

Original Research Article

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## Characterization of *Solanum spp* for Grafting and its Interpretation on Morphological, Production and Nutritional Quality of Fruit Under Polyhouse

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### ABSTRACT

Seven wild *Solanum* species (viz., *S. torvum*, *S. macrocarpon*, *S. incanum*, *S. aethiopicum*, *S. sisymbriifolium*, *S. viarum*, and *S. indicum*) were grafted onto three brinjal scions (viz., Patakata, PusaShyamla, and Bhangor) for its evaluation based on compatibility ratio and further characterization of successful graft combination for morphological, yield and quality attributing characters. On persual of grafting success percentage, Patakata and PusaShyamla grafted onto *S. torvum* had high compatibility and success rate. The species *S. torvum* exhibited better adaptability to the prevailing climate which led to more success indicating their compatibility. Complete failure on grafting was noticed in the species *S. aethiopicum*, *S. indicum*, and *S. sisymbriifolium*. The vegetative parameters were found to be maximum from the grafting combination of Patakata onto *S. torvum*, wherein PusaShyamla grafted onto *S. torvum* and *S. macrocarpon* exhibited high yield attributing characters and crop duration. Given quality parameters, the maximum values were attained from the combination of PusaShyamla and Patakata onto *S. torvum*.

#### Keywords

Grafting, *Solanum melongena*, compatibility, morphological, quality and yield

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### Introduction

In India, West Bengal holds the highest area under brinjal cultivation i.e., 162.93 lakh hectares (NHB 2018-19, 3<sup>rd</sup> Adv.Est.) with an annual production of 3019.00 MT. Currently,

the production of brinjal is declining due to invasion by numerous pests and diseases which is not at par to feed the increasing population. Constant and repeated use of fungicides, insecticides, bactericides, and nematicides tends to pose ecological threats

warranting safe disease management practices. At present grafting is regarded as a rapid additive tool to the relatively slow breeding methodology which is aimed at increasing environmental stress tolerance of fruit vegetables in a short duration. In addition to widely recognized advantages of disease tolerance and high crop yields, grafting technology is also highly effective in ameliorating crop losses caused by adverse environmental conditions such as low soil temperature and high salinity, especially under-protected cultivations where successive cropping or continuous farming is routinely practiced (Schwarza *et al.*, 2010). Through the years, research in *Solanum* has been progressing in diverse disciplines. Thus, owing to the importance of brinjal cultivation in India and the beneficial effects incurred by grafting over wild rootstock, the present investigation entitled "Characterization of *Solanum spp* for grafting and its interpretation on morphological, production and nutritional quality of fruit under polyhouse".

## **Materials and Methods**

Based on the performance of grafting success and days to graft union, the four probable rootstocks were selected and raised in a completely randomized block design with three replications using the cleft grafting method (Fig-1). Eight graft combinations using four rootstocks along with the two scions (non-grafts) were evaluated and five healthy plants of each treatment were tagged for recording data on morphological, flowering, yield, and quality parameters. Thirty days old grafts were transplanted on the raised beds with a spacing of 75 × 60 cm from polybags without damaging the ball of earth. Totally twenty plants were maintained in each treatment per replication. A fertilizer dose of 100: 80: 50 kg of NPK per hectare was applied. No plant protection measures were adopted during the cropping period and only

weeding and irrigation were undertaken. The mean data of selected plants in each replication for each genotype were subjected to analysis of variance appropriate for (CRD) completely randomized design (Panse and Sukhatme, 1957).

TSS was determined by a digital refractometer and expressed in °Brix. Total sugars were estimated as per (Dubois *et al.*, 1956). Anthocyanin content in the peel of the fruit was estimated spectrophotometrically by taking peel tissue (Srivastava and Kumar, 2002). Fresh fruits were collected from the third harvesting of the crop from each genotype in each replication. For estimation of vitamin C, the procedure proposed by (Sadasivam and Balasubraminan, 1987) was followed. Vitamin-C (mg/100g) content was measured as  $(\text{Dye Factor Value} \times \text{Titrant Value} \times \text{Volume make up} \times 100) / (\text{Aliquot} \times \text{Weight of the sample})$ , where, Dye Factor Value = 0.5/ Titrant reading (ml).

## **Results and Discussion**

### **Days to germination and germination percentage**

Based on the performance of different species, *S. torvum* (T3) took a minimum (8.75 days) to germinate followed by *S. macrocarpon* (T1) (10.57 days), however the maximum number of days for germination were recorded from *S. viarum* (T5) (42 days) (Table-1). Concerning to germination percentage at 15 DAS, the maximum values was obtained from *S. macrocarpon* (T1) (85.89 %) and *S. torvum* (T3) (80.99%), whereas at 25 DAS, *S. sisymbriifolium*(T2) had the highest germination percentage (87.26%) next to *S. macrocarpon* (T1) (91.78 %). On perusal of different species, *S. sisymbriifolium* though germinated later than *S. torvum* picked up its germination percentage equivalent to its predecessors at 25 DAS. Similar findings were

reported by (Ibrahim *et al.*, 2001) who revealed that *S. sisymbriifolium* had the highest germination percentage compared to other wild *Solanum* species in the later stages of a crop growth cycle.

