ISSN: 2224-0616
Int. J. Agril. Res. Innov. & Tech. 4 (2): 61-69, December, 2014 Available online at http://www.ijarit.webs.com

SCREENING OF TOMATO VARIETIES FOR FRUIT TREE BASED AGROFORESTRY SYSTEM

J. Hossain[1], T. Ahmed[2], M.Z. Hasnat[3]* and D. Karim[4]

Received 13 September 2014, Revised 2 November 2014, Accepted 22 December 2014, Published online 31 December 2014

Abstract

An experiment was conducted with four tomato varieties under a six year old orchard was accomplished at the Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU) research farm during October 2011 to April 2012. The experiment was laid out in a Randomized Complete Block Design with three replications. Four tomato varieties (BARI Tomato 2, BARI Tomato 8, BARI Tomato 14 and BARI Tomato 15) were grown under guava, mango, olive and control. Results showed that light availability in control plot (999.75 µ mol $m^{-2}s^{-1}$) was remarkably higher over fruit tree based agroforestry systems and it was 58.8, 43.9 and 31.5% of the control for guava, mango and olive based systems, respectively. The shortest tomato plant was observed in olive based system (54.91 cm), while the tallest plant was observed in mango based system (60.09 cm). The highest SPAD value and number of primary branches per plant was recorded in control plot. Fruit length, fruit girth was found lowest in olive based system. The highest yield (34.06 t ha^{-1}) was recorded in control plot while the lowest yield (10.26 t ha^{-1}) was recorded in olive based system. The economic performance of fruit tree based tomato production system showed that both the net return and BCR of mango and guava based system was higher over control and olive based system. The contents of organic carbon, nitrogen, available phosphorus, potassium and sulfur of before experimentation soil were slightly higher in fruit tree based agroforestry systems than the control. After experimentation, nutrient elements in soil were found increased slightly than initial soils. Fruit tree based agroforestry systems could be ranked based on the economic performance as mango> guava> control> olive based system with BARI Tomato 15, BARI Tomato 2, BARI Tomato 14 and BARI Tomato 8, respectively.

Keywords: Fruit Tree Based Agroforestry System, tomato plant growth and yield.

[1]Lecturer, Dept. of Agroforestry and Environmental Science, Exim Bank Agricultural University, Chapainawabganj, Bangladesh
[2]Associate Professor, Dept. of Agroforestry and Environment, BSMRAU, Gazipur, Bangladesh
[3]Information Officer (Plant Protection), Agriculture Information Service, Ministry of Agriculture, Bangladesh
[4]Senior Scientific Officer, Soil Resource Development Institute, Ministry of Agriculture, Bangladesh

*Corresponding author's email: zhasnat@yahoo.com (M.Z. Hasnat)

Introduction

Fruit tree based vegetable production system would be very good options for maximizing and diversifying as well as sustaining the production system with high vitamin source for the country. However, before giving any policy options on the selection of vegetable varieties for the fruit tree based agroforestry production system, adequate information on various aspects of the system at farm level is required. Information on this regards is very limited due to lack of adequate research on this aspect. Some sporadic research has been done on fruit tree based vegetable production system but information about performance of different vegetable varieties is limited. To identify the compatible tree-vegetable combination, particular understory species i.e. different vegetable varieties should be screened out in terms of their adaptability and yield under different tree canopies is needed. In Bangladesh, a large number of vegetable are grown of which most of them are grown in winter season. Among them Tomato (*Lycopersicon esculentum* L.) is very popular vegetable grown successfully throughout the Bangladesh. Tomato has good production potential in our climate. Miah (2001) observed that tomato (single variety) could be grown successfully without yield loss up to 25% shade level, but a lot of varieties were not systematically tested in agroforestry system or in natural shade condition to see their production ability. Very little scientific research work has been done in this field. To screen out suitable tomato variety, the best way to grow different tomato varieties under different tree species. It would be very useful information in selecting the best fruit tree-tomato combination in order to promote agroforestry at field level. The experiment was therefore undertaken to find out the light availability for tomato varieties under different fruit tree based agroforestry system, quantify the growth and yield of four tomato varieties under fruit tree based agroforestry system and determine soil fertility changes in different fruit tree based agroforestry system.

