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Effect of Grafting Compatibility of Different Rootstock and Scion on Yield of Eggplant in Bangladesh Condition

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Abstract

A field experiment was conducted at Olericulture Division, Horticulture Research Center (HRC) of Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh, during the period from October 2017 to April 2018 to study the effect of grafting compatibility of different rootstock with different scion for eggplant. The 24 grafted treatments (6 scion × 4 rootstock) and 6 non grafted treatments of eggplant (*Solanum melongena* L.) showed significant variation in grafted and non-grafted different characters studies. Thirty treatment combinations showed significant better yield, fruit and shoot borer infestation. Among the thirty treatment combinations grafted on different rootstock like *S. sisymbriifolium*, BARI Begun 8, BARI Begun 10 and EgN 203 with several scions viz., BARI Begun 4, BARI Begun 9, BARI Hybrid Begun 2, BARI Hybrid Begun 4, BARI Bt Begun 2, BARI Bt Begun 4. The highest marketable fruit in grafted treatment was observed in T_4 (28.97 fruit/plant) followed by in T_1 (26.9 fruit/plant), in T_5 (26.47 fruit/plant), while average fruit weight in grafted treatment was observed (321.47in T6 followed by T18 (266.47 g) T12 (236.47), T24 (201.47 g). The highest fruit length in grafted treatment was observed in T5 (16.7 cm) followed by T17 (16.3 cm), T3 (15.9 cm), T13 (15.9 cm), T23 (15.7 cm), while the highest fruit diameter in grafted treatment was observed in T24 (10.23 cm) followed by T12 (10.13 cm). The lowest infestation by fruit and shoot borer infestation was observed in T7 (4.93%), while the overall infestation (%) rate was 4.33–27.37. The significant highest fruit yield (36.77 t/ha) was produced by T6 closely followed by T1 (36.43 t/ha), T13 (35.35 t/ha), T4 (34.56 t/ha), T5 (32.69 t/ha), T19 (30.69 t/ha), T17 (30.07 t/ha), while lowest fruit yield was recorded (12.37 t/ha) was produced by T26 followed by T8 (15.32 t/ha), T28 (15.61 t/ha). Among the grafted and non- grafted eggplant treatments, T6 (36.77 t/ha), T1 (36.43 t/ha), T13 (35.35 t/ha), T4 (34.56 t/ha), T5 (32.69 t/ha), T19 (30.69 t/ha), T17 (30.07 t/ha) were the highest yielder. In compare of rootstock, better performance was observed in BARI Begun-8 rootstock while grafted with 4 scions viz., BARI Begun-4 (36.43 t/ha), BARI Hybrid Begun-4 (34.56 t/ha), BARI Bt Begun-2 (32.69 t/ha), BARI Bt Begun-4 (36.77 t/ha). However, the study was for one season experiment. So, to draw a conclusion it is needed to conduct this experiment in another season.

Keywords: Grafts; Harvest; Infestation; Treatment

Introduction

The advantages of vegetable grafting have been noticed by many workers. Grafts were used to induce resistance against low and high temperatures, enhance nutrient uptake increase synthesis of endogenous hormones improve water use efficiency reduce uptake of persistent organic pollutants from agricultural soils improve alkalinity tolerance, raise salt tolerance and limit the negative effect of heavy metal toxicity [1-10].

The scion variety affects size, yield, and quality of fruit in grafted plants, but rootstock effects can drastically alter these quality characteristics [11]. The quality characteristics might be affected by grafting as a result of the translocation of metabolites associated with fruit quality to the scion through the xylem and/or modification of physiological processes of the scion [5].

Eggplant (*Solanum melongena L.*), belonging to the family *Solanaceae*, is the most important and extensively consumed vegetable in Bangladesh. Brinjal is a very common and favorite vegetable in Bangladesh which has a link with the social, cultural and economic lives of rural people. It has been a staple vegetable in our diet since ancient times. Eggplant is rich in nutrition with appreciable amount of vitamins (A, B) and minerals like, B, Fe, I, Mg [12]. It has also with medicinal values. It contains medicinal properties Prevent Cancer and heart diseases and white eggplant or brinjal is said to be beneficial to diabetic patients.

In Bangladesh, vegetable production is uniform round the year. Most of the vegetable are produced in the winter. Among the vegetables, eggplant is very important. Eggplant is the most important vegetable crop in respect of total acreage (50415 ha) and production (504817 ton) in Bangladesh with an average yield of 10.00 tons per hectare, which is very low as compared to that other producing countries. The yield is quite low as compared to those advance country. One of the major reasons for low yield in Bangladesh is bacterial wilt disease [13]. A report from India reveals that bacterial wilt can causes 27% losses eggplant [14]. To causal organism resistant rootstock is an effective technology to prevent the bacterial wilt. A report from Bangladesh indicated that grafting of eggplant on resistant rootstocks to present bacterial wilt [15]. Grafting is an ideal technique for vegetable production because scions with desirable fruit-producing traits that are also susceptible to soil-borne disease or climatic pressures can be grafted onto rootstock that is more resistant to these pressures. The resulting union often results in a more productive plant. Proper grafting practice may lead to the production of relatively large size fruit, increase yield, early harvest, and longest time of harvesting of fruits and conveniences in intercultural operation less damage to the fruit or plants. But in Bangladesh, majority of the grower do not get

high quality fruit and high yield because of their ignorance about proper grafting technology practices. In a fertile soil with favorable condition, eggplants particularly grow continuously and produce large number of fruit. In this case, appropriate grafting method is necessary because to increase the yield and quality fruit of eggplant. Eggplant can be severely pruned without affecting the yield [16]. Grafting can reduce cost of production root-knot, increase the yield and improve the fruit quality of fruit. Therefore, the present investigation was undertaken to study the effect of grafting compatibility of different rootstock with different scion for eggplant production as well to find out the best combination of effect of grafting compatibility of different rootstock with different scion to maximize the yield quality eggplant.