### **Days for the graft union**

Among the seven rootstocks used for grafting, the species *S. torvum* took the least number of days for graft union with Patakata (T<sub>1</sub>) (10.20 days) followed by PusaShyamla (T<sub>8</sub>) (11.04 days) and Bhangor (T<sub>15</sub>) (11.95 days) whereas, *S. sisymbriifolium* took maximum number of days for union with Bhangor (T<sub>21</sub>) (24.05 days) through cleft grafting method (Table-2). This is a characteristic of graft-rootstock incompatibility, which contributes to poor vascular connection with poor connecting sieve tubes, cambium, and xylem in tomato on pepper and pepper on tomato grafts (Kawaguchi *et al.*, 2008).

### **Grafting success percentage**

Among all the grafts combination, Patakata grafted onto *S. torvum*(T<sub>1</sub>) recorded the highest success percentage of 91.33 per cent on 15<sup>th</sup> DAG, 82.22 percent on 30<sup>th</sup> DAG and 77.20 percent on 45<sup>th</sup> DAG (Table-2). The species *S. torvum* had better adaptability to the prevailing climate which led to more success and the cleft grafting method suited more for this species, which is in agreement with the report of Feng *et al.*, (2000). The lowest success percentage of (22.11 percent) at 15<sup>th</sup> DAG, (0.00 percent) at 30<sup>th</sup> DAG, and (0.00 percent) at 45<sup>th</sup> DAG was recorded from the graft combination of Bhangor onto *S. viarum*(T<sub>19</sub>). Complete failure on grafting was noticed in the species *S. aethiopicum*, *S. indicum* and *S. sisymbriifolium* with three brinjal scions at 45DAG which be due to lack of cellular recognition, wounding responses, presence of growth regulators or incompatible toxins, or an unfavorable grafting environment

which is in agreement with (Davis *et al.*, 2008). Among the three brinjal scions employed in this study, PusaShyamla and Patakata showed relatively higher grafting success compared to Bhangor.

### **Evaluation of grafts for growth, yield and qualitative parameters**

Based on the performance of grafting success and days to graft union, the probable rootstocks *viz.*, *S. torvum*, *S. macrocarpon*, *S. incanum* and *S. viarum* and two scions *viz.*, Patakata and PusaShyamla were selected and used for the study of morphological, production, and quality characters.

### **Vegetative parameters**

The pooled data revealed that Patakata grafted on *S. torvum* was found to be the best for plant height, the number of leaves and total number of branches at different stages of plant growth. The grafted plants exhibited no significant difference for vegetative parameters. Among all the graft combinations, the two non-grafts, Patakata recorded the highest plant height (17.05, 38.12, 71.72, and 85.32 cm at 30, 60, 90, 120 DAT) whereas, the lowest plant height (12.71, 34.02, 66.91, and 73.77 cm at 30, 60, 90, 120 DAT) was recorded from graft combination of PusaShyamla and *S. viarum* (Table-3). It has been reported that the plant hormones are important endogenous factors that regulate all aspects of vegetative growth in root-shoot communication (Aloni *et al.*, 2010) The low performance of other scion-rootstock compared to Patakata grafted onto *S. torvum* rootstock is justified by unsuitable graft relations that can induce undergrowth or overgrowth of the scion, which can lead to decreased water and nutrient flow through the graft union (Martinez-Ballesta *et al.*, 2010). The maximum number of leaves at different stages of crop growth *viz.*, (31.98, 83.06, 141.99 and 144.81 at 30, 60, 90, 120 DAT)

was obtained from graft combination of Patakata and *S. torvum*, which was statistically at par with PusaShyamla grafted onto *S. torvum* and *S. macrocarpon* (Table-3).

When compared to non-grafted plants, maximum number of total branches per plant was registered from Patakata grafted onto *S. torvum* (5.02, 11.85, 14.67 and 16.78 at 30, 60, 90, 120 DAT) and *S. macrocarpon*. The vigorous root system of the rootstock enhanced better growth of scion which resulted in more number of branches in grafted plants (Davis *et al.*, 2006). Grafting caused an increase in leaf area and leaf area index wherein Patakata grafted onto *S. torvum* recorded the highest leaf area index of (2.29) followed by PusaShyamla grafted onto *S. torvum* (2.24) (Table-4).

