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Research Article

Evaluation of Brinjal Production Influenced by Tree Canopies Under Litchi Based Agroforestry System

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Abstract

Brinjal is considered as one of the most important, popular and nutritious vegetable in the world as well as in Bangladesh. However, the production of this crop is low in Bangladesh as per the demand. We can increase it's production by bringing more cultivable land horizontally for brinjal cultivation. But agricultural land is decreasing in Bangladesh day by day. Under these circumstances, brinjal production under agroforestry system may be a good option. Considering this fact a field experiment was conducted during November 2018 to April 2019 cropping season in farmer's field located at Uttar Saidpur village, Auliapur union of Dinajpur Sadar upazila, Dinajpur district, Bangladesh. Aim of this experiment was to find out the most perfect brinjal-litchi canopy combination that will give maximum outcome. The experiment was laid out with single factor Randomized Complete Block Design (RCBD) consisting four replications and five different treatments viz. brinjal cultivation as sole cropping (T1), brinjal cultivation at the floor of 2 years old litchi canopy (T2), brinjal cultivation at the floor of 4 years old litchi canopy (T3), brinjal cultivation at the floor of 6 years old litchi canopy (T4) and brinjal cultivation at the floor of 12 years old litchi canopy (T5). The results of the experiment revealed that there were significant effect of litchi canopy sizes on the growth, yield contributing characters and yield of brinjal. The highest fruit yield was found in open field condition (10.89 t/ha) followed by brinjal cultivation under 2 years old litchi canopies (9.56 t/ha). Whereas, no fruit yield was recorded from the brinjal plants cultivated under 12 years old litchi tree canopies. From the economic analysis, it was observed that the highest BCR was received in brinjal cultivation at the floor of 2 years old litchi canopies (1.56) followed by where brinjal was cultivated with 4 years old litchi trees (1.37). On the other hand, the lowest BCR was obtained from open field condition (1.23) where brinjal was cultivated as sole crop. Finally, it may be concluded that, out of the five treatments, 2 years old litchi canopy (T2) would be the best brinjal-litchi combination. Anyway, brinjal can be cultivated at the floor of litchi up to 6 years old garden successfully and 12 years old litchi garden is not suitable for brinjal cultivation at all.

Keywords: Agroforestry System; Brinjal Production; Litchi Orchard; Tree Canopy

Abbreviations

AEZ: Agro Ecological Zone; AGF: Agroforestry; BBS: Bangladesh Bureau of Statistics; MPTs: Multipurpose Tree Species; BCR: Benefit Cost Ratio; DAT: Days After Transplanting; DMRT: Duncan's Multiple Range Test; MOP: Muriate of Potash; N: Nitrogen; TSP: Triple Super Phosphate; Ha: Hectare; RCBD: Randomized Complete Block Design; FAO: Food and Agriculture Organization; ICRAF: International Council for Research in Agroforestry; LER: Land Equivalent Ratio; BARI: Bangladesh Agricultural Research Institute; PCR: Polymeric Chain Reaction; UV: Ultraviolet; PCARRD: Philippine Council for Agriculture, Forestry and Natural Resources Research and Development

Introduction

Bangladesh is an agricultural country. About 80% people are directly involved with Agriculture. On the other hand, it is an over populated country and its population is increasing day by day. So, our cultivable lands are decreasing. The increased population demand for increased food supplement which is so tough for our small cultivable land area. In this situation, if we can practice the technique of producing agricultural crops intercropping with woody perennials, our extra food demand will be meet up as well as land scarcity will be minimized.

Brinjal *(Solanum melongena* L.*,* also known as aubergine or eggplant) is believed to have originated in the Indo-Burma region but has a secondary center of diversity in China [1]. It is one of the most important vegetables cultivated and consumed in Bangladesh [2]. Brinjal is a high-fiber, low-calorie food that is rich in nutrients and comes with many potential health benefits. From reducing the risk of heart disease to helping with blood sugar control and weight loss, eggplants are a simple and delicious addition to any healthy diet. Besides usual nutrient, it is valuable source of anthocyanins, phenols and ascorbic acid. It is produced on approximately 50,000 hectares and by about 150,000 farmers [3]. Available data at the national level indicate that eggplant yield is currently about eight tons per ha in Bangladesh [3]. Due in part to the prevalence of insect pests and diseases, the eggplant productivity in Bangladesh is the lowest in the world [4]. Bt brinjal-4 is a genetically modified brinjal carrying an additional gene that provides an in-built insect protection against fruit and shoot borer (FSB). Growers can significantly reduce the amount of chemical insecticides applied to the crop while maintaining enhanced yields.