Materials and Methods

The field experiment was conducted at Olericulture Division, Horticulture Research Centre, Bangladesh Agricultural Research Institute, BARI, Joydebpur, Gazipurduring 3 October, 2017 to 05 April 2018. The experimental field was at 23.99N Latitude and 90.41 E Longitudes having an elevation of 8.2 m from sea level. The seeds were sown in seed bed on 16 October, 2017 at 10 mm depth and nine to eleven days-old healthy plant were transplanted in experimental poly bag on 16 October, 2017. The grafting technology was conducted by cleft method for selecting treatment variety for six eggplant scions (BARI Begun-4, BARI Begun-9, BARI Hybrid Begun-2, BARI Hybrid Begun-4, BARI BtBegun-2, BARI BtBegun-4) were grafted onto four eggplant root stock (*S. sisymbriifolium*, BARI Begun-8, BARI Begun-10 and EgN 203) for interspecific grafting. For control 6 six eggplant scions were planted without grafting. Fifty days-old healthy grafting plant were transplanted in experimental plots on 25 December, 2017. The experiment was laid out in a RCB design with three replications. The unit plot size was 7.5 × 0.70 m and 10 plants were accommodated in a plot with a plant spacing of 75 cm apart in single row maintaining a row to row distance of 1 m with 50 cm drain. The land was fertilized with cowdung, N, P, K, S, Zn and B @ 10,000 100, 30, 75, 13, 1.5 and 0.8 kg/ha, respectively. One third of the cow-dung and half of P and full of S, Zn and B were applied during final land preparation. Rest of cow-dung and P and 1/3 of K were applied as basal in pit. Entire amount of N and rest of K were applied in four equal installment starting from 20 days after transplanting. Rest three installments were applied at vegetative, flowering and initial fruiting stage. Irrigation, weeding, crop protection measures and other intercultural operations were done following standard practice. Data on number of leaf per plant, leaf length (cm), leaf diameter (cm), plant height at 1st harvest (cm), plant height at last harvest (cm), number of branches/plant, days to 50% flowering (DAT), days to 1st harvest (DAT), days to last harvest (DAT), number of marketable fruit/ plant, average fruit weight (g), weight of fruit per plant (kg), fruit length (cm), fruit diameter (cm), fruit yield (ton/ha), fruit and shoot borer infestation (%) were recorded from five randomly selected plants per germplasm. Plot means for 11 quantitative characters were used for the statistical analysis. The collected data were statistically analyzed using MSTAT-C computer program developed [17]. The differences among the treatment means were evaluated by Least Significant Difference (LSD) test for interpretation of the result.

Results and Discussion

Grafting has proved to be an efficient tool for increasing the yield, disease resistance and quality of a number of vegetable crops [11,18-20]. Ideally, rootstocks should improve the yield and/or quality of the produce. This can be achieved by using rootstocks that have resistance to soil diseases or pests, tolerance to abiotic stress, selective absorption of available soil nutrients, or that confer a high degree of vigour to the scion [11,20,21]. Here, we have tested the effects of grafting the eggplant cultivars onto different species of rootstocks and have found that improvements in the production of eggplant can be achieved by using this technique. Benefits realized through rootstock grafts often justify the challenges that successful production of grafted plants requires including synchronization and good germination rates of the rootstock and scion, and high rates of graft success and stand establishment after transplant.

For evaluating the vegetative growth and yield performance of thirty treatment following parameters were considered like number of leaf per plant, leaf length (cm), leaf diameter (cm), plant height at 1st harvest (cm), plant height at last harvest (cm), number of branches/ plant, days to 50% flowering (DAT), days to 1st harvest (DAT), days to last harvest (DAT), number of marketable fruit/ plant, average fruit weight (g), weight of fruit per plant (kg), fruit length (cm), fruit diameter (cm), fruit yield (ton/ha), fruit and shoot borer infestation (%).

Number of leaves per plant

The significant differences was observed in number of leaves among the treatments studied (Table 1). Plant of all eggplant treatment grafted and non-grafted started average number leaves 32.23-81.47 days after transplanting. The highest number of leaves in grafted treatment was observed T_3 (81.47) followed by T_1 (78.5), T_6 (75.67), T_5 (71.7) and number of leaves was lowest T_{20} (38.37). The highest leaves in non-grafted treatment was observed T_{29} (44.13) followed by T_{30} (43.5), T_{28} (42.43) and number of leaves was lowest T_{25} (32.23).

Leaf length (cm)

Plant of all eggplant treatment grafted and non-grafted started average leaf length (cm) 11.97-17.57 days after transplanting. The highest leaf length in grafted treatment was observed T_6 (17.57 cm) followed by T_{21} (16.03 cm), T_4 (16.17 cm), T_{17} (12.97 cm) and leaf length was lowest T_{14} (12.1 cm). The highest leaf length in non-grafted treatment was observed T_{28} (16.47 cm) followed by T_{27} (16.07 cm) and leaf length was lowest T_{25} (12.57 cm) followed by T_{26} (13.97 cm).