### **Flowering and fruiting parameters**

The number of flowers was significantly influenced by different graft combinations during the experimental years. The maximum number of flowers per plant at different stages of plant growth was registered from PusaShyamla grafted onto *S. torvum* (11.69, 94.29, 78.33, and 47.82 at 30, 60, 90, and 120 DAT) wherein Patakata grafted onto *S. viarum* recorded minimum number of flowers at different growth stages (7.00, 72.75, 65.92, 37.00 at 30, 60, 90 and 120 DAT) (Table-4).

These results agreed with the findings of Eltayb *et al.*, (2013) who reported that grafting has the ability to influence and change leaf and flowers morphology of eggplant and pepper. Days to first fruit set and days to the first harvest is directly influenced by earliness in flowering where non-grafts PusaShyama and Patakata started to set fruit within 58.87 to 73.52 days after sowing. Among all the graft combination, the fruit set was noticed earlier from PusaShyamla grafted onto *S. torvum* (64.44 days) followed by Patakata onto

*S. torvum* (66.04 days). Vigorous plants by grafting extended the growth period and luxurious growth and delayed flowering and fruit set. (Table-5). Compared to grafted plants, non-grafted plant PusaShyamla (81.43 days) showed earlier fruit harvest whereas among the eight graft combinations, early fruit harvest was noticed in PusaShyamla grafted onto *S. torvum* (86.87 days) followed by Patakata onto *S. torvum* (88.01 days). The graft combinations of Patakata onto *S. viarum* took the highest number of days to first harvest (99.82 days). The earliness in fruit harvest might be due to hormonal signaling in rootstock-scion interactions which have a greater impact on flowering and fruit setting. Similar findings were observed by Sanjeev *et al.*, (2016) in grafted brinjal plants.

Respective non-grafted plants Patakata recorded the highest fruit length (22.67 cm) and diameter (5.68 cm) than the grafted plants. Among the eight graft combinations the highest fruit length was noticed in Patakata grafted onto *S. torvum* (22.53 cm) and *S. macrocarpon* (21.36 cm) (Table-5). This might be due to the superior nature of particular cultivar and size of the fruit was negatively correlated with number of fruits. The same results have been put forward by Mohammed *et al.*, (2009) who found that the fruit size of the grafted tomato was not greater than the fruit size of the non-grafted plants.

### **Crop duration**

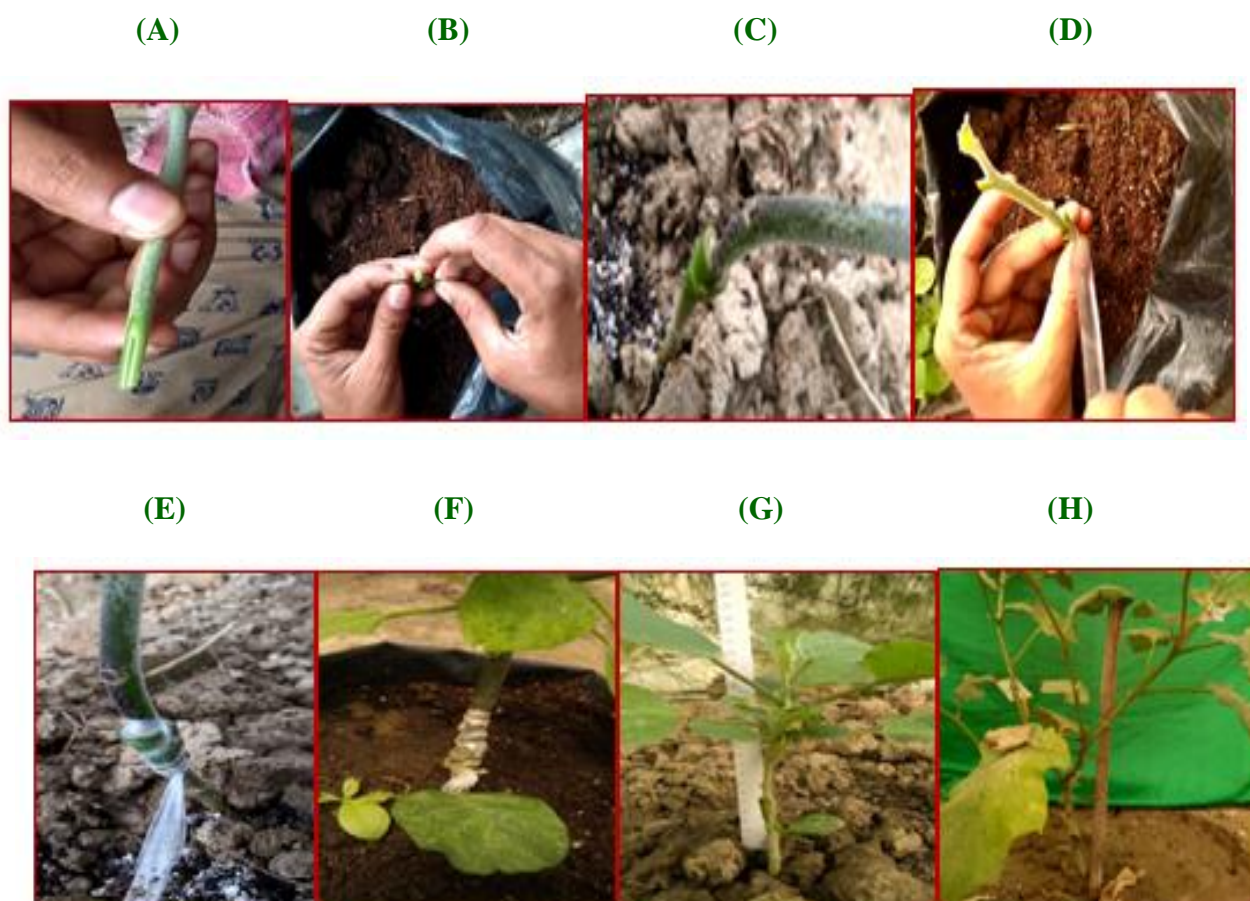
Crop duration was calculated from the date of transplanting wherein PusaShyamla grafted onto *S. torvum* and *S. incanum* recorded longer crop duration (194.89 and 182.91 days).

