

Performance of lemon and guava as middle layer crops under coconut based multistoried Agroforestry system

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ABSTRACT: The experiment was conducted at the existing multistoried coconut orchard of the Horticulture Farm, Bangladesh Agricultural University, Mymensingh, to investigate the performance of lemon and guava grown under coconut based multistoried Agroforestry system during the period of January 2004 to August 2004. The experiment was laid out in randomized complete block design with five replications. Treatments were :T₁- comprises the combination of coconut + lemon based Agroforestry system, T₂- comprises the combination of coconut + guava based Agroforestry system, T₃- lemon in open condition., T₄- guava in open condition. In open condition lemon and guava received 100% sunlight; while coconut + lemon and coconut + guava based Agroforestry system received, 65-75% sunlight for the growth and development of lemon and guava. Multistoried Agroforestry systems under this study had showed significant influence on yield, yield attributing and quality parameters of lemon and guava. The result revealed that the highest plant growth and best yield contributing characters of lemon was found coconut + lemon based Agroforestry system. The highest plant height, number of leaves, flowers, fruits, harvested fruits, single fruit weight, total yield and TSS were obtained when lemon grown under coconut + lemon based Agroforestry system. But for the guava plant, the highest plant height, number of leaves, flowers, fruits, harvested fruits, single fruit weight and total yield were obtained when guava grown under open condition. The trend of total soluble solids (TSS) content of both lemon and guava in different treatments indicates that TSS content was decreased in full sunny place.

Key words: Multistoried, Coconut, Lemon, Guava, agroforestry system

INTRODUCTION

Population throughout the world is increasing rapidly and the rate of increase is very high in developing countries like Bangladesh. Due to the ever growing population, per capita land area is decreasing at an alarming rate of 0.005 ha/cap/year since 1989 (Hossain & Bari, 1996) and therefore, steadily declining the land: man ratio. Again, much emphasis was not given in fruit production although it is an important source of nutrition. The Bangladesh consumes only 35 g/day/capita which are far behind the

requirements of 85 g. Moreover, most of the people of our country can not afford to buy even average requirements of fruits due to its unavailability and high price. Socio-economic, the consequence of this event is, therefore, widespread malnutrition throughout the country. Under this alarming condition it is necessary to find out a suitable alternative to overcome this situation. Incorporation of fruit trees under multistoried cropping system may be an alternative avenue. Multistoried cropping system is a combination of several (2-5) vertical strata of

different vegetation. It is generally assumed that the total production of multistoried cropping system is higher than that of an annual crop system or forestry alone, because growth resources namely light, nutrient, water are used efficiently in this system. Introducing of lemon and guava fruit trees into multistoried coconut based Agroforestry system is very important in Bangladesh condition. Coconut (*Cocos nucifera*) belonging to the family Palmae is one of the most popular fruit trees in Bangladesh. Under multistoried tree garden coconut can be grown in the upper layer and it will provide several advantages for middle layer and ground level fruit trees and crops. Again, lemon (*Citrus limon*) belonging to the family Rutaceae and guava (*Pisidium guajava*) belonging to the family Myrtaceae is also very important fruits in Bangladesh. Under multistoried tree garden, lemon and guava both the fruit trees can be grown in the middle layer. With this in view, the present investigation was undertaken to observe performance of lemon and guava in multistoried agroforestry system as middle layer crops.

Materials and Methods

The experiments were conducted in the existing multistoried coconut orchard of the Horticulture Farm, Bangladesh Agricultural University Mymensingh. The experimental site was situated under tropical monsoon climate and the soil texture was sandy loam with a pH of 6.6. The structure of the soil was fine and the organic matter content was 1.8%. The experiment was laid out following a Randomized Complete Block Design (RCBD) arrangement of multistoried production system. Four treatments were used in

this study. Five replications were followed for each treatment. The treatments were randomly distributed within the field. Treatment of the experiment were as: T₁- comprises the combination of coconut + lemon based Agroforestry system, T₂- comprises the combination of coconut + guava based Agroforestry system, T₃- lemon in open condition., T₄- guava in open condition. Treatment T₁ was a two layered canopy configuration consisted of coconut and lemon. Coconut was at the top layer and aged 25 years. The second layer had lemon plants which were five years old and were in fruiting condition. This layer allowed falling 65-75% of light intensity. Similarly, treatment T₂ was also a two layered canopy configuration consisted of coconut and guava. Coconut plant was 25 years old and at the standing top layer. The second layer had guava plants which were five years old and were in full bearing condition. This layer also received 65-75% sunlight while in open condition treatment T₃ and T₄ plants received 100% sunlight. Light interception was measured with Lux meter. Lemon was harvested on June 2004 and guava was harvested on August, 2004 at matured stage. The yield parameters under study from all of the experimental plants of lemon and guava were recorded and then the data were statistically analyzed following ANOVA technique and means were adjusted by LSD test at 1% and 5% level of significance.

