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Effect of intercropping on growth and yield of okra (*Abelmoschus esculentus L.*) with leafy vegetables

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ABSTRACT

A study was carried out to assess the impact of intercropping on growth, yield and yield attributes of Okra with leafy vegetables. Okra was used as the main crop; Indian spinach (*Basella alba*) (T2), Stem amaranth (*Amaranthus viridis*) (T3) and Coriander (*Coriandrum sativum*) (T4) were used as intercrops and were planted in between Okra rows in separate plots. Morphological growth data were recorded during 15, 30, 45, 60, 75, 90 and 105 days after sowing (DAS). Significant effect was found at different intercropping systems on the growth, yield and yield attributes compared with sole cropping (Okra). Plant height (cm), plant diameter (cm), no. of leaves plant^{-1}, petiole length (cm), leaf length (cm), fruit length (cm), fruit diameter (cm), fresh weight of fruit (g), dry weight of fruit (g) and total weight (g) of okra were negatively affected by the intercropping at an early stage with Stem amaranth. Stem amaranth affected adversely the yield and yield attributes of Okra. Intercropping with Coriander as well as Indian spinach at the early stage of Okra plant growth does not reduce the yield significantly, thus Coriander and Indian spinach may be intercropped in the Okra field for increasing yield and economic benefits.

Contribution/Originality: In this study, intercropping of okra was performed with different leafy vegetables made the study original and primary research.

1. INTRODUCTION

Intercropping has been proposed as a potential solution to effectively address the increasing demand for food due to the growth of the global population. This protocol facilitates cultivation of more than two crops simultaneously in the same field in the form of polyculture. Intercropping is a technique used in developing countries such as Bangladesh where cultivable land is decreasing gradually and population density is high, to increase cropping intensity [1-3]. Crop interplanting has been for years a widespread technique among smallholder and peasant farmers. Intercropping is used to increase crop yields by emphasizing plant cooperation rather than plant competition. It involves the practical application of ecological principles such as diversity, crop interaction and other natural regulation mechanism. The most evident ecological benefit of intercropping is land sparing, which is the most commonly used method of quantifying intercropping benefits [4, 5]. Intercropping also increases ground cover and changes microclimate condition which ultimately suppresses weeds, even it has multiplicative effect on soil health, disease, and insect resistance. Okra (*Abelmoschus esculentus*) species belong to Malvaceae family is a summer vegetable crop grown in Bangladesh during the Kharif-I season (February/March). Okra is a tall plant

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crop with a tall height and broad spacing. Studies on intercropped okra as influenced by factors such as population density, planting time, and so on have been conducted across the country, but the compilation of such works, which will put together and clearly show the trend of yield response, as well as the yield advantage of intercropped okra as affected by such factors, particularly under different intercropping systems and across diverse locations, has yet to be done. Multiple cropping may enable optimum resource utilization and enhanced production per unit area and time on a sustainable basis. Short-term vegetables like leaf amaranth (Data shak), Coriander Leaves (Dhania Pata), and Malabar spinach (pui shak) can be introduced as intercrops by utilizing the inter-row space of okra for diversification of crops and higher economic return. Summer vegetable shortages can be improved by intercropping green vegetables with okra. Intercropping is a safer and more dependable method of agricultural production than solo cropping for small farms with available labor and limited capital [6]. Intercropping offers a substantial chance of lowering insect and disease issues. Intercropping enhances output while boosting diversity in an agricultural system, safeguarding it against the threat of monoculture [6]. Intercropping is the best way to guarantee the sustainability of vegetable production, according to Ajayi, et al. [6]. Research on intercropping vegetables with field crops has also been done in-depth. On the other hand, hardly many studies on vegetable intercropping systems have been conducted. In order to maximize productivity and profit, the current study set out to ascertain the effects of intercropping okra with leaf amaranth (data shak), coriander leaves (dhania pata), and Malabar spinach (pui shak), as well as the financial benefits of doing so. Based on these findings, the optimal crop combination and percentage for the intercropping system was determined. Okra is becoming more and more popular in Bangladesh as a winter vegetable. But due of monoculture, there are often instances when the market is oversupplied. Intercropping lowers the chance of crop loss due to weather anomalies and increases yield stability in sensitive environmental circumstances [7, 8]. So intercropping in okra rows may address these concerns. But in Bangladesh, not much research has been done in this field. Considering the above factors, the present study was undertaken to assess the growth, yield and yield attributes of okra with leafy vegetables; and to find out increasing cropping intensity.

2. MATERIALS AND METHODS

2.1. Experimental Site and Climate

The research was conducted from March 2022 to July 2022, at the experimental field of the Crop Botany & Tea Production Technology department at Sylhet Agricultural University, which is located at the 23057′ to 25013′ North latitude and 90056′ to 92021′ East longitude. In the Kharif and Rabi seasons, the area is prone to low rainfall and high temperature respectively, and belongs to the sub-tropical region (Figure 1).

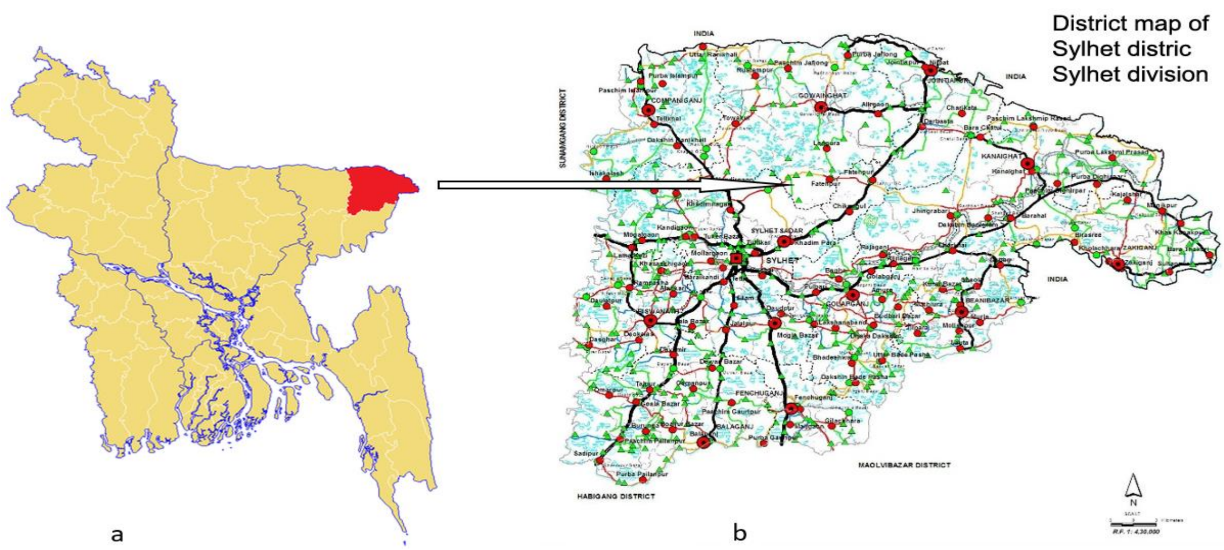

Figure 1(a, b). Geographical location of the study area (courtesy: Google. com), where a=Map of Bangladesh, b= Map of Sylhet Sadar Upazilla.