Litchi *(Litchi chinensis,* Family Sapindaceae) is regarded as one of the kings of sub-tropical fruits and famous for its excellent quality such as juiciness, slightly sour-sweet taste, characteristics pleasant flavor and attractive color [5]. It consists a thin, brittle shell enclosing a sweet, jelly like pulp and a single seed. It is rich in vitamins and minerals. The original home of litchi is China. In 2013 - 2014, the total area of cultivation and production of litchi were about 4602 acres and 67371 metric tons, respectively in Bangladesh [3].

The floor of litchi remains unused over the year. If litchi and brinjal based agroforestry technology can be fine tuning and adjust then a good farming technology will be invented. By using this technology farmers of north Bengal especially of Dinajpur district will be hugely benefited because litchi is largely cultivated here. So, the economic status i.e. livelihood of farmers will be increased tremendously.

While intercropping, there are several factors influencing the production of brinjal and litchi like competition for light, water, nutrient, space etc. Litchi tree canopy is most important issue here which directly and indirectly influence brinjal yield. Our low knowledgeable farmers would not find out the perfect litchi canopy combination with brinjal. They may fail and have a great economic loss. The aims of this work are to assess the brinjal yield under litchi and as a sole cropping, to find out the yield potentiality of brinjal under different canopy sizes of litchi tree and to evaluate the economic return from brinjal and litchi based agroforestry system.

Materials and Methods

The experiment was conducted at the existing Litchi orchard of farmer located at village- Uttar Saidpur, Union-Auliapur, Upazila-Dinajpur Sadar, District- Dinajpur. Brinjal seeds were collected from the wing of Department of Agricultural Extension (DAE). Seedlings were raised in nursery bed and the soil was well pulverized and converted into loose fragile and dried mass by spading. All weeds and stubbles were removed from the soil. Hundred gram seeds of BT Brinjal-4 variety were sown in the nursery bed on 4 November, 2018. Seedlings germinated on 8 November, 2018. The single factor experiment was laid out in the randomized complete block design (RCBD) with four replications. The entire experimental plot was divided into five segments and each containing four plots. In total, there were 20 plots in the experiment and each plot contained thirty plants. The size of each plot was 6 m at width and 6 m at the length. So the total area of each plot was 36 m^2, and plant to plant and line to line distance was 0.90 m and 1.2 m respectively. The experiment was consisted of single factor and the following treatments were included in the experiment:

T_1= Brinjal as sole cropping i.e., open field condition (control)

T_2= Brinjal + 2 years old litchi canopy (2.98% canopy size)

T_3= Brinjal + 4 years old litchi canopy (13.67% canopy size)

T_4= Brinjal + 6 years old litchi canopy (40.06% canopy size)

T_3= Brinjal + 12 years old litchi canopy (87.46% canopy size)

On 4 December 2018 fertilizers and manures were applied. Poultry manure and cow-dung application rate was 5 t/ha and 10 t/ha, respectively during the land preparation. Urea (N), TSP (P) and MP (K) of 120 g, 100 g and 80 g, respectively were applied in the plots (at the rate of urea 300 kg/ha, TSP 250 kg/ha and MP 200 kg/ha, according to Fertilizer Recommendation Guide 2014). Half of the urea, full of TSP and MP were mixed with the soil. The manures like cowdung and poultry as per the treatments were applied during the land preparation. Rest of urea was applied by three splits viz. first split is given one and half month after transplanting, second split is given after one month of first split application and final at three and half months after transplanting. Different intercultural operations like weeding, gap filling, irrigation, plant protection measures, harvesting of fruits etc. were done when necessary. Data were collected on plant height (cm), leaf length (cm), leaf breadth (cm), number of fruits per plant, diameter of fruit per plant (cm), weight of fruit per plant(g), yield of fruit (kg per plot), yield of fruit (ton per ha), total cost of production, total output, net return, benefit cost ratio (BCR) etc. parameters. Data were statistically analyzed using the "Analysis of variance" (ANOVA) technique with the help of computer software STATISTIX 10. Means were separated by Tukey HSD test. Co- efficient of variations (CV%) and Least Significant Differences (LSD) were obtained and included in the results.