Results and Discussion

Coconut + lemon based agroforestry system
Growth and yield contributing characters of lemon

Lemon plant cultivated under coconut plant grew more vigorously than those in the open field. The maximum plant height of lemon (1.88 m) was recorded under the treatment of T₁. The minimum height of lemon (1.78 m) was observed under the treatment of T₃. Similarly, the maximum number of leaves per plant (118.20) was observed under the treatment of T₁ while the minimum number of leaves per plant (102.800) was recorded under open plantation (Table 1). This may be attributed

due to the stimulation of cellular expansion and cell division under shaded conditions (Schoch, 1972). The data of number of flowers was recorded at 15 days interval. The number of flowers was increased up to 45 DAF and the maximum number of flowers (133.97) was recorded under the treatment of T₁. The minimum number of flowers (80.96) was observed under open field condition (T₃).

Table 1. Effect of multistoried coconut based agroforestry system on plant height, number of leaves, number of flowers plant⁻¹ of lemon and guava

Treatment	Plant height (m)	no. of leaves	no. of flowers plant ⁻¹						
			15 DAF	30 DAF	45 DAF	60 DAF	75 DAF	90 DAF	105 DAF
Coconut + Lemon	1.88	118.20	28.77	93.30	133.97	66.30	8.50	1.20	0.40
Coconut + Guava	2.64	304.86	5.50	6.20	12.33	15.03	229.60	100.13	0.60
Lemon open	1.85	102.80	23.56	70.76	80.96	53.53	4.90	2.43	0.31
Guava open	3.12	380.75	13.33	20.40	17.73	21.86	290.46	139.06	1.20
LSD 0.01	0.57	16.46	2.44	4.47	2.73	3.61	6.71	6.13	0.10
Level of significance	**	**	**	**	**	**	**	**	**

** = Significant at 1% level, DAF= Days After Flowering

Table 2. Effect of multistoried coconut based agroforestry system on number of fruits plant⁻¹ of lemon and guava

Treatment	no. of fruits plant ⁻¹							
	15 DAFr	30 DAFr	45 DAFr	60 DAFr	75 DAFr	90 DAFr	105 DAFr	120 DAFr
Coconut + Lemon	7.90	13.67	38.23	56.50	67.90	60.63	55.83	55.80
Coconut + Guava	4.37	5.67	13.20	15.90	26.96	155.80	122.36	105.20
Lemon open	7.00	10.62	28.53	37.46	41.43	35.10	32.10	30.16
Guava open	13.86	19.23	20.80	23.73	36.46	300.96	221.46	214.36
LSD 0.01	1.673	0.735	2.645	3.369	2.925	16.260	4.565	5.217
Level of significance	**	**	**	**	**	**	**	**

** = Significant at 1% level, DAFr= Days After Fruiting

Significantly the highest single fruit weight of lemon (87.83) was observed when lemon grown under coconut. The lowest fruit weight of lemon (85.63) was observed in open plantation (Table 3). The yield of lemon was found statistically significant. The maximum yield per plant (4.71) was observed under shade condition of T₃. The minimum yield per plant (1.98) was obtained under the open field condition of T₃ (Table 3).