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2.2. Okra Cultivation

2.2.1. Layout and Design of the Experiment

Three blocks, each representing three replications, were created within the experimental area. Then, there were four tiny plots in each block. In every plot within a block, the treatments were assigned at random. The plants were arranged in a 1.8 m x 1.6 m plot with 45 cm and 30 cm between rows and plants, respectively. As a result, each plot had four rows with a capacity of twenty plants each. The two plots were separated by 40 cm, and the two blocks were separated by 60 cm.

2.2.2. Treatments of the Experiment

Four treatments were used in the experiment. The details of different treatments are given below-

T_1 = Okra.

T_2 = Okra+ Indian Spinach.

T_3 = Okra+ Stem Amaranth.

T_4 = Okra+ Coriander.

2.2.3. Seed Sowing and Intercultural Operation

From the appropriate individual, okra seed BARI Okra-2 was gathered. On March 18, 2022, two seeds of Indian spinach and okra were planted in each hole, and on the same day, seeds of coriander and stem amaranth were dispersed across the experimental plot. Right after the seeds were sown, little irrigation was applied. Four days after sowing (DAS), seeds began to sprout and seedlings began to appear; 100% of the seeds germinated in nine days. To maintain just one seedling in each hole, thinning was carried out seven days after seed germination. In order to prevent drought stress, irrigation was applied at regular intervals. Ten-day intervals of hand weeding were used to keep the area clear of weeds.

2.3. Data Collection

2.3.1. Collection of Plant Growth Data

Data on the growth of the plants were gathered at 15, 30, 45, 60, 75, 90, and 105 DAS. In each instance, three leaves were chosen from each plant, and five plants were chosen from each plot for data collection. Every date also included a count of the number of leaves per plant. Using a meter scale, the plant height (cm), leaf length (cm), and petiole length (cm) at 15, 30, 45, 60, 75, 90, and 105 DAS were measured. At the base, middle, and top of the leaf, the identical leaf's width (in centimeters) was measured using a meter scale. These numbers were averaged and noted. Each chosen plant's diameter (in centimeters) was measured using a meter scale, and the mean leaf width was calculated by averaging the results. Plant fresh weight (g) was measured using an electric weight machine after harvesting (at 105 DAS), and plant dry weight (g) was measured using the oven-dry method three days later.

2.3.2. Collection of Yield Data

The fruit was harvested at 45, 60, 75, 90 & 105 DAS. In every case, total fruit weight (g) was measured by weight machine. The fruit length (cm) and fruit diameter was measured by using meter scale considering 5 plants plot-1. Fruit fresh weight (g) was taken by using electric weight machine and fruit dry weight (g) was taken after 3 days of harvesting by using oven dry method considering 5 plants plot-1.

2.4. Statistical Analysis

The mean was calculated by averaging the values of three replications and then the standard deviation and standard error of the mean (SEM) was calculated. All the statistical analysis was performed using "R & R-Studio" software.

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3. RESULTS AND DISCUSSION

3.1. Morphological Characteristics

3.1.1. Plant Height (cm)

The plant height (cm) of the okra plant did not vary significantly ($p<0.05$) among the treatments during 15 DAS and also 30 DAS. Plant height was influenced significantly ($p<0.05$) by the treatments at 45 DAS and the highest number of plant height (cm) was found in T1 (Okra) and the lowest was found in T4 (Okra+ Coriander) which was statistically similar to T2(Okra + Indian Spinach) as well as T3 (Okra + Stem amaranth). During 60 DAS, 75 DAS, 90 DAS and 105 DAS plant height was influenced significantly ($p<0.05$) by the treatments and here highest number of plant heights was found in T1 (Okra) and lowest was found in T3 (Okra + Stem amaranth) (Figure 2).

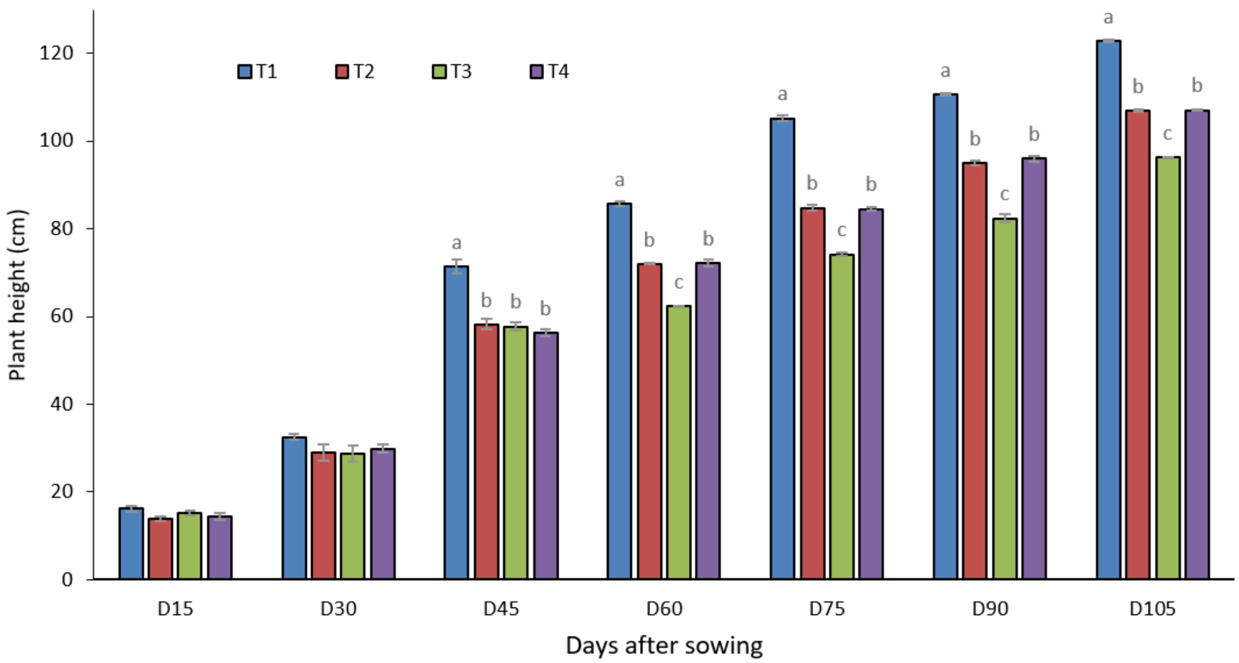

Figure 2. Effects of Intercropping on plant height of Okra at different day's intervals.