Materials and Methods

The experiment was conducted in a six years old orchard of the Department of Agroforestry and Environment, Bangabandhu Sheikh Mujibar Rahman Agricultural University (BSMRAU), Gazipur during the period from October 2011 to April 2012. The experiment was laid out in a Randomized Complete Block Design (factorial) with three replications.

The treatments were as follows:

Factor A: Fruit tree species (4) - Guava (*Psidium guajava*), Mango (*Mangifera indica*), Olive (*Olea europaea*) and Control (No tree).

Factor B: Tomato varieties (4) - BARI Tomato 2, BARI Tomato 8, BARI Tomato 14, BARI Tomato 15. The variety of guava was Bari Peyara 2, mango was BARI Aam 3 and olive was local variety. Twelve pits were prepared in each block and spacing for all trees were 4m × 4m.

Seeds were sown in the seedbed on 9 October 2011. Thirty five days old seedlings of tomato were transplanted at 60 cm × 50 cm spacing on 14 November 2011. The experimental plots were fertilized with 12 ton cow dung and 600 kg urea, 500 kg TSP, 300 kg MP per hectare. All cow dung, TSP and one third of Urea and MP were applied during the final land preparation and the rest of the Urea and MP were applied in two equal installments at 20 and 40 days after transplanting (Hussain and Miah, 2004). Various intercultural operations (weeding, rouging, bamboo sticking and pesticides application) were done in appropriate time. The harvesting started at 115 days and ended at 155 days after transplanting. During experiment SPAD (Soil Plant Analysis Development) values, the plant height and number of branches, number of fruits per plant, fruit length (mm), fruit girth (mm) and fruit weight (g) and yield (t ha^{-1}) was measured for tomato plant. For fruit tree component data on tree height (m), canopy spreading were recorded from every tree species. Chlorophyll content of the leaf was measured from selected plant by SPAD 502 plus Chlorophyll meter. Light was measured by Sunflect ceptometer (LP-80 Accu PAR ceptometer) from each plot. From collected soil sample organic carbon (%), total nitrogen (%), available phosphorus (ppm), exchangeable potassium (meq 100 g^{-1}) and sulphur (meq 100 g^{-1}) estimation were done. After 12 months of the experimentation, soil samples were again collected and same properties were analyzed.

Data recorded for different parameters of plant and soil were processed by Excel and statistically analyzed by "CROPstat" and MSTAT software and means were compared by DMRT at 5% level of significance.

Result and Discussion

Light availability over crop canopy

The light availability over four tomato varieties in fruit tree based agroforestry system were collected in three sampling dates at 9:00 AM, 12:00 PM and 3:00 PM. Results showed that the light availability over the tomato plants grown in control plots were higher (999.75 µ mol $m^{-2}s^{-1}$) than the fruit tree based agroforestry system. Among the tree species, light availability over tomato plants grown in guava trees (588.72 µ mol $m^{-2}s^{-1}$) were higher than mango (438.97 µ mol $m^{-2}s^{-1}$) and olive (308.29 µ mol $m^{-2}s^{-1}$) (Table1). The light availability over the tomato plants grown in guava, mango and olive based agroforestry system were 58.88, 43.90 and 31.51% of the control respectively. However, among the four tomato varieties, light availability did not vary much when they were grown within a tree.

Table 1. Light availability (PAR) over the tomato varieties grown in fruit tree based agroforestry system

Tree species	Average light on tomato plant grown under different fruit trees (µ mol $m^{-2}s^{-1}$)				Mean
	BARI Tomato 15	BARI Tomato 14	BARI Tomato 8	BARI Tomato 2	
Guava	568.81	553.17	651.17	581.73	588.72
Mango	450.12	460.32	420.66	424.78	438.97
Olive	316.83	331.58	314.78	296.99	308.29
Control	981	1038	1030	950	999.75
Mean	579.19	595.76	604.15	563.37	

Performance of tomato grown in association with different tree species

Plant height

In the study, the shortest plant was observed under olive tree where light availability was only 31% compare to control. Plant height of BARI Tomato 15 was significantly influenced when they were grown under different tree species. However, the tallest tomato plant was recorded under mango tree (58.27 cm) (Table 2) but it did not vary significantly with guava and control. However, significantly the shortest tomato plant (54.50 cm) (Table 2) was recorded under olive tree. Plant height of BARI Tomato 14, BARI Tomato 8 and BARI Tomato 2 showed similar trend of variation where the tallest plant was recorded under mango tree insignificantly followed by guava and control. On the other hand, the shortest plant was found under olive tree but it did not vary with control.