Qualitative characters of lemon

The total soluble solid (TSS) is one of the important factors for lemon. High TSS indicates high sweetness. The maximum TSS (6.32) was found in the shade condition of T₁. The minimum TSS (5.95) was found under open field condition of T₃ (Table 3). Considerable variation was observed among the lemon fruit shape in treatment T₁ and T₃. Treatment T₁ produced spheroid and treatment T₃ produced ellipsoid shape. Ahmed and Mazhar (1964) observed the ellipsoid to oblong shaped fruit in his experiment. The Epicarp colour of the fruit was categorized into three groups viz. green, light green and yellow. Epicarp colour of mature lemon fruit were green and light green of T₁ whereas light green to yellowish green were found in T₃. Webber (1948) observed the greenish yellow skin colour of the fruits in ripened lemon. Surface smoothness of epicarp varied from rough to smooth. Shade condition (T₁) and open condition (T₃) both the condition produced rough and medium rough fruits. Ahmed and Mazhar (1964) recorded

smooth and even or in conspicuously ribbed surface of lemon fruits.

Coconut + Guava based agroforestry system

Growth and yield contributing characters of guava

The heights plant height of guava (3.12 m) was observed in open field condition. The lowest plant height of guava (2.64) was found under the shade condition (Table 1). Similarly the highest number of leaves per plant (380.75) was recorded under open field condition while the lowest number of leaves per plant (304) was recorded under shade condition. Number of flowers per plant was found to be statistically significant. The data was recorded at 15 days interval. The number of flowers was increased with increasing day up to 75 days after flowering and the maximum number of flowers (290.46) was found under open field condition (T₄) and later it was reduced in case of all treatment. The minimum number of flowers (229.60) was found under shade condition (T₂).

Yield of guava:

Number of fruits per plant was significantly influenced by the shade level. The data was recorded at 15 days interval. The number of fruits was increased with increasing day up to 90 DAFr and the maximum number of fruits (300.96) was recorded under open field condition and later it was reduced in case of other treatment. The minimum number of fruits (155.80) was observed under shade condition (T₂) (Table 3).

Table 3. Effect of multistoried coconut based agroforestry system on harvested fruits, single fruit weight, yield and TSS plant⁻¹ of lemon and guava

Treatment	Number of harvested fruits plant ⁻¹	Single fruit weight of harvested fruits (g plant ⁻¹)	Yield of harvested fruits (kg plant ⁻¹)	TSS
Coconut + Lemon	53.33	87.83	4.71	6.32
Coconut + Guava	108.26	82.86	7.58	13.76
Lemon open	28.53	85.63	1.98	5.95
Guava open	221.66	88.86	14.06	11.94
LSD 0.01	6.147	-	0.595	2.060
0.05	-	3.502	-	-
Level of significance	**	*	**	NS

* = Significant at 5% level, ** = Significant at 1% level, NS = Non significant

Number of harvested fruits per plant showed almost similar trend like number of fruits per plant. The number of harvested fruits were maximum (221.66) at open condition (T₄). The minimum number of harvested fruits (108.26) was observed under shade condition (T₂) (Table 3). The highest fruit weight of guava (88.86) was observed when guava grown in open condition. The maximum yield per plant (14.06) of guava was observed under open condition. The minimum yield per plant (7.58) was obtained under the shade condition (T₂) (Table 3).

Qualitative characters of guava

The total soluble solid (TSS) of guava was found statistically significant. The maximum total soluble solid (13.76) was found in the shade condition (T₂). The minimum total soluble solid (11.95) was found under open field condition (T₄)

(Table 3). There were significant variations among the fruit shape of guava under different condition. Fruit shape was globosely under open condition (T₄). Fruit shape were ovate to roundish ovate under shade condition (T₂). The present findings are in agreement with Mitra and Bose (1990), Ullah *et al.* (1992), Nag (1998), and Hossain (1999) found wide variation in fruit shape of guava under different plantings. Wide range of variation was observed for predominant skin colour of matured guava fruit. Skin colour of mature guava fruit were yellowish green in T₄ and light green to greenish fruits were found in T₂. These results are in conformity with the findings of Hossain (1999) and Begum (1999), regarding the common varieties they studied. Surface smoothness varied from rough to smooth. Shade condition produced smooth to moderately smooth

while open condition produced rough to moderately rough surface of fruits. Considering the above mentioned results and discussion, it is, therefore, concluded that the performance of lemon and guava as middle layer crops under coconut based multistoried agroforestry production system were different. Among the two fruits, lemon is more suitable than that of guava. But in general the fruit plants like lemon and guava can be composed successfully as the second layer crops in multistoried agroforestry production system. However, the findings of the present study were achieved based on one season trial which may not be sufficient to assess the sustainability of the results. So, further study is necessary for at least in another season to arrive a valid conclusion.

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