Here, the plant height (cm) of the okra plant is at 15, 30, 45, 60, 75, 90, and 105 DAS. The treatment with different letters varies significantly ($p<0.05$) while treatment with the same letter is not. Here, T1= Okra (control), T2= Okra+ Indian spinach, T3= Okra+ Stem amaranth, T4= Okra+ Coriander.

3.1.2. Plant Diameter (cm)

The plant diameter (cm) of Okra did not differ substantially ($p<0.05$) across the treatments throughout the course of 15 DAS. At 30 DAS, plant diameter was significantly ($p<0.05$) impacted by the treatments; T1 (Okra) had the largest plant diameter (cm), while T3 (Okra + Stem amaranth) had the lowest, statistically similar to T4 (okra + coriander). During 45 DAS and 60 DAS plant diameter was influenced considerably ($p<0.05$) by the treatments and here largest number of plant diameter was found in T1 (Okra) and the lowest was found in T3 (Okra + Stem amaranth) which was statistically similar with T2 and T4. The plant diameter (cm) of the okra plant did vary significantly ($p<0.05$) among the treatments during 75 DAS and here highest number of plant diameter was found in T1 (Okra) and lowest was found in T2 (Okra + Indian Spinach. But during 90 DAS and 105 DAS Plant diameter was influenced significantly ($p<0.05$) and highest plant diameters (cm) was found in T1 (Okra) and lowest was found in T3 (Okra+ Stem amaranth) (Figure 3).

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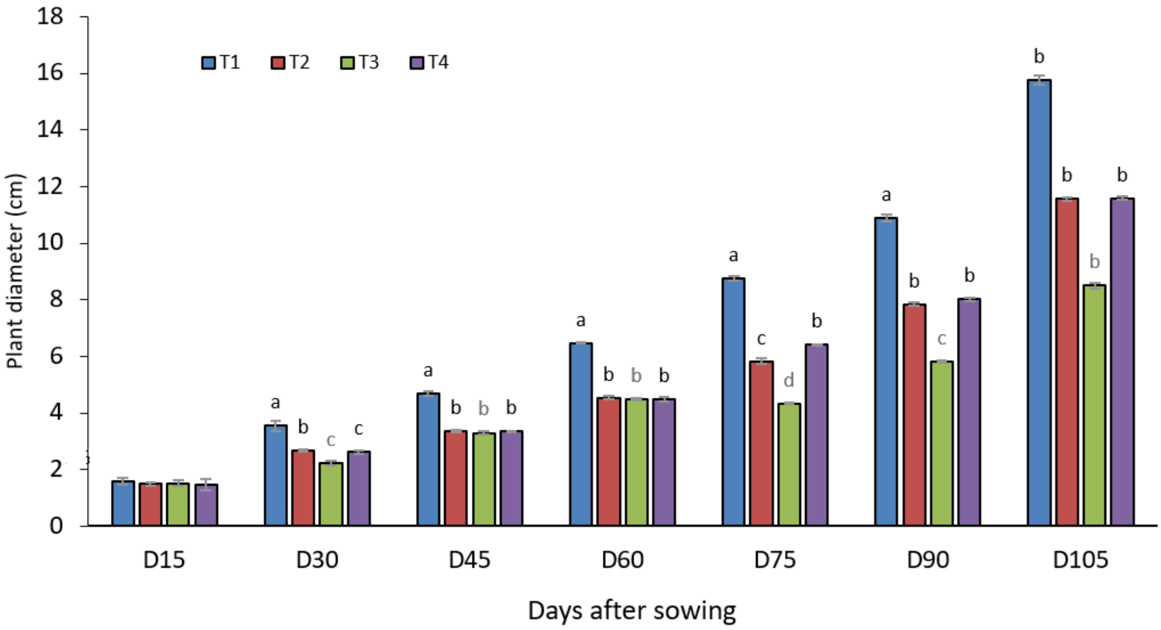

Figure 3. Effects of Intercropping on plant diameter (cm) of Okra at different days intervals.

Here, the plant diameter (cm) of the okra plant is at 15, 30, 45, 60, 75, 90, and 105 DAS. The treatment with different letters varies significantly ($p<0.05$) while treatment with the same letter does not. Here, T1= Okra (control), T2= Okra+ Indian spinach, T3= Okra+ Stem amaranth, T4= Okra + Coriander.

3.1.3. Petiole Length (cm)

Over the course of 15 DAS, there was no significant difference ($p<0.05$) in the petiole length (cm) of the okra plant among the treatments. Petiole length (cm) during 30 DAS, 60 DAS, 75 DAS, 90 DAS, and 105 DAS was significantly ($p<0.05$) influenced by the treatments; in this case, T1 (okra) had the greatest number of petiole length (cm), while T3 (Okra + Stem amaranth) had the lowest. Petiole length was influenced significantly ($p<0.05$) by the treatments and here highest number of petiole length was found in T1 (Okra) and lowest was found in T3 (Okra + Stem amaranth) which was statistically similar with T2 and T4 during 45 DAS (Figure 4).