Table 2. Effect of different tree species on the plant height of tomato varieties

Tree species	Height of tomato plant (cm)				Mean (cm)
	BARI Tomato 15	BARI Tomato14	BARI Tomato 8	BARI Tomato 2	
Guava	57.63 a A	58.13 a A	57.80 a A	57.87 a A	57.86
Mango	58.27 a A	60.60 a A	60.37 a A	61.13 a A	60.09
Olive	54.50 b A	54.73 b A	54.90 b A	55.50 b A	54.91
Control	55.83 a A	56.50 ab A	55.86 ab A	56.46 ab A	56.17
Mean±SE	56.56± o.86	57.49±1.25	57.23±1.21	57.74±1.23	

In a column, means followed by a common small letter and in a row, means followed by a common capital latter are not significantly different at the 5% level by DMRT.

SPAD value

In the present study, the highest SPAD value was recorded in tomato plants grown in control plots, while, the lowest value was recorded under olive tree. The SPAD value of BARI Tomato 15, BARI Tomato 14 and BARI Tomato 2 showed the highest value in control plots (Table 3) which did not differ significantly with the SPAD value recorded under guava and mango trees. The SPAD value recorded in tomato plants grown under olive tree were the lowest which did not vary significantly with the SPAD value recorded in tomato plants grown under guava and mango trees. However, the SPAD value of BARI Tomato 8 did not vary significantly when they were grown under different tree species. Among the varieties, the SPAD values did not vary in each tree species, except under olive tree. The SPAD value of BARI Tomato 8 was found highest which was identical with the SPAD value found in BARI Tomato 15. The SPAD values of BARI Tomato 14 (36.80) and BARI Tomato 2 (37.58) were found lowest which were also identical with BARI Tomato 15.

Table 3. Effect of different fruit tree species on the SPAD value of tomato varieties

Tree species	SPAD value of tomato plant				Mean
	BARI Tomato 15	BARI Tomato 14	BARI Tomato 8	BARI Tomato 2	
Guava	43.93 ab A	45.00 ab A	40.83 a A	41.39 ab A	42.79
Mango	40.75 ab A	42.47 ab A	44.17 a A	40.91 ab A	42.08
Olive	39.76 b AB	36.80 b B	43.23 a A	37.58 b B	39.34
Control	47.18 a A	48.35 a A	45.14 a A	43.00 a A	45.92
Mean±SE	42.90±1.68	43.16±2.44	43.34±0.92	40.72±1.14	

In a column, means followed by a common small letter and in a row, means followed by a common capital latter are not significantly different at the 5% level by DMRT.

Number of primary and secondary branch

In general, the highest number of branches per plant was recorded in control plot while the lowest value was found under olive tree. The branch number of BARI Tomato 15 and BARI Tomato 14 (Table 4) showed similar trend of variation where the highest number were recorded in control plots and the number of branches per plant recorded in other treatments were identical. In case of BARI Tomato 8 the number of branches per plant recorded in control, mango and guava trees were similar. However, significantly the lowest number of branches per plant was recorded under olive tree but it was identical to the number of branches per plant recorded under guava. On the other hand, number of branches per plant recorded in BARI Tomato 2 was more or less similar as observed in BARI Tomato 8 (Table 4) with little exception. Among the varieties in each tree species, the number of branches per plant did not vary, except BARI Tomato 8 in control. BARI Tomato 8 gave lower number of branches per plant compare to other varieties. The lower number of primary branches under shaded conditions might be due to higher auxin production in plant grown under shaded condition, which ultimately suppressed the growth of lateral branches (Miah *et al.*, 1994).

