatment (68.60 gm), was due to the application of tree green leaf biomass (Table 2). The second-highest fresh weight of root (82.43 gm) was generated by the treatment T_1 (Mander tree green leaf biomass @ 20 t/ha), which was statistically comparable to the treatments T_3 (Minjiri tree green leaf biomass @ 20 t/ha) and T_4 (Jhau tree green leaf biomass @ 20 t/ha) (Table 2). In response to farmyard manure and inorganic fertilizers for sustainable growth of carrot (*Daucus carota L.*) in Kadwa, Nigeria, Ahmed *et al.* (2014) reported that the highest fresh weight (128.20 gm) of carrot was found in the treatment where (20 t/ha) Farmyard manure was added to the soil, which was very supportive of the current study's findings.

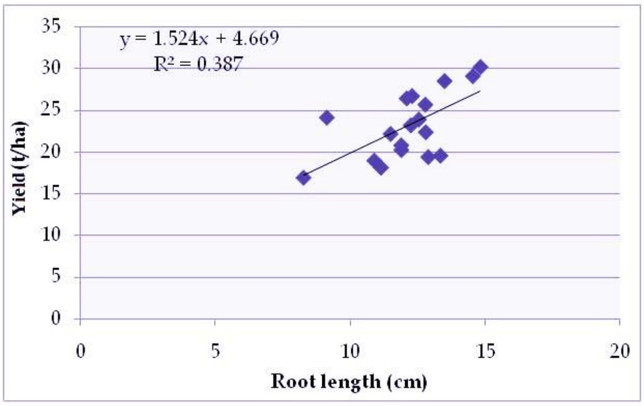

Figure 3. Correlation between root length (cm) with yield (t/ha)

Dry weight of root (gm): The use of various tree green leaf biomass led to a large difference in the dry weight of roots per plant (Table 2). Between 13.21 gm and 7.39 gm of dried roots were weighed (Table 2). From the T_0 (recommended fertilizer dose) treatment, the highest dry weight of root per plant of 13.21 gm was measured (Table 2). According to the tree leaf biomasses, T_2 (Ipil-Ipil tree green leaf biomass @ 20 t/ha), which was statistically comparable to T_1, T_3, and T_4 treatments, had the highest dry weight of root (10.90 gm) of ll the tree leaf biomasses (Table 2). From T_5 (Sissoo tree green leaf biomass @ 20 t/ha), the smallest dry weight of root was measured to be 7.39 gm (Table 2). According to grain, and 1000-grain weight and that's support the findings of current study.

Relationship between yield and yield independent character of carrot

The results of the study showed that the yield of carrots was highly dependent on the plant height, root length and root diameter (Figure 2-4). It was shown that the significant relationship between plant height (cm), root length, root diameter and yield of carrots. There was a positive relationship between plant height (cm) and yield (t/ha) with the value of r was 0.65 and R^2= 0.42. There was also a positive relationship between root length and yield (t/ha) with the value of r was 0.63 and R^2= 0.39. From correlation regression analysis, it was shown that the r value was 0.49, R^2= 0.24 at this point of view root diameter of the carrot had a positive relationship with the yield of the carrot (Figure 4)

Silva *et al.* (2018), the carrot intercropping system in Brazil had the maximum dry height of 4.97 gm in the treatment where the most rooster tree green manure was supplied to the soil (55 t/ha).

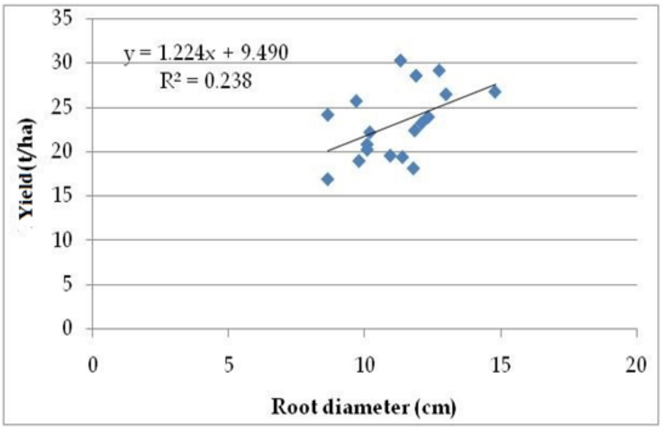

Figure 4. Relationship between root diameters with a yield of carrot

Yield of root (t/ha): The effect of tree green leaf biomass was significantly varied on the yield of the carrot root (Table 2). The highest (28.72 t/ha) yield of the root was recorded recommended fertilizer dose treatment which was statistically similar to the treatment of T_2 (Ipil-Ipil tree green leaf biomass @ 20 t/ha). The lowest (18.29 t/ha) yield of the root was obtained from T_5 (Sissoo tree green leaf biomass @ 20 t/ha) treatment (Table 2). However, the yield of T_1treatment (Mander tree green leaf biomass @ 20 t/ha) produced 21.98 t/ha followed by T_3 (Minjiri tree green leaf biomass @ 20 t/ha) 21.26 t/ha, and T_4 (Jhau tree green leaf biomass @ 20 t/ha) 20.22 t/ha which were statistically similar with T_1 (Table 2). Uddin (2004) conducted a field experiment to evaluate the effect of tree litter of Ipil-ipil, Sissoo, Akashmoni, and Mander as green manure on the yield of rice (cv. BR11) and found that the tree litter as green manure had a positive effect on the yield parameters such as plant height, panicle length, and effective tillers per hill, filled grain, unfilled grain, percentage healthy grain, spotted

CONCLUSIONs

All the vegetative and reproductive characteristics of carrot were significantly influenced by the application of different fresh leaf biomasses as a source of organic matter. According to the current findings, the recommended fertilizer dose always provided the highest root yield compared to the tree's green leaf biomass. Among the treatments, ipil-ipil tree green leaf biomass was found to be the most effective in maintaining all of the vegetative and reproductive characteristics of carrot. The increase of soil fertility can greatly benefit from the use of tree green leaf biomass. It provides the soil with vital nutrients as well as significant markers of soil production and ecosystem health. Since it is available in the agroforestry system, we can use tree leaf biomass as a source of organic matter for growing carrots, which considerably reduces the need for chemical

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fertilizers. As a result of this study's findings, it's possible to draw the conclusion that cultivating carrots with tree green leaf biomass might result in a larger yield of carrots as well as a greater economic return. In order to provide a more comprehensive proposal, this kind of research needs to be conducted in different agro-ecological zones of Bangladesh with various quantities of green leaf biomass from different tree species.

Conflict of Interest

There are no conflicts of interest declared by the authors.

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