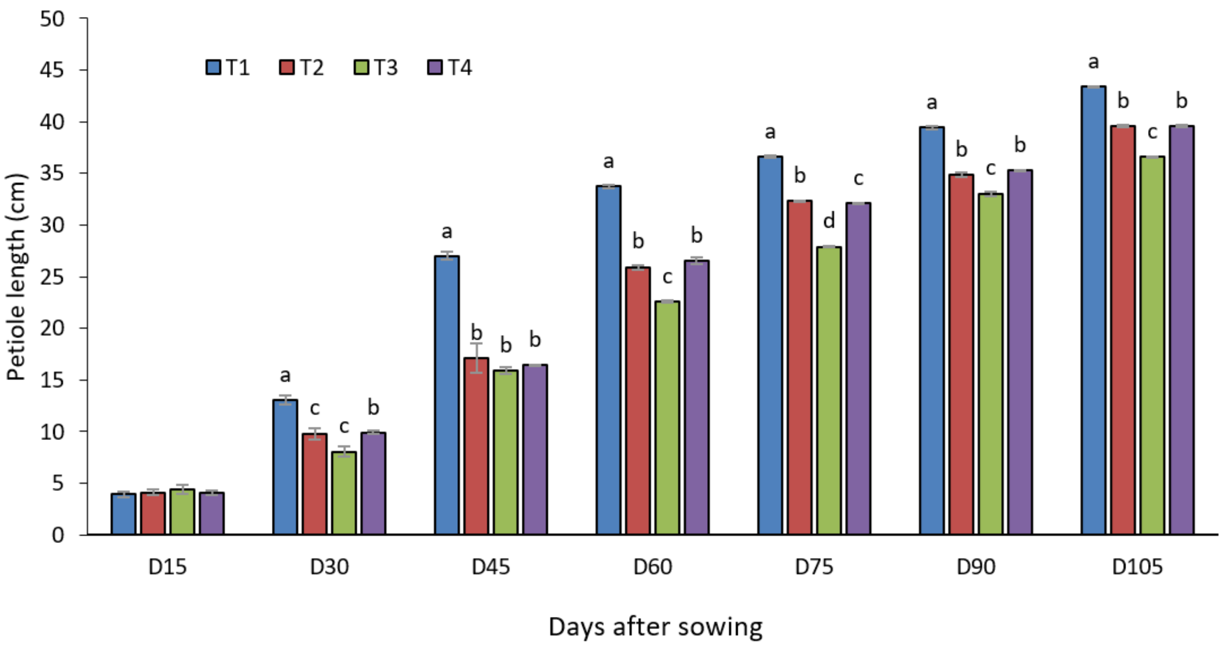

Figure 4. Effects of intercropping on petiole length (cm) of Okra at different day's intervals.

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Here, the petiole length (cm) of the okra plant is at 15, 30, 45, 60, 75, 90, and 105 DAS. The treatment with different letters varies significantly ($p<0.05$) while treatment with the same letter is not. Here, T1= Okra (control), T2= Okra+ Indian spinach, T3= Okra+ Stem amaranth, T4= Okra + Coriander.

3.1.4. Leaf Length (cm)

The leaf length (cm) of the okra plant did not vary significantly ($p<0.05$) among the treatments during 15 DAS. During 30 DAS, 75 DAS, 90 DAS and 105 DAS leaf length (cm) was influenced significantly ($p<0.05$) by the treatments and here largest petiole length (cm) was found in T1 (Okra) and lowest was found in T3 (Okra + Stem amaranth). But in case of 45 DAS and 60 DAS leaf length (cm) was influenced significantly ($p<0.05$) by the treatments and here largest petiole length (cm) was found in T1 (Okra) and lowest leaf length (cm) was found in T2 (Okra+ Indian Spinach) which was statistically similar with T3 and T4 during 45 DAS but smallest Leaf length (cm) was found in T3 (Okra + Stem amaranth) which was statistically similar with T2 and T4 during 60 DAS (Figure 5).

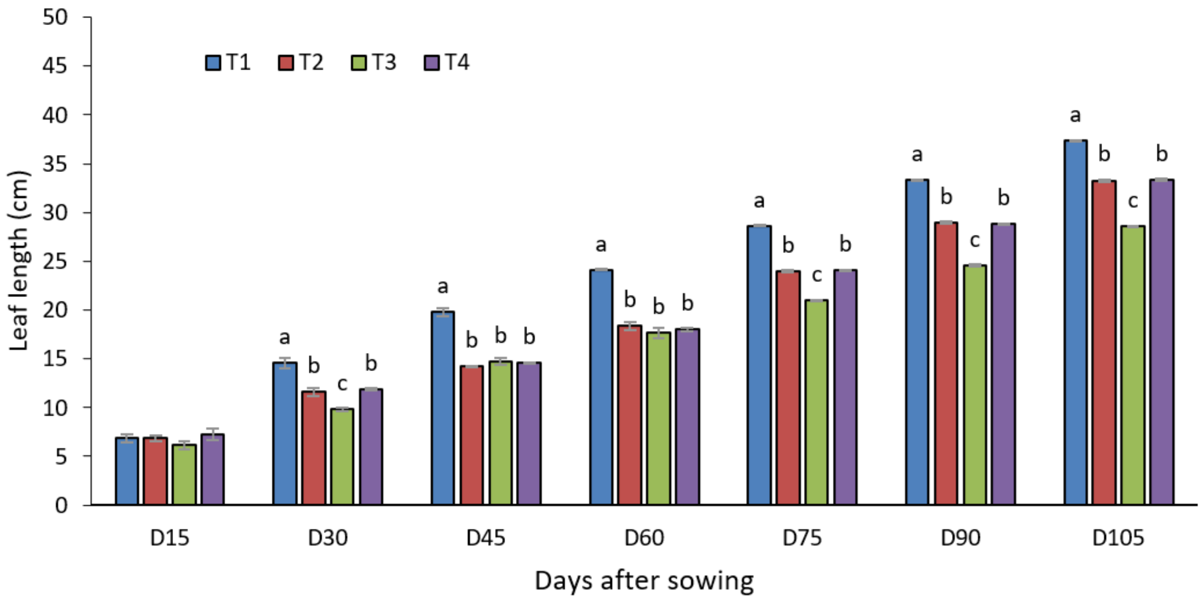

Figure 5. Effects of intercropping on leaf length (cm) of Okra at different day's intervals.

Here, the Leaf length (cm) of the okra plant at 15, 30, 45, 60, 75, 90, and 105 DAS. The treatment with different letters varies significantly ($p<0.05$) while treatment with the same letter is not. Here, T1= Okra (control), T2= Okra+ Indian spinach, T3= Okra+ Stem amaranth, T4= Okra + Coriander.

3.1.5. Leaf Breadth (cm)

Throughout 15 DAS, there was no significant difference ($p<0.05$) in the leaf breadth (cm) of the okra plant across the treatments. During 30 DAS, 45 DAS, 60 DAS, 75 DAS ,90 DAS and 105 DAS leaf breath(cm) was changed substantially ($p<0.05$) by the treatments and here highest leaf breadth (cm) was found in T1 (Okra) and lowest was found in T3 (Okra + Stem amaranth) (Figure 6).