Leaf diameter (cm)

Plant of all eggplant treatment grafted and non-grafted started leaf diameter (cm) 6.83-11.17 days after transplanting. The highest leaf diameter in grafted treatment was observed T_{21} (10.63 cm) followed by T_{16} (10.43 cm) and leaf diameter was lowest T_{14} (6.83 cm). The highest leaf diameter in non-grafted treatment was observed T_{28} (11.17 cm) followed by T_{27} (10.83 cm), T_{30} (9.83 cm) and leaf diameter was lowest T_{29} (6.53 cm).

Plant height at 1st harvest (cm)

Plant of all eggplant treatment grafted and non-grafted started Plant height at 1st harvest (cm) 33.23-58.7 days after transplanting. The highest plant height at 1st harvest in grafted treatment was observed T_3 (58.7 cm) followed by T_5 (58.43) cm, T_{21} (54.33 cm) and Plant height at 1st harvest was lowest T_{12} (34.43 cm) followed by T_{14} (38.93 cm). Plant height at 1st harvest in non-grafted treatment was observed T_{30}

(42.13 cm) followed by T_{26} (41.12 cm) and Plant height at 1st harvest was lowest T_{25} (33.23 cm).

Plant height at last harvest (cm)

Plant of all eggplant treatment grafted and non-grafted started Plant height at last harvest (cm) 62.1-86.77 days after transplanting. The highest Plant height at last harvest in grafted treatment was observed T_1 (86.77 cm) followed by T_5 (84.93 cm), T_3 (83.27 cm) and Plant height at last harvest was lowest T_{16} (62.1 cm). Plant height at last harvest in non-grafted treatment was observed T_{27} (76.77 cm) followed by T_{25} (73.43 cm), T_{30} (73.17 cm) and Plant height at last harvest was lowest T_{26} (69.8 cm).

Number of branches/ plant

Plant of all eggplant treatment grafted and non-grafted started branches per plant 26.47-38.77 days after transplanting. Branches per plant in grafted treatment was observed T_{21} (38.77/plant) followed by T_1 (35.37/plant), T_5 (35.67/plant) and Branches per plant was lowest T_{12} (26.47/plant). Branches per plant in non-grafted treatment was observed T_{27} (35.13/plant) followed by T_{29} (33.03/plant) and branches per plant was lowest T_{26} (29.27/plant) in Table 1.

Treatment	Number of leaves/ plant	Leaf length (cm)	Leaf diameter (cm)	Plant height at 1st harvest (cm)	Plant height at last harvest (cm)	Branches/ plant
T_1 (B8+B4)	78.5 ab	13.4 i-l	9.3 d-g	52.97 b	86.77 a	35.37 b-d
T_2 (B8+B9)	60.43 de	13 i-m	8.9 f-h	53.03 b	77.4 e-i	32.73 e-j
T_3 (B8 +H2)	81.47 a	13.03 i-m	7.9 ij	58.7 a	83.27 a-d	34.53 b-f
T_4 (B8+H4)	62.03 d	16.17 bc	9.83 cd	50.9 bc	73.8 i-l	33.13 d-i
T_5 (B8+Bt 2)	71.7 c	14.4 f-h	7.97 ij	58.43 a	84.93 ab	35.67 bc
T_6 (B8+Bt 4)	75.67 b	17.57 a	9.3 d-g	52.97 b	81.4 b-e	34.37 b-f
T_7 (Si+B4)	62.67 d	11.97 n	9.03 e-h	42.43 f-j	74.1 h-l	28.63 mn
T_8 (Si+B9)	46.47 i-l	12.83 j-n	9.23 d-h	51.63 bc	79.57 c-f	32.57 f-j
T_9 (Si+H2)	46.3 i-l	15.4 cde	9.73 c-e	53.77 b	75.63 f-k	34.13 b-g
T_{10} (Si+H4)	55.83 fg	15.07 d-f	9.3 d-g	53.03 b	71.1 k-m	30.9 i-m
T_{11}(Si+Bt2)	53.53 gh	12.77 j-n	7.5 jk	43.83 e-h	74.13 h-l	30.9 i-m
T_{12} (Si+Bt4)	47.1 ijk	13.53 h-k	9.27 d-g	34.43 lm	65.4 no	26.47 n
T_{13} (B10+B4)	48.57 i	12.43 l-n	7.63 j	53.27 b	72.87 i-l	31.7 g-k
T_{14} (B10+B9)	40.7 o-q	12.1 mn	6.83 kl	38.93 jk	74.8 g-k	29.03 lm
T_{15} (B10+H2)	44.9 j-m	13.13 i-l	9.6 d-f	51.1 bc	74.47 g-k	32.37 f-j
T_{16} (B10+H4)	47.77 ij	14.97 ef	10.43 a-c	48.43 cd	62.1 o	30.67 i-m
T_{17} (B10+Bt2)	52.3 h	12.97 j-m	7.37 jk	46.57 de	73.77 i-l	31.7 g-k
T_{18} (B10+Bt4)	57.5 ef	14.93 e-g	9.6 d-f	43.03 e-i	76.97 e-j	32.77 e-j
T_{19} (EG 203+B4)	41.37 n-q	13.97 g-i	8.45 hi	43.57 e-i	76.1 f-j	30.43 j-m
T_{20} (EG 203+B9)	38.37 q	13.97 g-i	8.57 g-i	46.23 d-f	67.4 mn	30.8 i-m
T_{21} (EG 203+H2)	47.17 ijk	16.03 b-d	10.63 ab	54.33 b	83.73 a-c	38.767 a
T_{22} (EG 203+H4)	58.57 ef	14.97 ef	0.458333333	52.4 b	78.8 d-g	36 b
T_{23} (EG 203+Bt2)	53.53 gh	13.2 i-l	7.9 ij	44.33 e-h	78.467 e-h	33.17 c-i
T_{24} (EG 203+Bt4)	52.37 h	15.03 ef	9.97 b-d	45.77 d-g	73.1 i-l	34 b-g