The pooled data revealed that shorter crop duration was recorded from non-grafts, Patakata (156.40 days) followed by PusaShyamla (159.38 days) (Table-5).

**Table.1** Performance of wild *Solanum species* on days to germination and germination percentage

| Treatments |                           | Days to germination | Germination % |       |
|------------|---------------------------|---------------------|---------------|-------|
|            |                           |                     | 15DAS         | 25DAS |
| T1         | <i>S. macrocarpon</i>     | 10.57               | 85.89         | 91.78 |
| T2         | <i>S. sisymbriifolium</i> | 12.35               | 61.58         | 87.26 |
| T3         | <i>S. torvum</i>          | 8.75                | 80.99         | 85.32 |
| T4         | <i>S. incanum</i>         | 11.50               | 69.55         | 79.97 |
| T5         | <i>S. viarum</i>          | 15.42               | 51.18         | 55.25 |
| T6         | <i>S. indicum</i>         | 12.72               | 47.49         | 53.48 |
| T7         | <i>S. aethiopicum</i>     | 14.75               | 41.61         | 46.56 |
| SE(d)      |                           | 0.31                | 1.49          | 1.58  |
| CD(P=0.05) |                           | 0.67                | 3.22          | 3.42  |

**Fig.1** Steps in Cleft grafting



(A) Scion preparation (wedge shaped), (B) Stock preparation, (C) Insertion, (D) Wrapping with polypropylene sheets, (E) Grafted plant, (F) Graft union, (G) Successful grafts inside polyhouse, (H) Grownup grafted plant

**Table.2** Performance of graft combinations on grafting success percentage and days for graft union

| Treatments |  | Grafting success percentage |              |              | Days for graft union |
|------------|--|-----------------------------|--------------|--------------|----------------------|
|            |  | 15 DAG                      | 30DAG        | 45 DAG       |                      |
| T1         | Patakata on <i>S. torvum</i>             | 91.33(9.58)                 | 82.22 (9.10) | 77.20 (8.81) | 10.20                |
| T2         | Patakata on <i>S. incanum</i>            | 83.14 (9.15)                | 71.18 (8.45) | 68.25 (8.29) | 13.63                |
| T3         | Patakata on <i>S. macrocarpon</i>        | 86.71 (9.33)                | 77.37 (8.82) | 73.84 (8.62) | 11.38                |
| T4         | Patakata on <i>S. aethiopicum</i>        | 39.44 (6.31)                | 8.89 (3.06)  | 0.00 (0.71)  | 19.61                |
| T5         | Patakata on <i>S. viarum</i>             | 68.93 (8.33)                | 65.07 (8.10) | 63.07 (7.97) | 15.58                |
| T6         | Patakata on <i>S. indicum</i>            | 47.64 (6.94)                | 12.24 (3.57) | 0.00 (0.71)  | 17.49                |
| T7         | Patakata on <i>S. sisymbriifolium</i>    | 35.84 (6.03)                | 0.00 (0.71)  | 0.00 (0.71)  | 20.40                |
| T8         | PusaShyamla on <i>S. torvum</i>          | 84.84 (9.24)                | 76.61 (8.78) | 72.40 (8.54) | 11.04                |
| T9         | PusaShyamla on <i>S. incanum</i>         | 77.36 (8.82)                | 70.52 (8.43) | 61.48 (7.87) | 14.62                |
| T10        | PusaShyamla on <i>S. macrocarpon</i>     | 81.32 (9.05)                | 75.48 (8.72) | 67.48 (8.24) | 13.38                |
| T11        | PusaShyamla on <i>S. aethiopicum</i>     | 35.12 (5.97)                | 6.63 (2.67)  | 0.00 (0.71)  | 20.05                |
| T12        | PusaShyamla on <i>S. viarum</i>          | 64.21 (8.04)                | 60.33 (7.80) | 58.45 (7.68) | 16.78                |
| T13        | PusaShyamla on <i>S. indicum</i>         | 41.93 (6.51)                | 25.47 (5.10) | 0.00 (0.71)  | 18.59                |
| T14        | PusaShyamla on <i>S. sisymbriifolium</i> | 28.36 (5.37)                | 0.00 (0.71)  | 0.00 (0.71)  | 21.74                |
| T15        | Bhangor on <i>S. torvum</i>              | 75.82 (8.74)                | 74.24 (8.65) | 66.58 (8.19) | 11.95                |
| T16        | Bhangor on <i>S. incanum</i>             | 65.35 (8.11)                | 70.11 (8.40) | 60.66 (7.82) | 15.97                |
| T17        | Bhangor on <i>S. macrocarpon</i>         | 61.66 (7.88)                | 54.66 (7.43) | 57.21 (7.60) | 14.15                |
| T18        | Bhangor on <i>S. aethiopicum</i>         | 30.48 (5.57)                | 5.66 (2.48)  | 0.00 (0.71)  | 23.22                |
| T19        | Bhangor on <i>S. viarum</i>              | 22.11 (5.35)                | 0.00 (0.71)  | 0.00 (0.71)  | 20.17                |
| T20        | Bhangor on <i>S. indicum</i>             | 40.58 (6.41)                | 25.12 (5.06) | 0.00 (0.71)  | 20.99                |
| T21        | Bhangor on <i>S. sisymbriifolium</i>     | 28.11 (5.35)                | 0.00 (0.71)  | 0.00 (0.71)  | 24.05                |
|            | SE(d)                                    | 1.42                        | 1.29         | 1.91         | 0.35                 |
|            | CD(P=0.05)                               | 2.88                        | 2.61         | 2.41         | 0.72                 |