Result and Discussions

Effect of litchi canopy size on the height (cm) of brinjal

Plant height is an important growth parameter considering performance. At different Days after Transplanting (DAT), plant height was varied significantly with different treatments (Table 1). At 30 DAT, the tallest plant (8.78 cm) was recorded from 2 years old litchi canopy (T_2), followed by open brinjal cultivation (T_1) whereas the shortest plant (5.84 cm) was obtained under 12 years old litchi canopy(T_5). Again at 45 DAT; the tallest plant (10.33 cm) was obtained under 4 years old litchi tree canopy (T_3) and it was followed by the brinjal plants under 6 years old litchi tree canopy (T_4). On the other hand, the shortest plant (6.46cm) was found under 12 years old litchi trees (T_5). The tallest plant (12.77 cm) was obtained from T_3 where brinjal was cultivated under 4 years old litchi trees and it was significantly followed by brinjal under T_2, T_4 and T_1, respectively at 60 DAT and also the shortest plant height was obtained under 12 years old litchi trees (T_5). Again at 75 DAT, the tallest plant (36.49 cm) was recorded from the brinal under 2 years old litchi trees (T_2) followed by 4 years old litchi trees (T_3), open(T_1) and 6 years old litchi canopies(T_3), respectively while the lowest plant (14.17 cm) was obtained under 12 years old litchi canopies (T_5). And lastly at 90 DAT the highest plant height was found from the brinjal plants grown under 2 years old litchi canopies (T_2) which was followed by open (T_1), 4 years old litchi trees (T_3) and 6 years old litchi trees (T_4), respectively. The lowest plant height was obtained from 12 years old litchi trees (T_5).This might be attributed due to the situation of cellular expansion and cell division of branches under shaded condition. Solanki., *et al.* [6] also concluded this result of stem elongation under shade in his experiment.

Treatments	Plant height (cm)				
	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT
T_1 (Open)	7.31b	6.90c	8.79b	35.34a	48.53ab
T_2 (2 years old litchi canopy)	8.78a	8.56b	12.51a	36.49a	51.55a
T_3 (4 years old litchi canopy)	6.61bc	10.33a	12.77a	36.14a	43.38b
T_4 (6 years old litchi canopy)	6.10c	8.94b	12.34a	15.91b	21.56c
T_5 (12 years old litchi canopy)	5.84c	6.46c	7.50b	14.17b	17.54c
$LSD_{(0.05)}$	1.14	0.97	1.63	4	5.16
CV (%)	7.31	5.23	6.69	6.41	6.26

In a column, figure having similar letter(s) do not differ significantly whereas figures bearing different letter(s) differ significantly (as per DMRT).

Table 1: Effect of litchi canopy size on the height of brinjal.

Effect of litchi canopy size on the leaf number, leaf size and shoots number per plant of brinjal

Number of leaves per plant of brinjal

Numbers of leaves were also varied at different DAT among the canopy size treatment (Table 2). At 30 DAT, the maximum number of leaves per plant (7.25) was recorded from the open field condition (T_1) and the minimum number (5.53) was observed from brinjal plants under 12 years old litchi canopy (T_5). Like 30 DAT, at 45 DAT the maximum number of leaves per plant (8.40) was recorded from open field (T_1) while the minimum (6.58) was recorded from the plants raised under 12 years old litchi canopy. Same results were also found for 60 DAT, 75 DAT and 90 DAT where the maximum numbers of leaves were (14.10), (68.40) and (115.65) while the minimum numbers of leaves were (7.31), (10.48) and (8.75), respectively. The maximum number of leaves were found from T_1 where brinjal plants were cultivated in open condition. This is because the optimum resources (light, water, nutrients etc.) were available for producing maximum number of leaves. Under 12 years old litchi trees these growth resources were scarce, so why there produced the minimum number of leaves. Similar results were found by Rahman., *et al.* [7] who conducted a field experiment and showed that except plant height all others morphological characters viz. Number of branches per plant, number of leaves per plant, number of fruits per plant, fruit length, fruit diameter and single fruit weight were the highest in open field condition among the different Agroforestry systems. Again, this finding was in agreement with the findings of Benoit., *et al.* [8] who stated that, cooler temperatures promote lower number of total leaf.