T_{25} (NG B4)	32.23 r	12.57 k-n	7.37 jk	33.23 m	73.43 i-l	33.47 c-h
T_{26} (NG B9)	34.63 r	13.97 g-i	7.97 ij	34.83 lm	69.8 l-n	29.27 k-m
T_{27} (NG H2)	39.27 pq	16.07 bc	10.83 a	37.33 kl	76.77 f-j	35.13 b-e
T_{28} (NG H4)	42.43 m-p	16.47 b	11.17 a	39.9 i-k	71.3 k-m	31.23 h-l
T_{29} (NG Bt2)	44.13 k-n	13.7 hij	6.53 l	42.13 g-j	72.83 j-l	33.03 d-i
T_{30} (NG Bt4)	43.5 l-o	15 ef	9.83 cd	41.8 h-j	73.17 i-l	33.7 b-h
$LSD_{(0.05)}$	3.24	0.97	0.79	3.81	4.56	2.51
CV (%)	3.81	4.2	5.38	4.98	3.71	4.72

B4	BARI Begun-4	H2	BARI Hybrid Begun-2	Si	*S. sisymbriifolium*
B8	BARI Begun-8	H4	BARI Hybrid Begun-4	NG	Non-Graft
B9	BARI Begun-9	Bt2	BARI Bt Begun-2		
B10	BARI Begun-10	Bt4	BARI Bt Begun-4		

Table 1: Number of leaves/ plant, Leaf length (cm), Leaf diameter (cm), plant height at 1st harvest (cm), plant height at last harvest (cm), branches/ plant of grafting different rootstock with different scion for eggplant production.

Days of 50% flowering

Days to 50% flowering are an important character to choose a good combination of eggplant. Plant of all eggplant treatment grafted and non-grafted started flowering 22.73-45.07 days after transplanting. It is general observation that non grafted plants bloomed earlier than grafted ones. Early flowering was observed in non-grafted plants after 22.73-32.07 days after transplanting. Flowering was late (45.06 days) in T_{19} which is followed by T_9 (41.73 days), T_{15} (41.73 days). The earliest days to 50% flowering was observed in grafted treatment was T_2 (31.73 days) followed by T_5 (32.73 days) and T_{17} (32.67 days). The delayed flower in grafted plants may be due to the growth of the scion was intercepted or slowed for nearly week due to the grafting. Similar trend of delayed flowering in grafted plant were also reported [15].

Days to 1st harvest

Plant of all eggplant treatment grafted and non-grafted started 1st harvest 53.87-72.87 days after transplanting. It was observed that non grafted plants 1st harvest fruit earlier than grafted ones. Early 1st harvest was done in non-grafted plants after 53.87 days in T_{26} followed by T_{28} (56.83 days). In case of grafted treatments; earlier 1st harvest was T8 (60.20 days), T_5 (61.33 days), T_3 (62.03 days) and T_{16} (63.03 days). The delayed 1st harvest in grafted plant was observed in T_{15} (72.87 days) followed by T_{20} (72.83 days), T_{23} (72.07 days) and T_{15}(72.87 days). In this study it is clearly discussed that non grafted plants was earlier harvested compare to grafted plants. It is due to the delayed flowering in grafted plant, reported [15].

Days to last harvest

Days to last harvest showed significant difference among the different treatments (Table 2). Plant of all eggplant treatment of grafted and non-grafted started last harvest during 108.6-128.4 days after transplanting. It was observed that days to last harvest of non-grafted plants were earlier than grafted ones. Earliest last harvest was observed in non-grafted plants after (108.6 days) in T_{28} and later last harvest was in T_{25} (118.6 days). The earliest days to last harvest was observed in grafted treatment was T_{18} (118.47 days), followed by T_{10} (118.53 days) and later last harvesting gra ted plant was observed in T_{12} (129.87 days) followed by T_{22} (128.4 days), T_5 (127.2 days), T_{15} (127.6 days).

Treatment	Days of 50% flowering	Days to 1st harvest	Days to last harvest
T_1 (B8+B4)	35.07ij	68.07 fg	125.33 b-f
T_2 (B8+B9)	31.73 l	65.87 gh	126.2 a-e
T_3 (B8 +H2)	39 cde	62.03 i-k	120.8 ij
T_4 (B8+H4)	39.73cd	66.07 gh	121.53 g-j
T_5 (B8+Bt 2)	32.73kl	61.33 jk	127.2 a-d
T_6 (B8+Bt 4)	39.73 cd	69.37 d-f	121.6 g-j