\*DAG-Days after grafting. Figures in parentheses are square root (X+0.5) transformed values

**Table.3** Performance of graft combinations and non-grafts for plant height, Number of leaves and Total no. of branches.

| Treatments        |  | Plant height |           |           |            | Number of leaves |           |           |            | Total no. of branches |           |           |            |
|-------------------|--|--------------|-----------|-----------|------------|------------------|-----------|-----------|------------|-----------------------|-----------|-----------|------------|
|                   |  | 30<br>DAT    | 60<br>DAT | 90<br>DAT | 120<br>DAT | 30<br>DAT        | 60<br>DAT | 90<br>DAT | 120<br>DAT | 30<br>DAT             | 60<br>DAT | 90<br>DAT | 120<br>DAT |
| <b>T1</b>         | <b>PusaShyamla on <i>S. torvum</i></b>     | 18.77        | 46.64     | 76.60     | 87.26      | 28.43            | 79.31     | 137.42    | 142.09     | 4.30                  | 10.37     | 13.93     | 15.94      |
| <b>T2</b>         | <b>PusaShyamla on <i>S. incanum</i></b>    | 14.08        | 37.32     | 70.31     | 77.18      | 24.38            | 73.82     | 102.19    | 107.44     | 3.05                  | 7.94      | 11.04     | 11.94      |
| <b>T3</b>         | <b>PusaShyamla on <i>S. macrocapon</i></b> | 16.07        | 43.34     | 75.57     | 81.69      | 26.53            | 76.69     | 119.73    | 123.92     | 3.62                  | 9.48      | 12.25     | 14.35      |
| <b>T4</b>         | <b>PusaShyamla on <i>S. viarum</i></b>     | 12.71        | 34.02     | 66.91     | 73.77      | 20.83            | 68.52     | 90.02     | 101.31     | 2.94                  | 7.42      | 9.41      | 10.13      |
| <b>T5</b>         | <b>Patakata on <i>S. torvum</i></b>        | 19.87        | 49.66     | 80.30     | 89.72      | 31.98            | 83.06     | 141.99    | 144.81     | 5.02                  | 11.85     | 14.67     | 16.78      |
| <b>T6</b>         | <b>Patakata on <i>S. incanum</i></b>       | 17.51        | 40.32     | 73.36     | 84.15      | 26.84            | 76.11     | 107.05    | 112.08     | 3.74                  | 9.85      | 12.84     | 14.09      |
| <b>T7</b>         | <b>Patakata on <i>S. macrocapon</i></b>    | 17.87        | 43.52     | 77.21     | 85.38      | 30.20            | 78.41     | 126.01    | 128.95     | 4.52                  | 11.13     | 13.79     | 15.10      |
| <b>T8</b>         | <b>Patakata on <i>S. viarum</i></b>        | 16.35        | 38.80     | 71.93     | 82.76      | 25.63            | 74.36     | 97.13     | 110.87     | 3.20                  | 8.57      | 11.32     | 11.41      |
| <b>T9</b>         | <b>PusaShyamla</b>                         | 14.80        | 33.84     | 67.72     | 80.38      | 24.04            | 68.07     | 76.16     | 89.73      | 3.34                  | 6.91      | 12.35     | 13.58      |
| <b>T10</b>        | <b>Patakata</b>                            | 17.05        | 38.12     | 71.72     | 85.32      | 26.03            | 73.66     | 82.90     | 94.89      | 3.90                  | 7.98      | 13.60     | 14.83      |
| <b>SE(d)</b>      |  | 0.39         | 0.77      | 1.50      | 1.59       | 0.62             | 1.71      | 2.04      | 2.40       | 0.08                  | 0.22      | 0.23      | 0.28       |
| <b>CD(P=0.05)</b> |  | 0.83         | 1.61      | 3.16      | 3.33       | 1.30             | 3.59      | 4.29      | 5.05       | 0.18                  | 0.47      | 0.49      | 0.60       |