Treatments	Number of leaves per plant					Leaf size (cm^2)
	30 DAT	45 DAT	60 DAT	75 DAT	90 DAT	
T_1(Open)	7.25a	8.40a	14.10a	68.40a	115.65a	96.20a
T_2 (2 years old litchi canopy)	6.15b	7.60ab	13.56a	54.95b	111.82a	98.74a
T_3 (4 years old litchi canopy)	5.90b	7.24ab	12.84a	48.50b	70.30b	91.69ab
T_4 (6 years old litchi canopy)	5.63b	6.68b	8.73b	18.05c	24.35c	80.88b
T_5 (12 years old litchi canopy)	5.53b	6.58b	7.31b	10.48c	8.75d	58.14c
$LSD_{(0.05)}$	1.00	1.37	1.80	8.27	12.57	12.64
CV (%)	7.31	8.34	7.07	9.14	8.41	6.58

In a column, figure having similar letter(s) do not differ significantly whereas figures bearing different letter(s) differ significantly (as per DMRT).

Table 2: Effect of litchi canopy size on the leaf number and leaf size of brinjal.

Leaf size per plant (cm^2)

Data of leaf length and breadth were collected at 90 DAT. Leaf size was calculated by multiplying leaf length with leaf breadth and the measurement unit was cm^2. From (Table 2) we found the largest leaf size (98.74 cm^2) from the brinjal plants raised under 2 years old litchi canopy (T_2) and it was followed by open (T_1), 4 years old litchi canopy coverage (T_3) and 6 years old litchi canopy coverage (T_4), respectively. On the other hand, the smallest leaf size (58.14) was found under 12 years old litchi coverage (T_5).In open field condition there are the maximum number of leaves compared with 2 years old litchi coverage. As the number of leaves were maximum in open ($T_{1)}$, the leaves were comparatively smaller than leaves under partial shade under 2 years old litchi trees(T_2).Moreover, cellular expansion and cell division of branches occurs more under partial shaded condition. This result is similar to Rahman., *et al.* [7].

Number of shoots per plant

The numbers of shoots were measured at 90 DAT. From the (Figure 1) we may conclude that the maximum shooting (4.60) were recorded in the plants under open condition (T_1). The 2nd highest numbers of shoots (4.45) were found from the brinjal plants under 2 years old litchi canopy coverage (T_2). This was followed by the plants under 4 years (T_3) and and 6 years old litchi coverage (T_4), respectively. The lowest shooting (1.10) was observed under the plants of 12 years old litchi trees. Available growth resource was plenty in open field condition, so maximum number of branching occurred in open condition. This result is supported by Rahman., *et al.* (2010).

Effect of litchi canopy size on the yield traits and yield of brinjal

Number of fruits per plant

The number of fruit per plant was significantly varied among different canopy size treatments (Table 3). The maximum number of fruits per plant (8.20) was recorded from the open field condition (T_1) which was followed by plants under 2 years (T_2) and 4 years old litchi tree canopy coverage (T_3), respectively. Whereas minimum number of fruits per plant (3.60) was obtained from brinjal plants under 6 years old litchi trees (T_4). Brinjal plants under 12 years old litchi trees (T_5) produced no fruits at all. Rahman., *et al.* (2010) [7] also says that the maximum number of fruits per plant can be obtained from open field condition than shade.

Weight of fruit per plant (g)

It was evident from the (Table 3) that different canopy size treatment showed significant effect on weight of fruit per plant. Among five treatments the maximum weight of fruit per plant (192.00 g) was recorded from the brinjal plants cultivated under 2 years old litchi trees (T_2) and the 2nd highest weight of fruit per plant was obtained from open field condition (T_1). These results were followed by where brinjal were raised under 4 years old litchi trees (T_3). Minimum fruit weight (146.00g) was recorded from the 6 years understorey crops (T_4). As no fruits were produced under 12 years old litchi trees, so there is no question of fruit weight in (T_5).In the open field condition the number of fruits per plant was maximum. So fruit size and weight were a little bit smaller than brinjal plants under partial shade especially than 2 years old litchi canopy coverage (T_2).

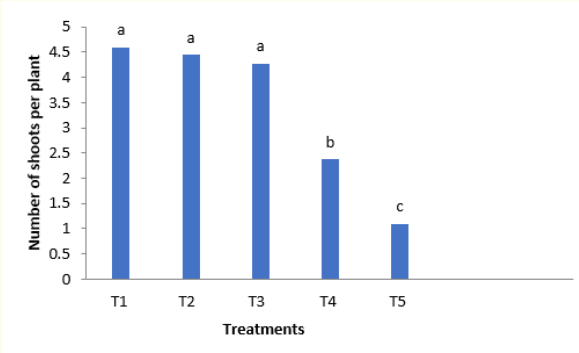

Figure 1: Effect of litchi canopy size on the number of shoots per plant.