T_7 (Si+B4)	36.33 g-i	68.23 e-g	121.47 g-j
T_8 (Si+B9)	35.07 ij	61.20jk	123.4 e-i
T_9 (Si+H2)	41.73 b	70.77 a-e	124.9 b-g
T_{10} (Si+H4)	37.0fgh	68.5 e-g	118.53 jk
T_{11}(Si+Bt2)	34.73 ij	64.67 hi	123.4 e-i
T_{12} (Si+Bt4)	33.73 jk	67.87 fg	129.87 a
T_{13} (B10+B4)	37.73 e-g	71.17 a-d	121.5 g-j
T_{14} (B10+B9)	34.67 ij	67.6 fg	123 e-i
T_{15} (B10+H2)	41.73 b	72.87 a	127.6 a-c
T_{16} (B10+H4)	34.73 ij	63.03 ij	123.67 d-i
T_{17} (B10+Bt2)	32.67 kl	70.2 b-f	124.9 b-g
T_{18} (B10+Bt4)	35.73 hi	60.77 jk	118.47 jk
T_{19} (EG 203+B4)	45.07 a	69.6 c-f	125.6 b-f
T_{20} (EG 203+B9)	40.73 bc	72.83 ab	124.5 c-h
T_{21} (EG 203+H2)	38.33 d-f	68.17 e-g	125.6 b-f
T_{22} (EG 203+H4)	40.33 b-d	68.4 e-g	128.4 ab
T_{23} (EG 203+Bt2)	39.73 cd	72.07 a-c	122.03 f-j
T_{24} (EG 203+Bt4)	40.07 b-d	68.97 d-f	121.2 h-j
T_{25} (NG B4)	24.73 o	60.1 k	118.6 jk
T_{26} (NG B9)	22.73 p	53.87 m	110.8 mn
T_{27} (NG H2)	29.73 m	62.17 ij-	115.43 kl
T_{28} (NG H4)	25.73 no	56.83 l	108.6 n
T_{29} (NG Bt2)	26.67 n	69.8 c-f	115.3 kl
T_{30} (NG Bt4)	32.07 kl	59.7 k	114.4 lm
$LSD_{(0.05)}$	1.82	2.66	3.67
CV (%)	3.13	2.46	1.85

Table 2: Days of 50% flowering, days to 1st harvest, days to last harvest of grafting different rootstock with different scion for eggplant production.

Number of marketable fruit/plant

Plant of all eggplant treatment grafted and non-grafted started number of marketable fruit per plant 8.07-28.98 days after transplanting. The highest marketable fruit in grafted treatment was observed T_4 (28.97 fruit/plant) followed by T_1 (26.9 fruit/plant), T_5 (26.47 fruit/plant), T_{16} (24.43 fruit/plant), T_{17} (23.77 fruit/plant) and marketable fruit was lowest T_{26} (8.17 fruit/plant) followed by T_{28} (9.0 fruit/plant), while the highest marketable fruit in non-grafted treatment was observed T_{29} (23.7 fruit/plant) and marketable fruit was lowest T_{26} (8.07 fruit/plant) followed by T_{28} (12.97 fruit/plant).

Average fruit weight (g)

Plant of all eggplant treatment grafted and non-grafted started average fruit weight (g) 106.83-321.47 g. The average fruit weight in grafted treatment was observed T_6 (321.47 g) followed by T_{18} (266.47 g), T_{12} (236.47), T_{24} (201.47 g) and average fruit weight was lowest T_{10} (106.83 g) followed by T_4 (107.63 g), T_{11} (111.5 g), T_{22} (112.33 g), T_5 (112.66 g), T_{23} (120.47 g), T_7 (122.67 g), T_1 (123.3 g), while the highest average fruit weight in non-grafted treatment was observed T_{30} (221.47 g) followed by T_{26} (138.67 g), T_{25} (128.83 g) and average fruit weight was lowest T_{28} (109.3 g) followed by T_{29} (112.1 g).

Weight of fruit per plant (kg)

Plant of all eggplant treatment grafted and non-grafted started Weight of fruit (kg/plant) 1.12-3.34 days after transplanting. Maximum weight of fruit in grafted treatment was observed in T_6 (3.34 kg/ plant), T_1 (3.31 kg/ plant), T_4 (3.15 kg/plant) and fruit weight was lowest T_8 (1.39 kg/ plant) followed by T_9 (1.69 kg/ plant), T_{20} (1.59 kg/plant), T_{22}

(1.81 kg/plant). The highest Weight of fruit kg/plant in non-grafted treatment was observed T_{30} (2.97 kg/plant) followed by T_{29} (2.68 kg/plant) and Weight of fruit kg/plant weight was lowest T_{26} (1.12 kg/plant) followed by T_{27} (1.42 kg/plant), T_{27} (1.98 kg/plant).

Fruit length (cm)

Plant of all eggplant treatment grafted and non-grafted started average fruit length (cm) 7.83-16.9 days after transplanting. The highest fruit length in grafted treatment was observed T_5 (16.7 cm) followed by T_{17} (16.3 cm), T_3 (15.9 cm), T_{13} (15.9 cm), T_{23} (15.7 cm) and fruit length was lowest T_8 (7.83 cm) followed by T_{10} (7.9 cm), T_{14} (8.3 cm), T_{22} (8.8 cm), T_{10} (8.9 cm). The highest fruit length in non-grafted treatment was observed T29 (16.9 cm) followed by in T25 (16.3 cm), T_{30} (12.03 cm) and fruit length was lowest T_{26} (8.5 cm) followed by T_{28} (9.4 cm).

Fruit diameter (cm)

Plant of all eggplant treatment grafted and non-grafted started fruit length (cm) 3.33-10.13 days after transplanting. The highest fruit diameter in grafted treatment was observed T_{24} (10.23 cm) followed by T_{12} (10.13 cm) and fruit diameter was lowest T_7 (3.33 cm) followed by T_{19} (3.43 cm), T_1 (3.73 cm), T_{17} (4.23 cm). The highest fruit diameter in non-grafted treatment was observed T_{30} (10.03 cm) followed by T_{28} (6.63 cm), T_{27} (6.13 cm) and fruit diameter was lowest T_{25} (3.53 cm) followed by T_{29} (4.23 cm) (Table 3).