Table 4. Effect of different fruit tree species on the number of primary branches of tomato varieties

Tree species	Number of primary branches of tomato				Mean
	BARI Tomato 15	BARI Tomato 14	BARI Tomato 8	BARI Tomato 2	
Guava	2.00 b A	2.66 b A	2.33 ab A	2.66 b A	2.42
Mango	2.66 b A	3.00 b A	3.33 a A	3.66 ab A	3.17
Olive	1.33 b A	2.00 b A	2.00 b A	1.66 b A	1.75
Control	4.33	4.66	3.33	4.00	4.08
Mean±SE	2.58±0.64	3.08±0.57	2.75±0.34	3.00±0.53	

In a column, means followed by a common small letter and in a row, means followed by a common capital latter are not significantly different at the 5% level by DMRT.

Secondary branches per plant

The number of secondary branches per plant of tomato was also influenced by different tree species (Table 5). BARI Tomato 15, BARI Tomato 14 and BARI Tomato 2 showed significantly lowest number of branches per plant when plant grown under olive tree. While the other treatment gave identical number of branches per plant. However, the number of branches per plant did not vary in case of BARI Tomato 8. Among the varieties the number of branches per plant did not vary.

Table 5. Effect of different fruit tree species on the secondary branches of tomato varieties

Tree species	Number of secondary branches of tomato				Mean
	BARI Tomato 15	BARI Tomato 14	BARI Tomato 8	BARI Tomato 2	
Guava	3.00 a A	3.88 a A	4.00 a A	4.00 a A	3.58
Mango	3.98 a A	3.67 a A	4.00 a A	3.89 a A	3.88
Olive	2.00 b A	2.33 b A	2.67 a A	2.00 b A	2.25
Control	3.67	4.00	4.66	3.77	3.92
Mean±SE	3.17±0.44	3.58±0.39	3.92±0.42	3.42±0.47	

In a column, means followed by a common small letter and in a row, means followed by a common capital latter are not significantly different at the 5% level by DMRT.

Fruit length

The influence of different tree species on the fruit length of tomato varieties was similar and the lowest fruit length was observed in the tomato varieties grown under olive tree (Table 6). The fruit length of tomato grown under mango, guava and control produced identical fruit length and significantly higher over olive. However, fruit length of tomato varieties did not vary when they were grown under each tree species. Different experiment showed similar effect on fruit length. Miah (2001) observed the longest length of carrot (17.59 mm) and radish (16.25 mm) under 75% PAR.

Table 6. Effect of different tree species on the fruit length of different tomato varieties

Tree species	Length of tomato (mm)				Mean
	BARI Tomato 15	BARI Tomato 14	BARI Tomato 8	BARI Tomato 2	
Guava	50.67 a A	50.16 a A	48.83 a A	52.14 a A	50.45
Mango	59.96 a A	59.05 a A	56.07 a A	50.34 a A	56.35
Olive	36.19 b A	38.15 b A	39.46 b A	38.85 b A	38.17
Control	53.33	54.67	56.00	52.00	54.00
Mean±SE	50.04±5.01	50.51±4.5	50.09±3.93	48.33±3.19	

In a column, means followed by a common small letter and in a row, means followed by a common capital latter are not significantly different at the 5% level by DMRT.

Fruit girth

The fruit girth of BARI Tomato 15 and BARI Tomato 14 showed that the highest fruit girth was recorded in control, which was identical with the fruit girth recorded under mango tree (Table 7). On the other hand, fruit girth of tomato recorded under mango tree was also similar to the fruit girth recorded under guava but these values were significantly higher over olive. Fruit girth recorded in case of BARI Tomato 8 did not vary among the tree species, except under olive. Fruit girth of tomato grown under olive tree was significantly the lowest compare to other treatments including control. In case of BARI Tomato 2, the highest fruit girth was recorded in control plot, which did not vary with the fruit girth recorded under guava tree. Among the tomato varieties, fruit girth did not vary when they were grown under guava and olive but BARI Tomato 2 produced the lowest fruit girth when they were grown under mango tree and control.