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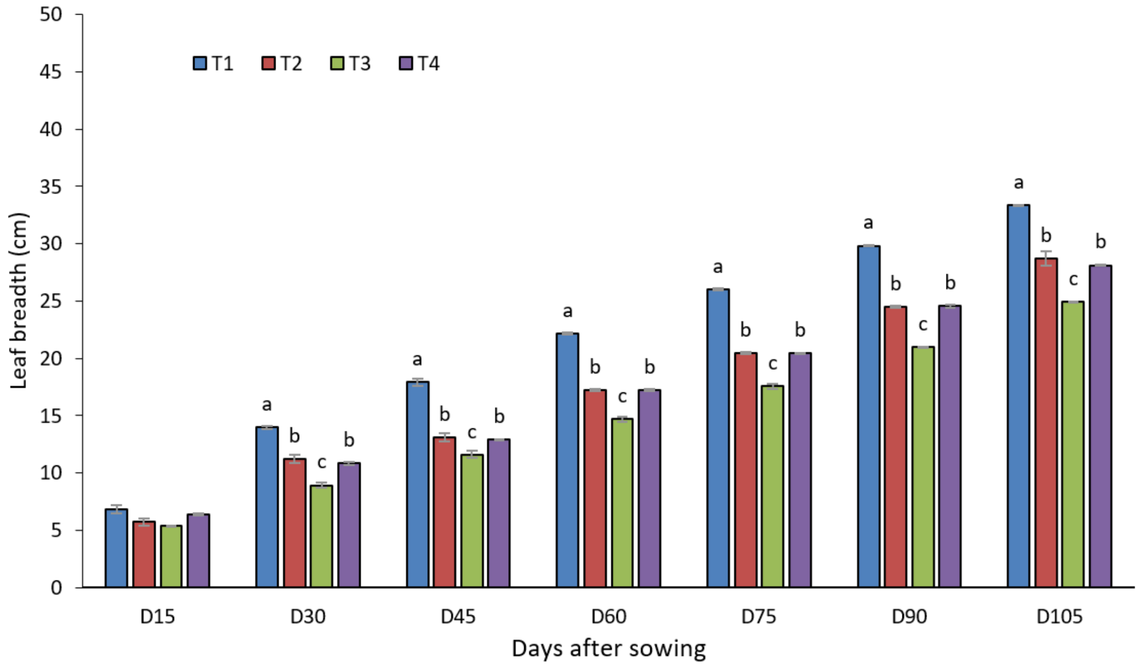

Figure 6. Effects of intercropping on leaf breadth (cm) of Okra at different day's intervals.

Here, the Leaf breadth (cm) of the okra plant is at 15, 30, 45, 60, 75, 90, and 105 DAS. The treatment with different letters varies significantly ($p<0.05$) while treatment with the same letter does not. Here, T1= Okra (control), T2= Okra+ Indian spinach, T3= Okra+ Stem amaranth, T4= Okra + Coriander.

3.1.6. Number of Leaves

A number of the leaf of the okra plant did not vary significantly ($p<0.05$) among the treatments during 15 DAS. During 30 DAS, 60 DAS, 75 DAS, 90 DAS, and 105 DAS number of the leaf was influenced significantly ($p<0.05$) by the treatments, and here highest number of leaves was found in T1 (Okra) and lowest was found in T3 (Okra + Stem amaranth). A Number of the leaf was influenced significantly ($p<0.05$) by the treatments and here highest number of leaf was found in T1 (Okra), and the lowest was found in T4 (Okra + Coriander) which was statistically similar with T2 and T3 during 45 DAS (Figure 7).

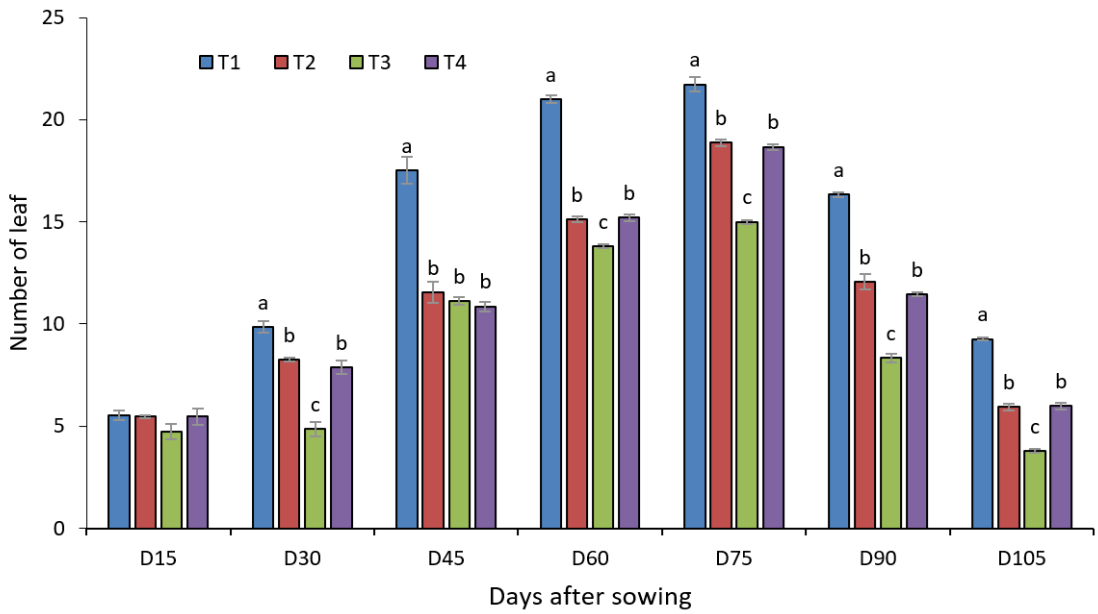

Figure 7. Effects of intercropping on the number of leaves of Okra at different day's intervals.

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Here, the Leaf number of the okra plant is at 15, 30, 45, 60, 75, 90, and 105 DAS. The treatment with different letters varies significantly ($p<0.05$) while treatment with the same letter does not. Here, T1= Okra (control), T2= Okra+ Indian spinach, T3= Okra+ Stem amaranth, T4= Okra + Coriander.

3.2. Yield and Yield Attributes

3.2.1. Fruit Length (cm)

The fruit length (cm) of the okra plant did vary significantly ($p<0.05$) among the treatments during 45 DAS and here largest fruit length was found in T1 (Okra) which was statistically similar with T2 (Okra + Indian Spinach) and smallest was found in T3 (Okra + Stem amaranth) which was statistically similar to T2 (Okra + Indian Spinach) and T4 (Okra + Coriander). During 60 DAS and 75 DAS fruit length (cm) was influenced significantly ($p<0.05$) by the treatments and here largest fruit length (cm) was found in T1 (Okra) and the lowest was found in T3 (Okra + Stem amaranth) but fruit length (cm) was influenced significantly ($p<0.05$) by the treatments and here largest fruit length (cm) was found in T1 (Okra) and lowest was found in T4 (Okra + Coriander) which was statistically similar with T2 (Okra + Indian Spinach) and T3 (Okra + Stem amaranth) during 90 DAS as well as 105 DAS (Figure 8).