Treatment	Number of marketable fruit/ plant	Average Fruit weight (g)	Weight of fruit (kg/plant)	Fruit length (cm)	Fruit diameter (cm)
T_1 (B8+B4)	26.9 ab	123.3 m-o	3.313bc	15.9 a-d	3.73 n
T_2 (B8+B9)	16.37 g-j	147.17 fg	2.43 f-h	8.7 i-l	5.67 i
T_3 (B8 +H2)	17.47 f-i	132.83 i-l	2.35 f-i	15.9 a-d	6.43 f
T_4 (B8+H4)	28.98 a	107.63 r	3.15 b-e	9.8 h	6.83 d
T_5 (B8+Bt 2)	26.47 a-c	112.63 p-r	2.97 c-e	16.7 ab	4.33 l
T_6 (B8+Bt 4)	10.38 m-p	321.47 a	3.34bc	11.97 g	10.43 a
T_7 (Si+B4)	17.83 f-h	122.67 no	2.19 g-j	15.4 c-e	3.33 p
T_8 (Si+B9)	10.03 n-p	137.67 h-k	1.39 lm	7.83 l	5.03 k
T_9 (Si+H2)	13.17 k-m	127.17 l-n	1.69 j-l	15.26 c-e	6.03 h
T_{10} (Si+H4)	19.07 fg	106.83 r	2.04 h-k	8.9 h-k	6.43 f
T_{11} (Si+Bt2)	19.5 ef	111.5 qr	2.19 g-j	15.5 c-e	4.13 m
T_{12} (Si+Bt4)	8.17 p	236.47 c	1.94 h-k	12.1 g	10.13 bc
T_{13} (B10+B4)	22.77 d	140.67 f-j	3.22 b-d	15.9 a-d	3.53 o
T_{14} (B10+B9)	12.17 l-n	149.3 f	1.82 j-l	8.3 kl	5.43 j
T_{15} (B10+H2)	14.87 i-l	126.47 l-n	1.89 i-l	14.73ef	6.13 gh
T_{16} (B10+H4)	24.43 b-d	112.33 p-r	2.74 d-f	9.57 hi	6.53 ef
T_{17} (B10+Bt2)	23.77 cd	114.47 o-r	2.73 d-f	16.3 a-c	4.23 m
T_{18} (B10+Bt4)	9.0 op	266.47 b	2.41 f-h	12.5 g	10.03 c
T_{19} (EG 203+B4)	19.8 ef	139.63 g-j	2.79 d-f	14.9 d-f	3.43 op
T_{20} (EG 203+B9)	11.17 m-o	141.47 f-i	1.59 k-m	7.9 kl	5.03 k
T_{21} (EG 203+H2)	14.37 j-l	131.97 j-m	1.89 i-l	13.87 f	6.23 g
T_{22} (EG 203+H4)	16.03 h-k	112.33 p-r	1.81 j-l	8.8 h-l	6.43 f
T_{23} (EG 203+Bt2)	22.07 de	120.47 n-q	2.67 e-g	15.7 b-e	4.23 m
T_{24} (EG 203+Bt4)	9.17 op	201.47 e	1.86 i-l	12.1 g	10.23 b
T_{25} (NG B4)	18.1 f-h	128.83 k-n	2.35 f-i	16.3 a-c	3.53 o
T_{26} (NG B9)	8.07 p	138.67 g-j	1.12 m	8.5 j-l	5.33 j
T27 (NG H2)	16.2 g-j	121.47 n-p	1.98 h-k	15.7 b-e	6.13 gh

T_{28} (NG H4)	12.97 l-n	109.3 r	1.42 lm	9.4 h-j	6.63 e
T_{29} (NG Bt2)	23.7 cd	112.1 qr	2.68 e-g	16.9 a	4.23 m
T_{30} (NG Bt4)	13.17 k-m	221.47 d	2.97 c-e	12.03 g	10.03 c
$LSD_{(0.05)}$	2.97	9.26	0.51	1.06	0.2
CV (%)	10.67	3.86	13.22	5.07	2.02

Table 3: Number of marketable fruit/ plant, average fruit weight (g), weight of fruit, fruit length, and fruit diameter of grafting different rootstock with different scion for eggplant production.

Fruit yield (t/ha)

The yield of marketable fruit per plot was converted into per hectare basis and was expressed in tones. Different grafted and non-grafted treatment significantly influenced the yield of production fruit per hectare (Figure 1). The highest yield (36.77 t/ha) was recorded in T_6 treatment and the lowest yield (12.37 t/ha) was found from T_{26}. The significant highest fruit yield (36.77 t/ha) was produced by T_6 closely followed by T_1 (36.43 t/ha), T_{13} (35.35 t/ha), T_4 (34.56 t/ha), T_5 (32.69 t/ha), T_{19} (30.69 t/ha) in,T17 (30.07 t/ha), while lowest fruit yield was recorded (12.37 t/ha) was produced by T_{26} followed by T_8 (15.32 t/ha), T_{28} (15.61 t/ha). Among 24 grafted treatments, eight treatments produced more than 30 t/ha, 4 grafted treatment produced more than 25 t/ha, six grafted treatment produced more than 20 t/ha and out of 6 non-grafting treatment one treatment produce more than 30 t/ha, three treatments produced 20 t/ha yield. So, these eight high yielding treatments may be selected considering higher yield.