**Table.4** Performance of graft combinations and non-grafts for number of flowers, Days to 1<sup>st</sup> flowering, Days taken for 50% flowering, Leaf Area (cm<sup>2</sup>) and LAI.

| Treatments        |  | Number of flowers |        |        |         | Days to 1 <sup>st</sup> flowering | Days taken for 50% flowering | Leaf Area (cm <sup>2</sup> ) | LAI  |
|-------------------|--|-------------------|--------|--------|---------|-----------------------------------|------------------------------|------------------------------|------|
|                   |  | 30 DAT            | 60 DAT | 90 DAT | 120 DAT |                                   |                              |                              |      |
| <b>T1</b>         | <b>PusaShyamla on <i>S. torvum</i></b>     | 11.69             | 94.29  | 78.33  | 47.82   | 56.44                             | 59.90                        | 160.87                       | 2.24 |
| <b>T2</b>         | <b>PusaShyamla on <i>S. incanum</i></b>    | 8.62              | 77.90  | 68.96  | 40.72   | 60.84                             | 68.21                        | 155.08                       | 2.05 |
| <b>T3</b>         | <b>PusaShyamla on <i>S. macrocapon</i></b> | 10.09             | 86.95  | 73.81  | 43.84   | 59.82                             | 65.78                        | 158.42                       | 2.12 |
| <b>T4</b>         | <b>PusaShyamla on <i>S. viarum</i></b>     | 8.29              | 75.04  | 59.40  | 38.04   | 63.43                             | 71.16                        | 151.58                       | 1.86 |
| <b>T5</b>         | <b>Patakata on <i>S. torvum</i></b>        | 10.95             | 93.89  | 76.43  | 43.95   | 57.90                             | 63.69                        | 169.28                       | 2.29 |
| <b>T6</b>         | <b>Patakata on <i>S. incanum</i></b>       | 7.08              | 75.64  | 69.38  | 37.85   | 63.04                             | 70.73                        | 165.05                       | 1.95 |
| <b>T7</b>         | <b>Patakata on <i>S. macrocapon</i></b>    | 8.64              | 85.41  | 73.25  | 41.21   | 60.45                             | 67.67                        | 167.22                       | 2.12 |
| <b>T8</b>         | <b>Patakata on <i>S. viarum</i></b>        | 7.00              | 72.75  | 65.92  | 37.00   | 65.78                             | 71.79                        | 160.30                       | 2.02 |
| <b>T9</b>         | <b>PusaShyamla</b>                         | 8.96              | 89.37  | 77.30  | 45.16   | 50.94                             | 56.42                        | 146.30                       | 1.84 |
| <b>T10</b>        | <b>Patakata</b>                            | 8.05              | 74.03  | 63.84  | 39.99   | 52.76                             | 59.07                        | 149.81                       | 1.91 |
| <b>SE(d)</b>      |  | 0.22              | 1.92   | 1.60   | 0.95    | 1.29                              | 1.42                         | 3.56                         | 0.05 |
| <b>CD(P=0.05)</b> |  | 0.46              | 4.02   | 3.36   | 1.99    | 2.71                              | 2.97                         | 7.49                         | 1.10 |

\*Days taken for 1<sup>st</sup> flowering, Days taken for 50% flowering were calculated from the date of sowing.