T1 (Open); T2 (2 years old litchi canopy); T3 (4 years old litchi canopy); T4 (6 years old litchi canopy); T5 (12 years old litchi canopy). In a column, figure having similar letter(s) do not differ significantly whereas figures bearing different letter(s) differ significantly (as per DMRT).

Treatments	Number of fruits per plant	Weight of fruit per plant (g)	Fruit diameter (cm)	Yield (kg per plot)
T_1(Open)	8.20a	185.00ab	7.85a	39.20a
T_2 (2 years old litchi canopy)	6.40b	192.00a	8.10a	34.40b
T_3 (4 years old litchi canopy)	5.10c	170.00b	6.75b	21.50c
T_4 (6 years old litchi canopy)	3.60d	146.00c	5.65c	12.80d
T_5 (12 years old litchi canopy)	0.00e	0.00d	0.00d	0.00e
$LSD_{(0.05)}$	0.93	19.18	0.91	3.35
CV (%)	8.87	6.13	7.11	6.87

In a column, figure having similar letter(s) do not differ significantly whereas figures bearing different letter(s) differ significantly (as per DMRT).

Table 3: Effect of litchi canopy size on the yield traits and yield of brinjal.

Diameter of fruit per plant (cm)

Diameter of fruit per plant was significantly influenced (Table 3). The largest diameter of fruit per plant (8.10cm) was observed from the fruits obtained under 2 years old litchi trees (T_2) followed by open field condition (T_1), 4 years old litchi trees (T_3) and 6 years old litchi trees (T_4), respectively. Under 12 years old litchi canopies

(T_5) there was no fruit so no measurement for fruit diameter. The number of fruits per plant were maximum in the open field condition. So fruit diameter were somewhat smaller than brinjal plants under partial shade especially than (T_2) where brinjal were raised under 2 years old litchi trees.

Yield (kg per plot)

The contents of the data presented in (Table 3) revealed that the treatments had significant effects on yield of fruit. The highest fruit yield (39.20 kg/plot) was recorded in open field condition (T_1). The lowest fruit yield (12.80 kg/ plot) was observed from the plants under 6 years old litchi tree canopies (T_4). No yield was found from 12 years old litchi canopy (T_5).

Yield (ton per ha)

The treatments had significant effect on yield(ton) of fruits per hectare. The yield data are presented in (Figure 2) revealed that the highest fruit yield (10.89 t/ ha) was obtained from open field condition (T_1). And this was followed by plants under 2 years old litchi trees (T_2), 4 years old litchi trees (T_3), respectively. The lowest fruit yield (3.55 t/ ha) was observed from where brinjal was cultivated under 6 years old litchi tree canopies (T_4). Where the crops were covered with 12 years old litchi canopy (T_5), no yield was found from here.

Economic analysis of brinjal production under different litchi canopy

Growing brinjal with different canopy size treatments as intercropping in litchi based Agroforestry system was calculated based on local market rate prevailed during experimentation. The return of produces and the profit i.e. Benefit Cost Ratio (BCR) have also been presented in (Table 4).

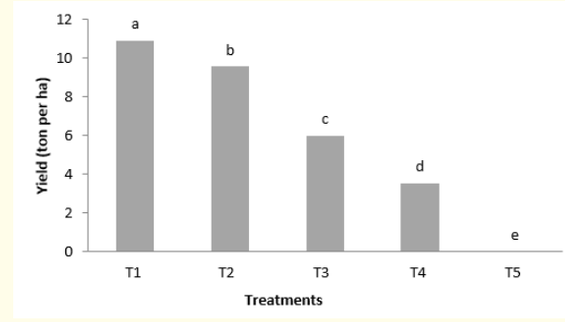

Figure 2: Yield of fruit (ton per ha).

T1 (Open); T2 (2 years old litchi canopy); T3 (4 years old litchi canopy); T4 (6 years old litchi canopy); T5 (12 years old litchi canopy). In a column, figure having similar letter(s) do not differ significantly whereas figures bearing different letter(s) differ significantly (as per DMRT).

Total cost of production

The values presented in (table 4) indicate that the total cost of production was minimum (150834 TK/ha) in the production system where brinjal was cultivated as sole crop. Whereas the maximum cost of production (179450 TK/ha) was recorded from the intercropping of brinjal with 12 years old litchi trees (T_5).