In compare of rootstock, rootstock BARI Begun-8 and BARI Begun-10 produced more than 30 t/ha in four combinations, rootstock EG203 produced more than 30 t/ha in one combination, while *S. sisymbriifolium* produce none for more than 30 t/ha. BARI Begun-8 produced good yield rather than BARI Begun-10.

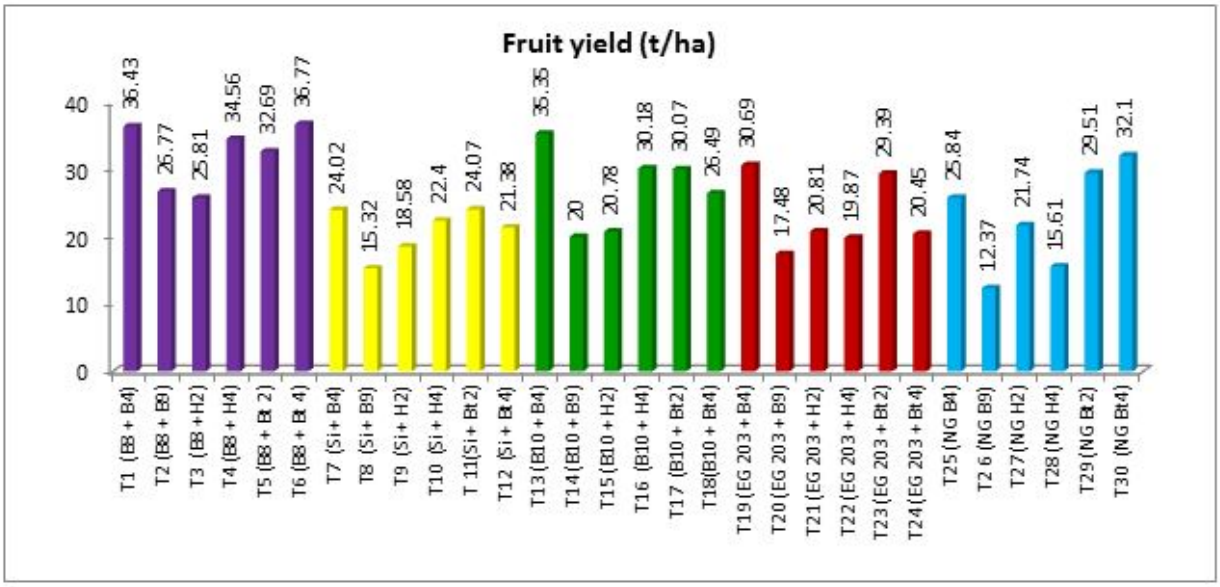

Figure 1: Yield (t/ha) of different eggplant scion with different rootstock.

Fruit and shoot borer infestation (%)

Though the incidence of eggplant Fruit and Shoot Borer (FSB) infestation is lower during winter season compare to summer season, but significant amount of infestation was noticed in the study. Minimum infestation by FSB was observed in T_7 (4.93%), while the overall infestation (%) rate was 4.33-27.37. Less than 14% was recorded T_1-T_{20} except T_{18} which is a very optimistic to select good treatment (Figure 2).

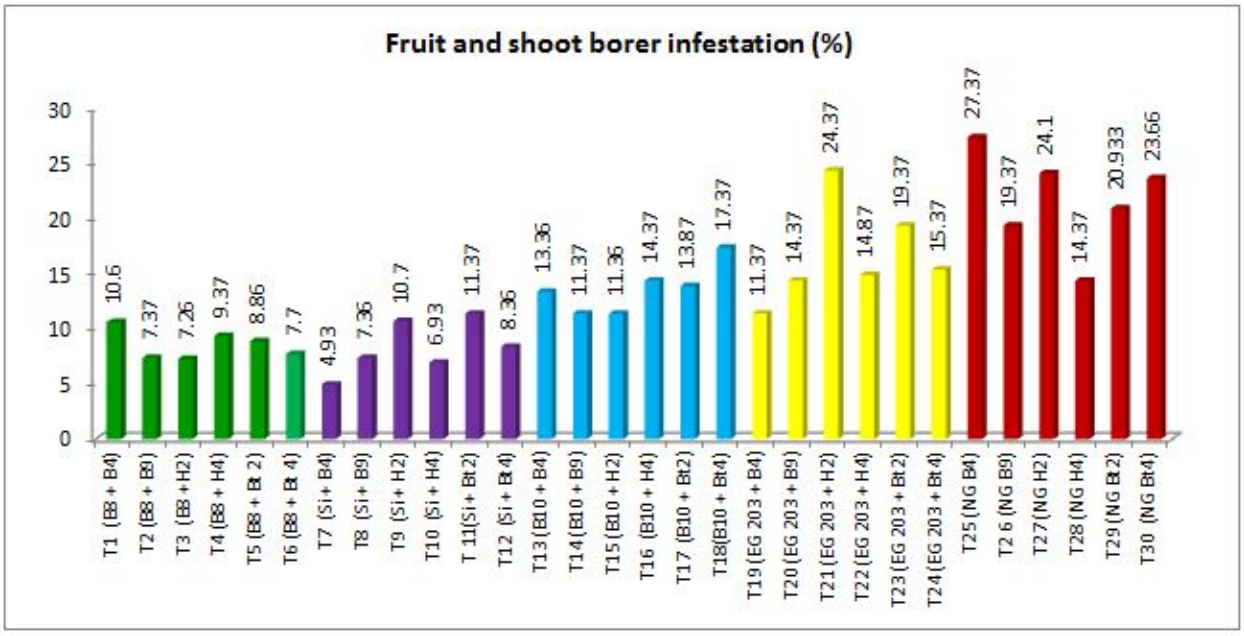

Figure 2: Fruit and shoot borer infestation (%) of different eggplant scion with different rootstock.

