Original Research Article

Studies on Cleft Grafting its Compatibility and Growth Performance of Brinjal (*Solanummelongena* L.)

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ABSTRACT

Grafting in brinjal is an effective technology and it is a alternative to chemical treatments for control of soilborne pathogens with minimum impact on product quality and environment.The present study was carried out to determine the graft compatibility of brinjal scions (Dhruva andCO 2) with five wild *Solanum* rootstocks and their growth performance in open field condition. The cleft grafting method was adopted in this study. The non-grafted plants were used as control under open field condition. *Solanumtorvum* recorded less number of days for graft union with Dhruva (10.36) and CO 2 (10.54) followed by *Solanumcapsicoides* and *Solanumchrysotrichum*. The results on grafting success at 30 days after grating revealed that the highest success percentage was observed in Dhruva (83.42%) and CO 2 (82.08%) grafted with *Solanumtorvum* rootstock followed by *Solanumcapsicoides* and *Solanumchrysotrichum*. The field survival rate was higher in Dhruva (88.75%) and CO 2 (85.20%) grafted onto *Solanumtrovum* followed by *Solanumcapsicoides* and *Solanumchrysotrichum*. Dhruva (90.52cm, 9.15) and CO 2 (80.17cm, 7.29) grafted onto *Solanumtorvum* recorded maximum plant height and more number of primary branches per plant respectively followed by *Solanumchrysotrichum*. Though *Solanumcapsicoides* performed well throughout thegrafting process their growth performance was poor in open field condition. Hence *Solanumtorvum*followed by*Solanumchrysotrichum* could be used as compatible rootstock for grafting with brinjal scions.

Keywords: Grafting, rootstock, scion,brinjal.

1. INTRODUCTION

Brinjal (*Solanummelongena*L., 2n = 24) belonging to the family Solanaceae is a native crop of India with China as its secondary center of origin (Vorontsova and Knapp, 2012). It is a warm-season crop, adapted to a wide range of climatic conditions of the country. Brinjal finds its place as the poor man's vegetable in Indian curries. Furthermore, brinjal is a region-specific crop where consumer acceptance is based on their preference for color, shape and taste suited for their specific locality (Chinthaguntiet *al.,* 2018).

Despite the high economic importance the major contstraint in brinjal production is their susceptible nature to soil borne diseases, pests and nematodes which results in heavy yield loss(Miceliet *al.,* 2014). With few resistant varieties and region-specific preference nature by consumer, grafting has become an alternate approach in brinjal to mitigate the yield loss(Chinthaguntiet *al.,* 2018).Grafting brinjal cultivars with perennial and wild Solanaceous species as rootstock, proved to increase the yield and long availability period of the fruits through ratoon crop(Gisbertet *al.*, 2011). Grafting is also highly effective in ameliorating crop losses caused by adverse environmental conditions (Dietmar*et al*., 2010). Hence proper selection of rootstock with resistance to biotic and abiotic stress can provide perennially nature along with disease and pest free plants, increased yield and fruit quality. Thus, the aim of this study was to identify the compatible rootstock for grafting with brinjal based on the success percentage of graft combination, field survival rate and their growth performance in open field condition.

2. MATERIAL AND METHODS

The experiment was conducted in College Orchard, Department of Vegetable Science, HC & RI, TNAU, Coimbatore during 2021-22. The experimental materials for the present study comprised five wild *Solanum*species namely *Solanumcapsicoides*, *Solanumchrysotrichum*, *Solanumsisymbriifolium, Solanumviolaceum*and *Solanumtorvum*as rootstocks and two cultivated brinjalnamely Dhruva and CO 2 a cultivar from TamilNadu Agricultural Universitywere used as scion for grafting.