Treatments	Return (tk/ ha/yr)		Gross return (tk/ha)	Production cost (tk/ha/yr)	Net return (tk/ha)	BCR
	Litchi	Brinjal				
T_1 (Open)	-	217800	217800	150834	66966	1.23
T_2 (2 years old litchi canopy)	45000	191200	236200	151887	84313	1.56
T_3 (4 years old litchi canopy)	90000	119400	209400	152170	57230	1.37
T_4 (6 years old litchi canopy)	135000	71000	206000	152396	53604	1.35
T_5 (12 years old litchi canopy)	238000	-	238000	179450	58550	1.32

In a column, figure having similar letter(s) do not differ significantly whereas figures bearing different letter(s) differ significantly (as per DMRT).

Note: Brinjal 20 tk/kg and a 20 years old litchi tree returns 3000 tk/yr. There are total 150 litchi trees per hectare.

Table 4: Economic analysis of brinjal production under different litchi canopy.

Total output

Total output is an important indicator whether crop cultivation is profitable or not. It varied with the canopy size effects upon brinjal. The values in Table 4.4 indicate that the highest value of total output (238000tk/ha) was obtained from 12 years old litchi + brinjal based agroforestry system (T_5) followed by (236200 tk/ ha) where brinjal was cultivated under 2 years old litchi canopies (T_2). On the other hand, the lowest value of total output (206000 tk/ha) was obtained from intercropping of brinjal with 6 years old litchi trees (T_4).

Net return

Result presented in the Table 4 showed that the net return (84313 tk/ha) was found comparatively higher under litchi based agroforestry system where brinjal was intercropped with 2 years old litchi trees (T_2). The lowest net return (53604tk/ha) was recorded from the intercropping of brinjal with 6 years old litchi trees (T_4).

Benefit cost ratio (BCR)

The value in Table 4 indicates that the highest benefit cost ratio (1.56) was recorded from 2 years old litchi + brinjal based Agroforestry system (T_2) followed by (1.37b) where brinjal+ 4 years old litchi (T_3) was cultivated. On the other hand, the lowest benefit cost ratio (1.23) was found in sole cropping of brinjal (T_1). Indeed, in brinjal with 2 years old litchi canopy (T_2) practice additional return was added from litchi tree. Therefore, the BCR was increased in this treatment than open field condition (T_1) i.e., sole cropping of brinjal.

Conclusion

The findings of the present investigation indicate that diversification of farming system and growing brinjal as ground layer crops under litchi tree orchard up to 6 years old is a viable option for increasing income of farmers. Despite some negative effects of canopies on the growth, yield and physiological attributes of brinjal, litchi based agroforestry system is still beneficial as it ensure higher returns because of diversified products in comparison to sole cropping. More than 10 years old litchi orchard is not suitable for brinjal cultivation as associated understorey crops. From the results and foregoing discussion, it is clear that open field condition is so good for the production of brinjal but cultivation of Bt brinjal-4 under 2 years old litchi trees (T2) brings an additional return as per investment in terms of money, food safety, and environmental benefits.

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Bibliography

1. Bellow J and Nair PKR. "Comparing common methods for assessing understory light availability in shaded-perennial Agroforestry systems". *Agricultural and Forest Meteorology* 114 (2003): 197-211.

2. Saifullah M., *et al.* "Utilization of indigenous vegetables for sustainable vegetable production in Bangladesh". International Symposium on Sustainable Vegetable Production in Southeast Asia, Salatiga, Indonesia (2012).

3. BBS. Bangladesh Bureau of Statistics, Statistical Year Book of Bangladesh, Agriculture Statistical Wing, Ministry of Planning, Government of Peoples Republic of Bangladesh, Bangladesh (2014): 154.

4. Choudhary B and K Gaur. "The development and regulation of Btbrinjal in India (eggplant/aubergine)". International Service for the Acquisition of Agri-Biotech Applications (ISAAA), Ithaca, NY, USA (2009): 38.

5. Singh G., *et al.* The Litchi, Food and Agricultural Organization of the United Nations, New Delhi, India (2012).

6. Solanki KR. "Agroforestry research in India". *Indian Journal of Agricultural Sciences* 68.8 (1998): 559-566.

7. Rahman KM., *et al.* "Performance of tomato under multistoried agroforestry system". *Journal of Agroforestry and Environment* 4.2 (2010): 109-111.

8. Benoit GR., *et al.* "Potato top growth as influenced by day– night temperature differences". *Journal of Agronomy* 78 (1986): 264-269.