Conclusion

Among the thirty treatments, it could be concluded that eggplant can be grafted on different rootstock viz., BARI Begun-8, BARI Begun-10 and EgN203, *S. sisymbriifolium* with several desired scions viz., BARI Begun-4, BARI Begun-9, BARI Hybrid Begun-2, BARI Hybrid Begun-4, BARI Bt Begun-2, BARI Bt Begun-4. Among the 24 grafted treatments, eight treatments viz., T_6 (36.77 t/ha), T_1 (36.43 t/ha), T_{13} (35.35 t/ha), T_4 (34.56 t/ha), T_5 (32.69 t/ha), T_{19} (30.69 t/ha) in, T_{17} (30.07 t/ha) produced more than 30 t/ha. So, these eight high yielding treatments may be selected considering higher yield. Among the grafted and non- grafted eggplant treatments, T_6 (36.77 t/ha), T_1 (36.43 t/ha), T_{13} (35.35 t/ha), T_4 (34.56 t/ha), T_5 (32.69 t/ha), T_{19} (30.69 t/ha), T_{17} (30.07 t/ha) were the highest yielder. In compare of rootstock, better performance was observed in BARI Begun-8 rootstock while grafted with 4 scions viz., BARI Begun-4 (36.43 t/ha), BARI Hybrid Begun-4 (34.56 t/ha), BARI Bt Begun-2 (32.69 t/ha), BARI Bt Begun-4 (36.77 t/ha). However, the study was for one season experiment. So, to draw a conclusion it is needed to conduct this experiment in another season.

References

1. Rivero RM, Ruiz JM, Romero L (2003) Role of grafting in horticultural plants under stress conditions. J Food Agric Environ 1: 70-74.
2. Venema JH, Dijk BE, Bax JM, Hasselt P, Elzenga JTM (2008) Grafting tomato (*Solanum lycopersicum*) onto the rootstock of a high-altitude accession of Solanum habrochaites improves sub-optimal temperature tolerance. Environ Exp Bot 63: 359-367.
3. Pulgar G, Villora G, Moreno DA, Romero L (2000) Improving the mineral nutrition in grafted watermelon plants: nitrogen metabolism. Biol Plant 43: 607-609.
4. Colla G, Suarez CMC, Cardarelli M, Rouphael Y (2010) Improving nitrogen use efficiency in melon by grafting. Hort Sci 45: 559-565.
5. Rouphael Y, Cardarelli M, Colla G, Rea E (2008) Yield, mineral composition, water relations, and water use efficiency of grafted mini watermelon plants under deficit irrigation. Hort Sci 43: 730-736.
6. Otani T, Seike N (2007) Rootstock control of fruit dieldrin concentration in grafted cucumber (*Cucumissativus*). J Pestic Sci 32: 235-242.
7. Colla G, Rouphael Y, Cardarelli M, Salerno A, Rea E (2010) The effectiveness of grafting to improve alkalinity tolerance in watermelon. Environ Exp Bot 68: 283-291.
8. Martinez-Rodriguez MM, Estan MT, Moyano E, Garcia-Abellan JO, Flores FB, et al. (2008) The effectiveness of grafting to improve salt tolerance in tomato when an 'excluder' genotype is used as scion. Environ Exp Bot 63: 392-401.
9. He Y, Zhu Z, Yang J, Ni X, Zhu D (2009) Grafting increases the salt tolerance of tomato by improvement of photosynthesis and enhancement of antioxidant enzymes activity. Environ Exp Bot 66: 270-278.
10. Savvas D, Colla G, Rouphael Y, Schwarz D (2010) Amelioration of heavy metal and nutrient stress in fruit vegetables by grafting. Sci Hort 127: 156-161.
11. Davis AR, Perkins-Veazie P, Hassell R, Levi A, King SR, et al. (2008) Grafting effects on vegetable quality. Hort Sci 43: 1670-1672.
12. Bose TK, Som MG (1990) Vegetable Crops in India. National Library of Australia.
13. Anonymous (2017) Bangladesh Bureau of Statistics. Ministry of Planning, Government of Peoples Republic of Bangladesh.
14. Peddy P (1986) Analysis of crop losses in certain vegetables due to *meloidogyneincognita*. Int Nematol Net New let 3: 3-5.
15. Ali M, Alam MZ, Akanda MAM (1994) Grafting: A technique of control soil-borne diseases of tomato and eggplant. Studies in Agriculture.
16. Rahman MA, Rashid MA, Hossain MM, Salam MA (2002) Performance of some gra ted eggplant genotypes on wild Solanum root stocks against root-knot nematode. Bangladesh Agriculture Research Institute.
17. Russel DF (1986) MSTAT-C package Programme. Crop and Soil Science Department.
18. King SR, Davis AR, Liu W, Levi A (2008) Grafting for disease resistance. Hort Sci 43: 1673-1676.

19. King SR, Davis AR, Zhang X, Crosby K (2010) Genetics, breeding and selection of rootstocks for *Solanaceae* and *Cucurbitaceae*. Sci Hort 127: 106-111.

20. Lee JM (1994) Cultivation of grafted vegetables: current status, grafting methods and benefits. Hort Sci 29: 235-239.

21. Lee JM, Oda M (2003) Grafting of herbaceous vegetable and ornamental crops. Hort Rev 28: 61-124.