Table 7. Effect of different fruit tree species on the girth of tomato varieties

Tree species	Girth of tomato (mm)				Mean
	BARI Tomato 15	BARI Tomato 14	BARI Tomato 8	BARI Tomato 2	
Guava	55.20 b A	51.59 b A	54.67 a A	49.37 ab A	52.71
Mango	59.16 ab A	56.86 ab A	53.16 a A	46.71 b B	53.97
Olive	31.02 c A	34.41 c A	36.85 b A	37.55 c A	34.96
Control	66.67	62.00	60.33	57.67	61.67
Mean±SE	53.01±7.71	51.22±5.99	51.25±5.04	47.82±4.14	

In a column, means followed by a common small letter and in a row, means followed by a common capital latter are not significantly different at the 5% level by DMRT.

Tomato yield

Fruit yield of tomato was influenced when the tomato varieties were grown under different tree species and different varieties responded differently as well. In general, the highest tomato yield was recorded (34.06 t ha^{-1}) (Table 8) in control plot while the lowest yield (10.20 t ha^{-1}) was recorded under olive tree. The yield of tomato grown under guava (23.47 t ha^{-1}) and mango (19.94 t ha^{-1}) (Table 8) were higher over olive but lower over control. The yield performance of BARI Tomato 15 grown under different tree species showed that the highest yield was observed in control plot (26.94 t ha^{-1}) which was identical with the yield obtained from guava (22.68 t ha^{-1}) and mango (23.85 t ha^{-1}) tree. However, yield obtained from olive tree was the lowest (8.28 t ha^{-1}). In case of BARI Tomato 14 and BARI Tomato 8 the highest and the lowest yield was recorded in control and olive tree. Tomato yield recorded under guava and mango tree were significantly lower than control but higher than olive. In case of BARI Tomato 2, though the highest yield was recorded in control plot (31.43 t ha^{-1}) (Table 8) but the value was similar to the tomato yield obtained under guava tree. Tomato yield obtained under olive tree was the lowest and yield obtained from mango tree was higher over olive but lower than control and guava. The yield of tomato varieties did not vary significantly when they were grown under guava, mango and olive tree. In control, BARI Tomato 14 gave the highest yield (44.60 t ha^{-1}) compare to the other varieties. The average yield of tomato grown under different tree species showed that the highest yield was recorded in control plot. The yield of tomato grown under olive tree was found to suffer severely and it was 69.87% lower than control. The yield of tomato grown under mango and guava were also suffered and these values were 41.45 and 31.09% lower than control, respectively.

Table 8. Effect of different fruit tree species on the fruit yield of different tomato varieties

Tree species	Tomato variety yield				Mean
	BARI Tomato 15	BARI Tomato 14	BARI Tomato 8	BARI Tomato 2	
Guava	22.68 a A	21.56 b A	21.86 b A	27.79 a A	23.47
Mango	23.85 a A	19.40 b A	19.04 b A	17.46 b A	19.94
Olive	8.28 b A	10.17 c A	12.02 c A	10.54 c A	10.26
Control	26.94 a B	44.60 a A	33.27 a B	31.43 a B	34.06
Mean±SE	20.44±4.15	23.93±7.32	21.55±4.42	21.81±4.78	

In a column, means followed by a common small letter and in a row, means followed by a common capital latter are not significantly different at the 5% level by DMRT

Relationship graph between light and yield of tomato in this experiment

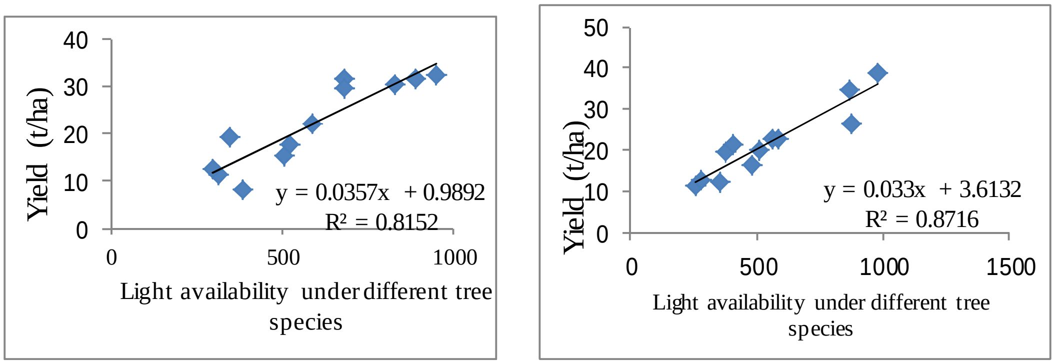

Fig. 1. Relationship between light availability under different tree species and yield of BARI Tomato 2 and BARI Tomato 8