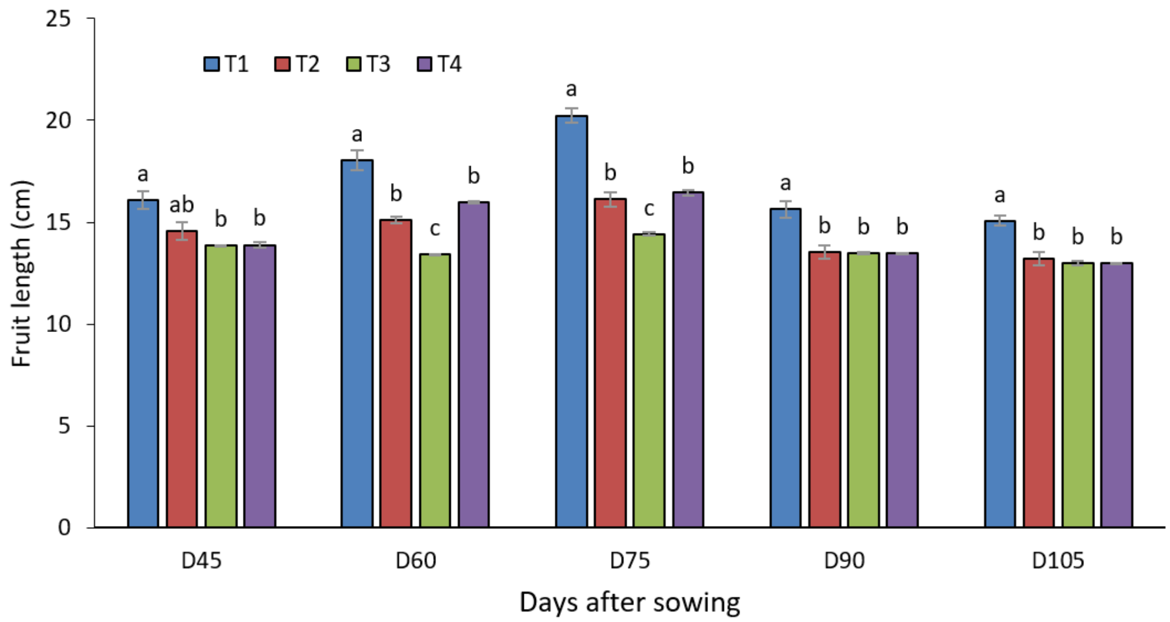

Figure 8. Effects of Intercropping on fruit length (cm) of Okra is at different day intervals.

Here, the Fruit length of okra is at 45, 60, 75, 90, and 105 DAS. The treatment with different letters varies significantly ($p<0.05$) while treatment with the same letter is not. Here, T1= Okra (control), T2= Okra+ Indian spinach, T3= Okra+ Stem amaranth, T4= Okra + Coriander.

3.2.2. Fruit Diameter (cm)

Fruit diameter (cm) was influenced significantly ($p<0.05$) by the treatments during 45 DAS, 90 DAS and 105 DAS, here largest fruit diameter (cm) was found in T1 (Okra) and smallest was found in T3 (Okra + Stem amaranth) which was statistically similar with T2 (Okra + Indian Spinach) and T4 (Okra + Coriander). The fruit diameter (cm) of the okra plant did vary significantly ($p<0.05$) among the treatments during 60 DAS and 75 DAS, here highest fruit diameter was found in T1 (Okra) and the smallest was found in T3 (Okra + Stem amaranth). T3 (Okra + Stem amaranth) was statistically similar with T2 (Okra + Indian Spinach) during 75 DAS (Figure 9).

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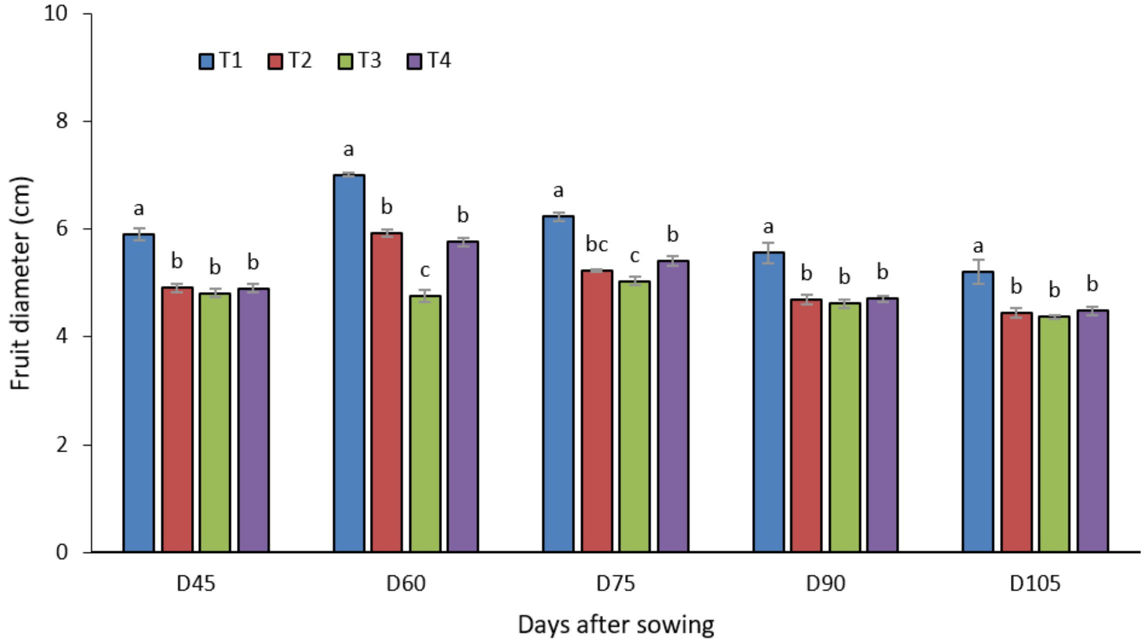

Figure 9. Effects of Intercropping on fruit diameter (cm) of Okra is at different days intervals.

Here, the Fruit diameter of okra is at 45, 60, 75, 90, and 105 DAS. The treatment with different letters varies significantly ($p<0.05$) while treatment with the same letter is not. Here, T1= Okra (control), T2= Okra+ Indian spinach, T3= Okra+ Stem amaranth, T4= Okra + Coriander.

3.2.3. Fruit Fresh Weight (g)

Fruit fresh weight (g) was influenced significantly ($p<0.05$) by the treatments during 45 DAS, 60 DAS, 75 DAS and 90 DAS, here highest fresh weight (g) was found in T1 (Okra) and lowest was found in T4 (Okra + Coriander) which was statistically similar with T2 (Okra + Indian Spinach) and T3 (Okra + Stem amaranth). The fruit fresh weight (g) of the okra plant did not vary significantly ($p<0.05$) among the treatments during 105 DAS (Figure 10).