**Table.5** Performance of graft combinations and non-grafts for Days to 1<sup>st</sup> fruit set, Days to 1<sup>st</sup> harvest, Fruit length (cm), Fruit diameter (cm), Crop duration, Number of fruits per plant, Average fruit weight (g/fruit), and Fruit yield (kg/plant).

| Treatments        |  | Days to 1 <sup>st</sup> fruit set | Days to 1 <sup>st</sup> harvest | Fruit length (cm) | Fruit diameter (cm) | Crop duration | Number of fruits per plant | Average fruit weight (g/fruit) | Fruit yield (kg/plant) |
|-------------------|--|-----------------------------------|---------------------------------|-------------------|---------------------|---------------|----------------------------|--------------------------------|------------------------|
| <b>T1</b>         | <b>PusaShyamla on <i>S. torvum</i></b>     | 64.44                             | 86.87                           | 18.59             | 5.08                | 194.89        | 21.06                      | 123.93                         | 2.62                   |
| <b>T2</b>         | <b>PusaShyamla on <i>S. incanum</i></b>    | 70.10                             | 93.83                           | 17.98             | 4.72                | 182.91        | 17.34                      | 118.74                         | 2.06                   |
| <b>T3</b>         | <b>PusaShyamla on <i>S. macrocapon</i></b> | 68.96                             | 92.37                           | 18.27             | 4.92                | 177.46        | 19.04                      | 119.50                         | 2.28                   |
| <b>T4</b>         | <b>PusaShyamla on <i>S. viarum</i></b>     | 73.43                             | 97.12                           | 16.37             | 4.69                | 180.77        | 16.08                      | 116.89                         | 1.88                   |
| <b>T5</b>         | <b>Patakata on <i>S. torvum</i></b>        | 66.04                             | 88.01                           | 22.53             | 5.46                | 171.93        | 18.12                      | 128.17                         | 2.32                   |
| <b>T6</b>         | <b>Patakata on <i>S. incanum</i></b>       | 72.92                             | 95.29                           | 19.23             | 5.00                | 160.58        | 15.78                      | 121.83                         | 1.92                   |
| <b>T7</b>         | <b>Patakata on <i>S. macrocapon</i></b>    | 69.69                             | 93.87                           | 21.36             | 5.18                | 158.43        | 17.04                      | 124.30                         | 2.16                   |
| <b>T8</b>         | <b>Patakata on <i>S. viarum</i></b>        | 73.52                             | 99.82                           | 18.57             | 4.95                | 158.64        | 15.17                      | 119.05                         | 1.81                   |
| <b>T9</b>         | <b>PusaShyamla</b>                         | 58.87                             | 81.43                           | 20.92             | 5.35                | 159.38        | 17.54                      | 127.10                         | 2.23                   |
| <b>T10</b>        | <b>Patakata</b>                            | 61.27                             | 82.81                           | 22.67             | 5.68                | 156.40        | 16.22                      | 132.96                         | 2.12                   |
| <b>SE(d)</b>      |  | 1.48                              | 1.98                            | 0.47              | 0.12                | 3.82          | 0.56                       | 2.40                           | 0.07                   |
| <b>CD(P=0.05)</b> |  | 3.11                              | 4.16                            | 0.99              | 0.25                | 8.03          | 1.18                       | 5.03                           | 0.14                   |

Days to 1<sup>st</sup> fruit set and Days to 1<sup>st</sup> harvest were calculated from the date of sowing.

\*\*Crop duration is from the date of transplanting.

**Table.6** Performance of graft combinations and non-grafts for quality parameters.

| Treatments |                                     | TSS ( <sup>o</sup> Brix) | Titrateable acidity (%) | Anthocyanin in peel (mg g <sup>-1</sup> ) | Total Sugar (%) | Vit. C (mg g <sup>-1</sup> ) |
|------------|-------------------------------------|--------------------------|-------------------------|---|-----------------|------------------------------|
| T1         | PusaShyamla on <i>S. torvum</i>     | 5.16                     | 0.66                    | 6.59                                      | 1.72            | 0.115                        |
| T2         | PusaShyamla on <i>S. incanum</i>    | 4.90                     | 0.60                    | 5.84                                      | 1.64            | 0.110                        |
| T3         | PusaShyamla on <i>S. macrocapon</i> | 4.98                     | 0.64                    | 6.49                                      | 1.67            | 0.112                        |
| T4         | PusaShyamla on <i>S. viarum</i>     | 4.82                     | 0.57                    | 5.73                                      | 1.59            | 0.108                        |
| T5         | Patakata on <i>S. torvum</i>        | 5.18                     | 0.58                    | 5.71                                      | 1.68            | 0.112                        |
| T6         | Patakata on <i>S. incanum</i>       | 4.89                     | 0.53                    | 5.72                                      | 1.61            | 0.105                        |
| T7         | Patakata on <i>S. macrocapon</i>    | 4.76                     | 0.56                    | 5.49                                      | 1.65            | 0.109                        |
| T8         | Patakata on <i>S. viarum</i>        | 4.67                     | 0.50                    | 4.71                                      | 1.53            | 0.100                        |
| T9         | PusaShyamla                         | 4.85                     | 0.61                    | 5.88                                      | 1.66            | 0.111                        |
| T10        | Patakata                            | 4.74                     | 0.48                    | 5.17                                      | 1.63            | 0.107                        |
|            | SE(d)                               | N.A                      | 0.01                    | 0.42                                      | 0.04            | 0.006                        |
|            | CD(P=0.05)                          | 0.21                     | 0.03                    | 0.89                                      | 0.08            | 0.013                        |

The possible reason for longer crop duration is that grafting takes a longer time in forming a compatible union between stock and scion, which ultimately delayed the vegetative and reproductive growth stages of a plant. Rashid *et al.*, (2005) and Sherly, (2011) also stated that harvest duration was about one month longer when eggplant was grafted to *S. torvum*.