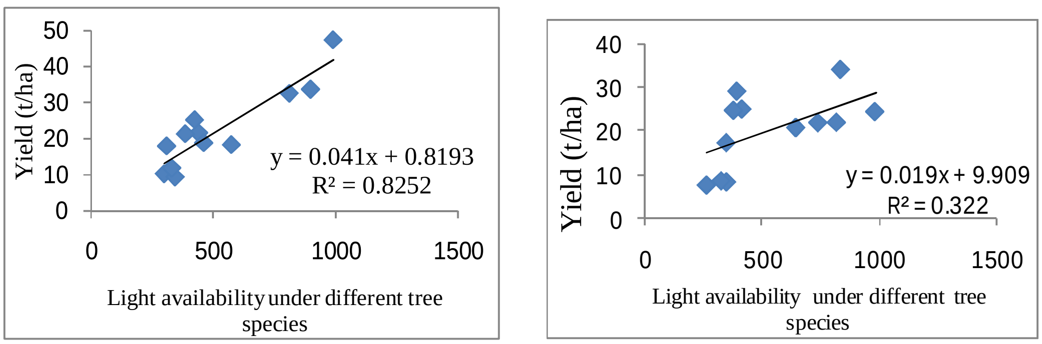

Fig. 3. Relationship between light availability under different tree species and yield of BARI Tomato 14 and BARI Tomato 15

Economic performance of agroforestry systems

The performance of tomato fruit tree based agroforestry systems in terms of economic performance was estimated and is presented in Tables 9-10. The overall economic performance of mango-tomato based system was found to outperform over other systems. The average net return of mango-tomato based system were (Tk. 515956.9) and BCR (4.9). Among the tested tomato varieties both the net return (TK. 555081.88) and BCR (5.3) of BARI Tomato 15 was found the highest compared to other varieties. The economic performance of guava-tomato based system was higher over control and olive based systems, but slightly lower than mango based system with the average net return (Tk. 442955.20) and BCR (4.3), respectively. Both the net return (Tk. 486130.19) and BCR (4.7) of BARI Tomato 2 was found highest in guava based system. The average net return control and olive based system were (Tk. 244019.50), (Tk. 62836.09) and BCR were (2.5), (0.61), respectively. In control and olive based systems BARI Tomato 14 and BARI Tomato 8 gave the highest net return (Tk. 349419.49), (Tk. 80511.09) and BCR (3.6), (0.79), respectively.

Table 9. Total cost and return of different agroforestry system and control (BSMRAU 2011-2012)

	System productivity						BCR
System	Tomato varieties (Tk)	Tomato fruit (Tk)	Return from tree (Tk)	Cost (Tk)	Total return (Tk)	Net return (Tk)	
Guava	BARI Tomato 2	277900	310879	102649	588779	486130.19	4.73
	BARI Tomato 8	218600	310879	102649	529479	426830.19	4.15
	BARI Tomato 14	215600	310879	102649	526479	423830.19	4.12
	BARI Tomato 15	226800	310879	102649	537679	435030.19	4.23
Mango	BARI Tomato 2	174600	419940	103358	594540	491181.88	4.75
	BARI Tomato 8	190400	419940	103358	610340	506981.88	4.90
	BARI Tomato 14	194000	419940	103358	613940	510581.88	4.93
	BARI Tomato 15	238500	419940	103358	658440	555081.88	5.37
Olive	BARI Tomato 2	105400	61800	101489	167200	65711.09	0.64
	BARI Tomato 8	120200	61800	101489	182000	80511.09	0.79
	BARI Tomato 14	101700	61800	101489	163500	62011.09	0.61
	BARI Tomato 15	82800	61800	101489	144600	43111.09	0.42
Control	BARI Tomato 2	314300	-	96580.5	314300	217719.49	2.25
	BARI Tomato 8	332700	-	96580.5	332700	236119.49	2.44
	BARI Tomato 14	446000	-	96580.5	446000	349419.49	3.61
	BARI Tomato 15	269400	-	96580.5	269400	172819.49	1.78