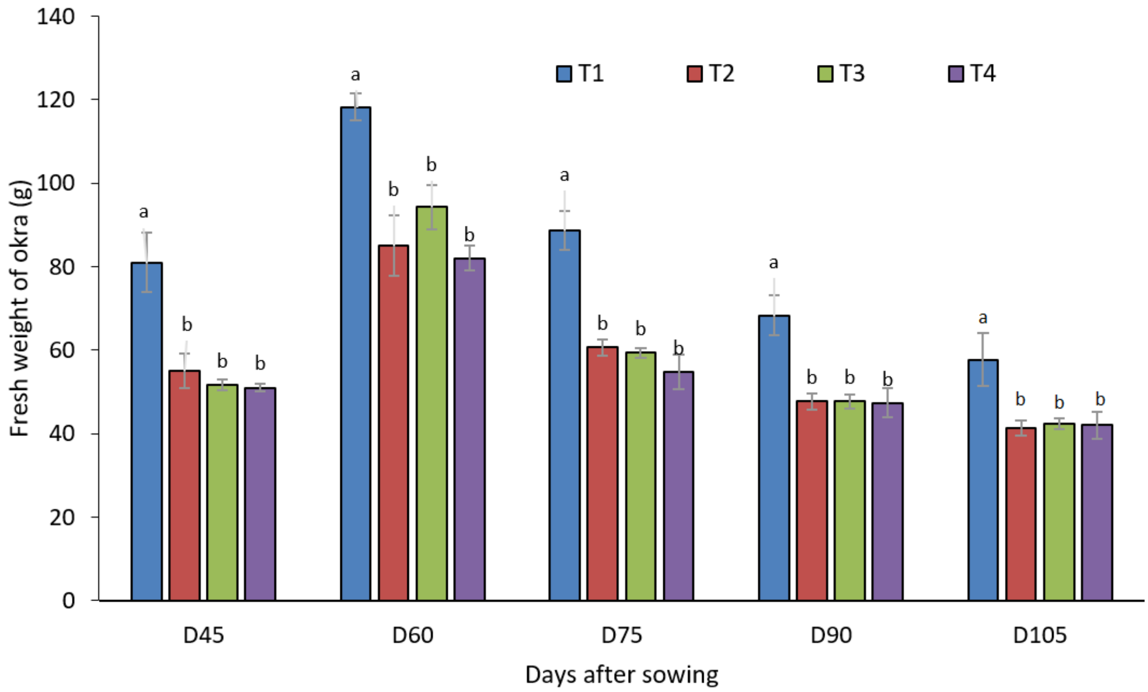

Figure 10. Effects of Intercropping on fruit fresh weight (gm) of Okra at different day's intervals.

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Here, the fruit fresh weight of okra (g) is at 45, 60, 75, 90, and 105 DAS. The treatment with different letters varies significantly ($p<0.05$) while treatment with the same letter is not. Here, T1= Okra (control), T2= Okra+ Indian spinach, T3= Okra+ Stem amaranth, T4= Okra + Coriander.

3.2.4. Fruit Dry Weight (g)

Fruit dry weight (g) was influenced significantly ($p<0.05$) by the treatments during 45 DAS, 60 DAS, 75 DAS, 90 DAS and 105 DAS. Highest fruit dry weight (gm) was found in T1 (Okra) and lowest was found in T3 (Okra + Stem amaranth) which was statistically similar with T2 (Okra + Indian Spinach) and T4 (Okra + Coriander) during 45 DAS and 75 DAS. Highest fruit dry weight (g) was found in T1 (Okra) and lowest was found in T4 (Okra + Coriander) which was statistically similar with T2 (Okra + Indian Spinach) and T3 (Okra + Stem amaranth) during 60 DAS, 90 DAS and 105 DAS (Figure 11).

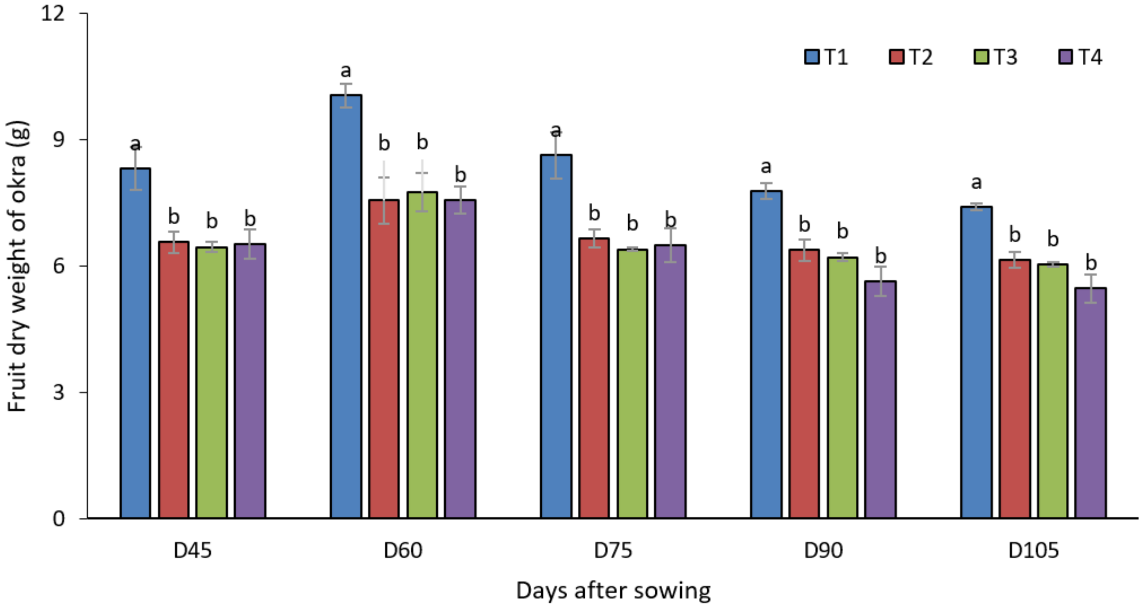

Figure 11. Effects of Intercropping on fruit dry weight (gm) of Okra at different days intervals.

Here, the fruit dry weight of okra (g) at 45, 60, 75, 90, and 105 DAS. The treatment with different letters varies significantly ($p<0.05$) while treatment with the same letter does not. Here, T1= Okra (control), T2= Okra+ Indian spinach, T3= Okra+ Stem amaranth, T4= Okra + Coriander.

3.2.5. Total Weight (g)

Total weight (g) was influenced significantly ($p<0.05$) by the treatments during 45 DAS, 60 DAS, 75 DAS, 90 DAS and 105 DAS. Highest total weight (g) was found in T1 (Okra) which was statistically similar with T2 (Okra + Indian Spinach) and T4 (Okra + Coriander) and lowest was found in T3 (Okra + Stem amaranth) during 45 DAS. Highest number of total weight (gm) was found in T1 (Okra) which was statistically similar with T2 (Okra + Indian Spinach) and lowest was found in T3 (Okra + Stem amaranth) during 60 DAS and 75 DAS. Maximum number of total weight (g) was found in T1 (Okra) and lowest was found in T3 (Okra + Stem amaranth) which was statistically similar with T2 (Okra + Indian Spinach) during 90 DAS and 105 DAS (Figure 12).