### **Yield parameters**

Brinjal scion grafted onto rootstock *Solanum torvum* showed the maximum number of fruits and higher fruit weight due to increase in the xylem sap and hormone concentrations. The number of fruits per plant had a strong relationship in increasing the yield of a crop where more number of fruits produced by any kind of vegetable is a direct indicator of high yield (Table-5). More number of fruits per plant was noticed from PusaShyamla grafted onto *S. torvum*(21.06) and *S. macrocarpon* (19.04). Perez *et al.*, (2006) also observed that number of fruits per plant was high in grafted tomato plants than in self-grafted plant. The maximum average fruit weight during the experimental years was registered from Patakata grafted onto *S. torvum*(128.17 g) and *S. macrocarpon*(124.30 g). This might be due size (length and diameter) of the fruit being positively correlated with the weight of the fruit.

### **Fruit yield (kg/plant)**

Among the eight graft combinations, PusaShyamla grafted onto *S. torvum* and *S. macrocarpon* recorded maximum fruit yield (2.62 and 2.28 kg/plant) (Table-5). The graft combination of Patakata onto *S. Viarum* recorded minimum fruit yield (1.81 kg/plant) which was on par with PusaShyamla onto *S. viarum*(1.88 kg/plant). Among the two brinjal plants (non-grafted), PusaShyamla had the maximum fruit yield (2.23 kg/plant) than

Patakata (2.12 kg/plant). Compared to four different rootstocks, grafts on *S. torvum* and *S. macrocarpon* used as rootstocks showed more number of fruits and fruit yield per plant than *S. incanum* and *S. viarum*. These findings corroborate with the earlier results of Alexios *et al.*, (2007) who reported that in plants irrespective of rootstock the fruit yield was significantly higher in the grafted plants than in the non-grafted control.

### **Quality parameters**

The quality parameters (Total soluble solids, Titrable acidity, Anthocyanin, Vit C, and Total sugar) were found to be significantly influenced by grafting. The highest TSS and Titrable acidity were recorded from PusaShyamla grafted onto *S. torvum*(5.16 °Brix and 0.66%), which was on par with PusaShyamla grafted onto *S. macrocarpon*(4.98 ° Brix and 0.64%) and respective non-grafts.

The experimental findings revealed that grafting may have positive effects on acidity of the brinjal fruits produced. These results were under study of earlier workers, Turhan *et al.*, (2011) who reported that suitable rootstock improved the titratable acidity value of grafted tomato plants. The results on anthocyanin content and total sugar in brinjal fruits also showed that the grafting significantly promoted the anthocyanin content in peel of brinjal fruits, compared to respective non-grafts (Table-6). The lowest anthocyanin value was noticed in Patakata grafted onto *S.viarum*(4.71 mg g<sup>-1</sup>). The highest value of total sugar was observed from PusaShyamla grafted onto *S. torvum* (1.72 %), *S. macrocarpon*(1.67 %) and *S. incanum* (1.64 %). PusaShyamla and Patakata when grafted onto *S. viarum* exhibited the lowest value of total sugar (1.59 and 1.53 % respectively). These could visualize that the dominance of scion over rootstock in an expression of

quality as true to the type of its originality. The highest Vit-C content was recorded from PusaShyamla grafted onto *S. torvum* (0.115 mg g<sup>-1</sup>) and *S. macrocarpon* (0.112 mg g<sup>-1</sup>). Among the two non-grafts, PusaShyamla had more- Vit-C content (0.111 mg g<sup>-1</sup>) than Patakata (0.107 mg g<sup>-1</sup>) (Table-6). The results indicated that grafting had a positive effect on quality parameters (Vit-C and Titrable acidity) Liu Na *et al.*, 2012.

The probable rootstocks *viz.*, *S. torvum*, *S. macrocarpon*, *S. incanum* and *S. viarum* was selected based on promising compatibility and high success percentage with two scions *viz.*, Patakata and PusaShyamla. Complete failure on grafting was noticed in the species *S. aethiopicum*, *S. indicum*, and *S. sisymbriifolium* with three brinjal scions at 45DAG due to lack of cellular recognition, wounding responses, presence of growth regulators or incompatible toxins or an unfavorable grafting environment. Among all the graft combinations PusaShyamla grafted onto *S. torvum* and *S. macrocarpon* gave better field performance *vis a vis* quality and yield.

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