Table 10. Total cost and return of four tomato varieties in agroforestry and non agroforestry system (BSMRAU 2011-2012)

Tree species	Item	Price (Tk) cost and income of four varieties (Average)	BCR
Guava	Cost	102648.91	4.3
	Gross return	545604.10	
	Net return	442955.20	
Mango	Cost	103358.12	4.9
	Gross return	619315.00	
	Net return	515956.90	
Olive	Cost	101488.91	0.61
	Gross return	164325.00	
	Net return	62836.09	
Control	Cost	96580.51	2.5
	Gross return	340600.00	
	Net return	244019.50	

Soil fertility changes

Soil organic carbon

The SOC content of the experimental field before experimentation varied between 0.54% to 0.71%. The highest SOC content was estimated from guava based system was 0.71%, followed by mango (0.66%) (Fig. 1) and olive (0.59%) based system, respectively. The lowest SOC content was estimated from control plot (0.54%). The SOC content of soil increased slightly after one season and it varied from 0.81% to 0.95%. The highest SOC content was estimated from guava (0.95%) based system followed by mango (0.91%) and olive (0.89%) (Fig. 1). However, the lowest value was estimated from control plot (0.81%). The changes in SOC content of the soil collected from guava, mango and olive based agroforestry systems were higher over control, but the changes were more or less similar among the tree species. Organic matter accumulation under trees was due to a better stability of litter from tree leaves (Bernhard, 1982).

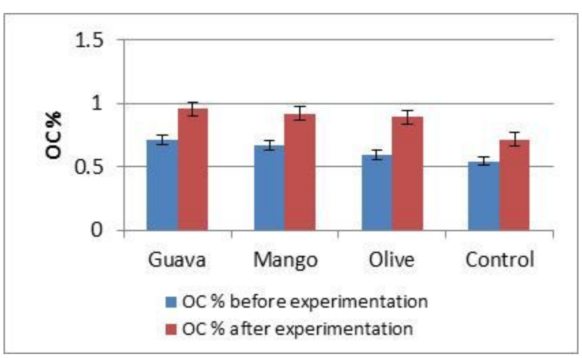

Fig. 1. Effect of fruit tree species on the organic carbon of soil

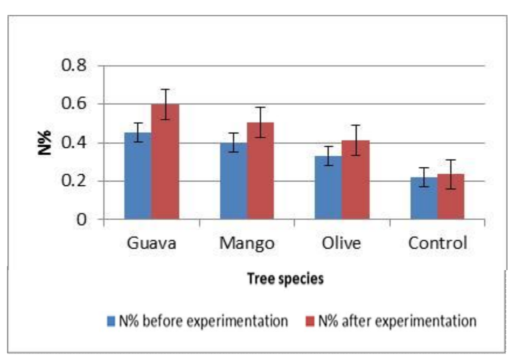

Fig. 2. Effect of fruit tree species on the nitrogen content of soil

Soil nitrogen content

The Nitrogen content of the soil of different fruit tree based agroforestry systems before experimentation varied between 0.22 % to 0.45 %. The highest nitrogen content was estimated from the guava based agroforestry system (0.45%) (Fig. 2), followed by mango (0.40%) and olive (0.33%) based agroforestry system. However, the lowest nitrogen content was established from control (0.22%). The nitrogen content of soil of the same field increase slightly after experimentation and it varied from 0.23% to 0.60%. The highest N content was estimated from guava based agroforestry system (0.60%) followed by mango (0.50%), olive (0.41%) and control (0.23%).

Potassium

The K content of the soil of different fruit tree based agroforestry systems was higher over control plot, both before and after experimentation (Fig. 3). The highest total K content was recorded in mango based agroforestry system (0.22 meq 100g soil^{-1}) which was closely followed by olive (0.19 meq 100g soil^{-1}) and guava (0.19 meq 100g soil^{-1}) based agroforestry system. In control plot, K content was 0.18 meq 100g soil^{-1}, which was slightly lower than fruit based agroforestry systems. After experimentation, the total K content was found the highest in mango based system (0.27 meq 100g soil^{-1}), which was followed by olive (0.24 meq 100g soil^{-1}), guava (0.22 meq 100 g soil^{-1}) and control (0.20 meq 100 g soil^{-1}).