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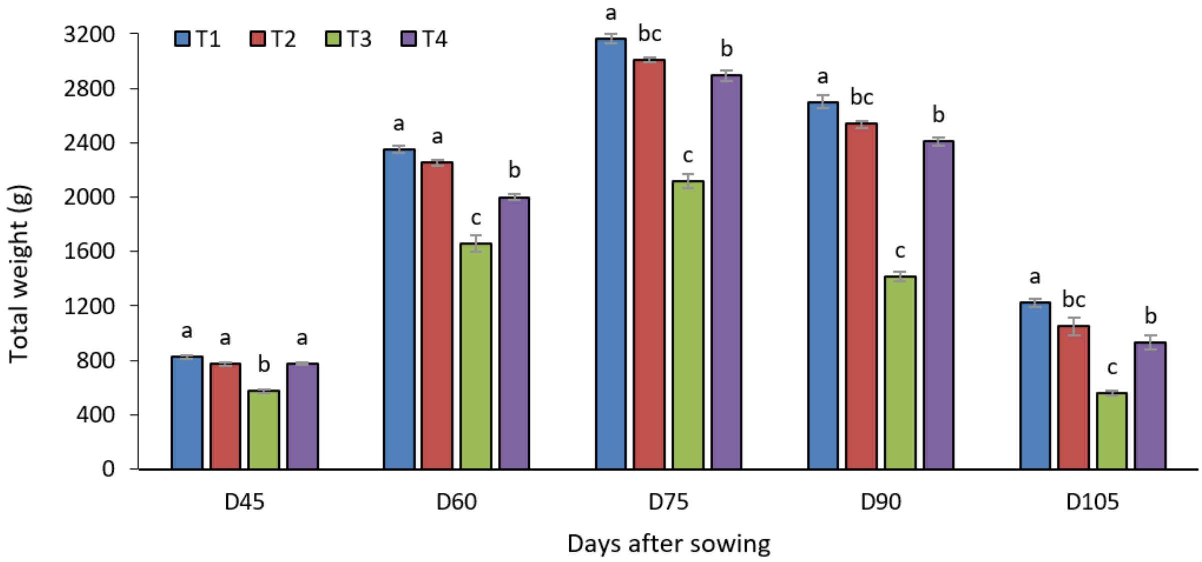

Figure 12. Effects of Intercropping on total weight (gm) of Okra at different day's intervals.

Here, Total weight of okra fruit at 45, 60, 75, 90, and 105 DAS. The treatment with different letters varies significantly ($p<0.05$) while treatment with the same letter does not. Here, T1= Okra (control), T2= Okra+ Indian spinach, T3= Okra+ Stem amaranth, T4= Okra + Coriander.

4. DISCUSSION

The findings regarding plant height are consistent with those of Tohura, et al. [9] on mungbean intercropping with maize plants, Adafre [10] on maize intercropping with haricot bean, and Abdelkader and Mohsen [11] on fennel intercropping with onion. The okra's plant diameter (cm) in this study is also consistent with the findings of Odedina, et al. [12] who found that okra stem girth increased with wide row spacing and a lower plant population. The results for petiole length (cm) are in line with those of Tohura, et al. [9] for mungbean interplanted with maize plants and Asibi, et al. [13] involving cowpea. The okra plant's leaf length (cm) is comparable to that of Adafre [10] on maize interplanted with haricot beans and Abdelkader and Mohsen [11] on fennel interplanted with onions. In addition to the direct transfer of fixed N2 from cowpea to okra plants, the increased light availability to the okra plant may have contributed to the number of leaves via increasing photosynthetic output and its impact on plant growth.

According to Mawnai, et al. [14] sole-cropped cabbage had a much higher number of leaves than intercropping. Regarding the fruit length (cm) of okra plants among the treatments, Abdelkader and Mohsen [11] on coriander interplanted with onion, and Adeola, et al. [15] on soybean interplanted with maize reached comparable conclusions. When coriander and onion were grown together, Abdelkader and Mohsen [11] found comparable results in terms of fruit diameter (cm).

The sole okra planter produced the highest pod production of okra/fed when intercropping garlic and cabbages. According to a study by Samsuri, et al. [16] which is also consistent with the results of this study, the most popular approach in young rubber plantations is the sweet corn-okra intercropping pattern of 20% okra+80% sweet corn+rubber rather than only growing sweet corn or okra. Palak, fenugreek, green gram, and radish were interplanted alongside okra, which was the primary crop farmed on the plot. In okra, compared to intercropping treatments, all growth indices and yield attributes were comparatively greater under solitary cropping, which eventually resulted in a higher fruit yield. Kumar and Kerketta reported these findings [17].

Alam, et al. [18] conducted a study in Bangladesh and found that, one row of maize alternated with one row of okra (1M: 1Ok) pattern of intercropping system gave highest yield. The findings of this study also in accordance the findings of the study conducted by Ajayi, et al. [6] where growth and yield of okra has increased by

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intercropping with varying populations of legumes. Maximum yield of okra was obtained by intercropping of Okra with cow pea stated by Odedina, et al. [12]; Kumar, et al. [7] and Arumugasamy, et al. [19] in a study. Increased Okra yield was noted in another research by Islam, et al. [20] under Koroi and Mandar based agroforestry where yield of okra is influenced by tree leaf litters and cowdung. Overall, okra grown with bean at high density was the most economically profitable combination clearly stated by Singh, et al. [1] which also support the findings of this study. This study also supports the findings of the other research regarding intercropping of other leafy vegetables where yield has been increased such as cabbage stated by Ananda, et al. [21] and Hossen Hasan, et al. [3].

5. CONCLUSIONS

Plant height(cm), Plant Diameter (cm), No. of leaves (plant-1), Petiole length (cm), leaf length (cm), and yield data comprising fruit length (cm), fruit diameter (cm), fresh weight (g), dry weight (g) and as well as total weight (g) were statistically dissimilar at different days interval. Intercropping with coriander as well as Indian spinach at the early stage of okra plant growth does not reduce the yield significantly, thus coriander and as well as Indian spinach can be intercropped in the okra field for extra income. In the case of yield, the yield of the okra varied significantly among the treatments but intercropping with Stem amaranth reduce the ultimate yield of okra by almost 40%. At the end of conclusion, it can be said that intercropping can increase the productivity of vegetables per unit area. The results indicate that okra intercropped with leafy vegetables like Coriander, Indian spinach would be a remunerative cropping system that produced mostly similar yields and economic returns when compared to a monocrop of okra.

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Institutional Review Board Statement: The Ethical Committee of the Sylhet Agricultural University, Bangladesh has granted approval for this study on 10 January 2022 (Ref. No. SAU/EC/2022/43).
Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
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