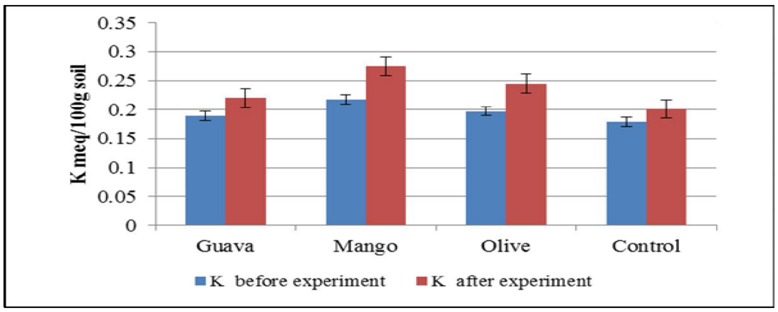

Fig. 3. Effect of fruit tree species on the potassium content of soil

Phosphorus

Available P content before experimentation of fruit tree based agroforestry plots were also slightly higher than control plot (11.87 ppm) (Fig. 4). Among the fruit tree based agroforestry systems, the available P content did not vary much where the highest P content was in guava based system (12.57 ppm) and the lowest P content was in olive based system (12.17 ppm). After harvesting of tomato, the available P content increased remarkably in fruit tree based agroforestry systems. However, it did not increase too much in control plot. The highest increase of available phosphorus was in olive based system (7.14 ppm) but it did not vary too much in guava (6.78 ppm) and mango (6.67 ppm) based systems.

Sulfur

The sulfur content (ppm) of the experimental soil before and after experimentation were very much distinct. Irrespective of fruit tree based agroforestry systems, the initial soil sulfur content was higher in the fruit tree based agroforestry systems compare to the control plot, (Fig. 5). Before experimentation, soil S content was the highest in mango based system (15.86 ppm) which was followed by guava (15.51 ppm) and olive (15.13 ppm) based systems, whereas in control plot it was (11.14 ppm). After harvesting of tomato, the highest soil S content was recorded in olive (28.16 ppm) followed by mango (26.89 ppm) and guava (26.79 ppm), whereas in control plot it was (17.12 ppm).

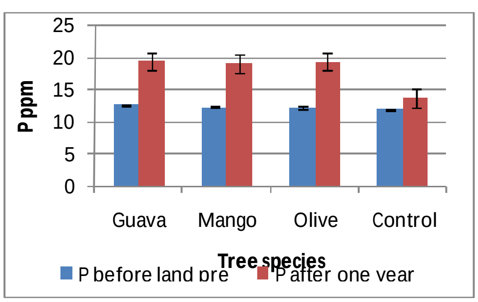

Fig. 4. Effect of fruit tree species on the P content of soil

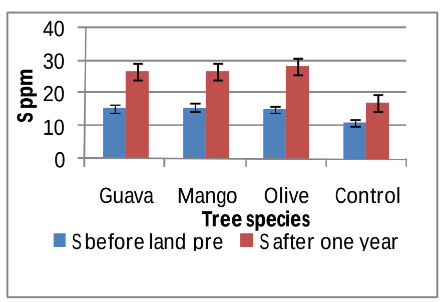

Fig. 5. Effect of fruit tree species on the S content of soil

Conclusion

With the findings of the present study it may be concluded that different fruit tree based agroforestry systems affected the light availability for tomato cultivation. Light availability in olive, mango and guava based systems were only 31.5, 43.9 and 58.8% of control, respectively. The yield of tomato grown in olive, mango and guava based systems were 10.26 t ha^{-1}, 19.94 t ha^{-1}, 23.47 t ha^{-1}, when yield of tomato in open field was 34.06 t ha^{-1}. The net return and BCR of mango and guava based system were higher over control and olive based system and BARI Tomato 15 and BARI Tomato 2 gave the highest net return (Tk.555081.88), (Tk.486130.19) and BCR (5.3), (4.7) in mango and guava based system respectively. The increment in organic carbon, nitrogen, available phosphorus, potassium and sulfur in soil indicated the fertility improvement of soil under tree based agroforestry system.

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