2.1 GRAFTING

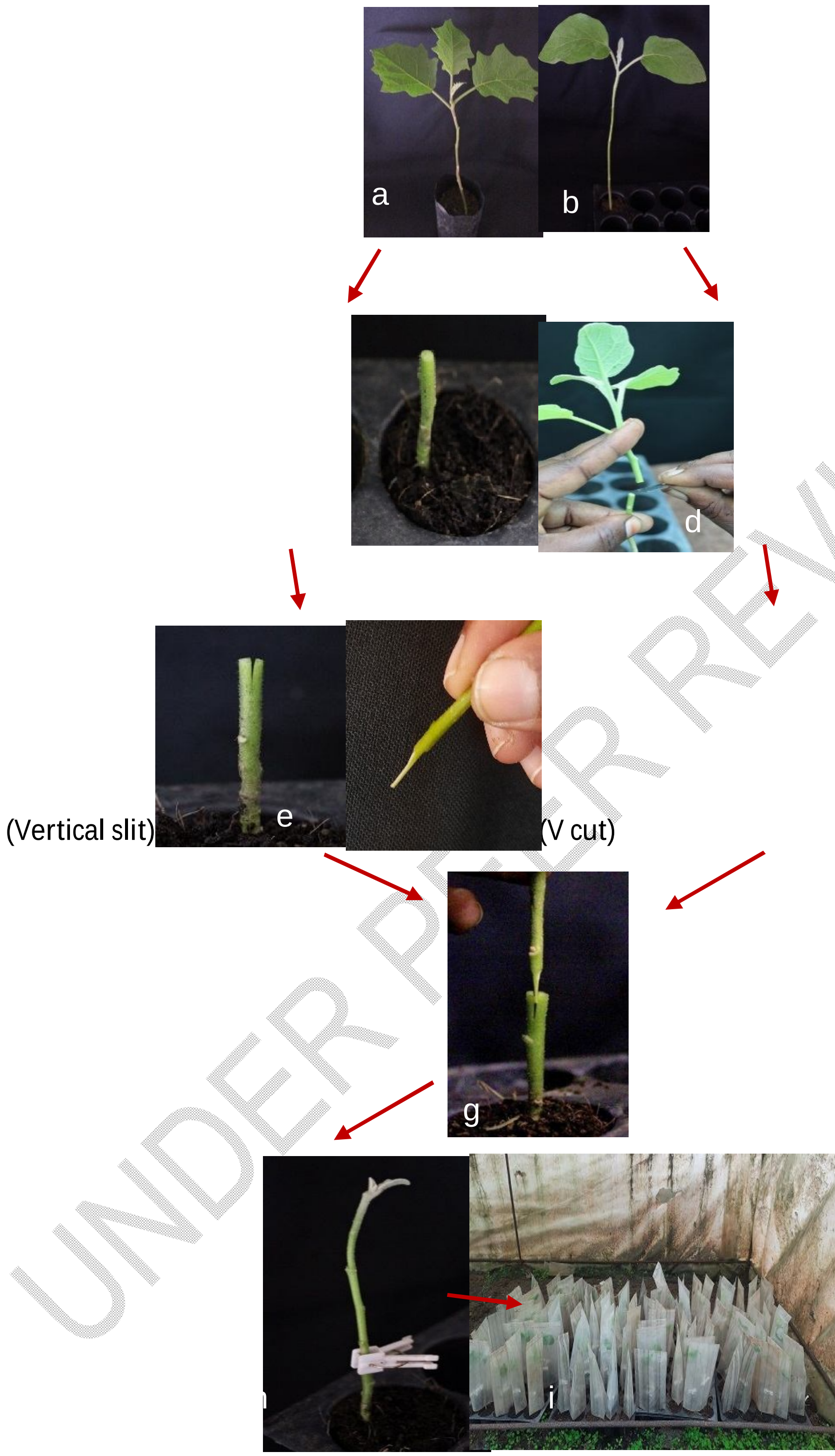
Grafting was performed in the rootstock which attained pencil-size stem thickness and 35 days old scion seedlings. The grafting method adopted in this experiment was cleft grafting (Pugalendhi*et al.,*2020). Grafting was done under greenhouse condition during morning and evening hours. Immediately after grafting the plants are covered with 1000 gauge polythene bag and transferred inside the mist chamber to maintain optimum humidity (RH >95%) and temperature (25-30□ C). The plants were kept inside the mist chamber for seven days to form asuccessful graft union(Fig1). Once the scion started sprouting the polythene cover was removed and the plants were transferred to shade net condition for five to seven days. After acclimatization, the plants were transplanted into the open field. The grafting experiment underthegreenhouse followedCompletely Randomized Design (CRD) with three replications. Graft compatibility was assessed in terms of Number of days taken for graft union and graft success percentage at 15 and 30 days after grafting (DAG). While open field condition followed Randomized Block Design (RBD) with three replications including 10 plants for each replication.The observations *viz.,* field survival rate at 30 days after transplanting (DAT), plant height at 90 days after transplanting (DAT) and No. of primary branches per plant at 90 days after transplanting (DAT) were recorded in open field (Table 1).

2.2STATISTICAL ANALYSIS

The analysis was carried out using the statistical software SPSS v.25; Data were subjected to analysis of variance (ANOVA) at two significant levels (P<0.05 and P<0.01) and critical difference (CD) valueswere calculated each time.

3. RESULTS AND DISCUSSION

The graft compatibility study indicated that grafting Dhruva (10.36) and CO 2 (10.54) grafted onto *Solanumtorvum*recorded significantly faster graft union followed by Dhruva (10.95) and CO 2 (11.03) grafted onto*Solanumchrysotrichum*through cleft grafting. These findings were in line with Sherly (2011) and Kumar *et al.*(2017) that *Solanumtorvum*recorded minimum number of days for graft union compared to other rootstocks. Rasool*et al.* (2020) reported that graft union is the key factor for grafting success and further growth of the plant. Graft union is associated with cohesion between rootstock and scion (i.e., callus formation, vascular bundle differentiation and connectivity at the graft interface) that insures the balanced development of both scion and rootstock**.** (Soltan*et al.,* 2017). Hence the process



a.	Rootstock	d.	Scion preparation	g.	Insertion of scion into rootstock
b.	Scion	e.	Wedge cut in rootstock	h.	Clipping
C.	Beheading rootstock	f.	V-shaped cut in scion	i.	Grafted plants in polytunnel

Figure 1. Steps in cleft grafting

of graft union and wound healing might be faster in *Solanumtorvum*and*Solanumchrysotrichum*than other species.

Dhruva (17.52) and CO 2 (18.36) grafted onto *Solanumsisymbrifolium*recorded maximum number of days for graft union. Similar results reported that *Solanumsisymbrifolium* took maximum number of days for graft union with Bhangor (24.05 days) through cleft grafting method and complete failure of grafts found during 30 DAG (Subba*et al.,* 2021). In addition to that Pugalendhi*et al.*(2021) reported that TNAU tomato hybrid CO3 and Shivam grafted on *Solanumtorvum*took the least number of days for graft union (9.5 days) while *Solanumsisymbrifolium*and *Solanumcapsicoides*did not show vascular connection on 21 days of grafting. It took more time for graft union. Failure in graft union may be due to lack of cellular recognition, interference in the wounding response or incompatible toxins which forms distorted unions and eventually leading to graft failure (Wang *et al.,* 2011).

From the Table 1 it is evident that Dhruva (90.32%, 83.42%) and CO 2 (89.17%, 82.08%) grafted onto *Solanumtorvum* recorded the highest grafting success percentage at 15 DAG and 30 DAG followed by *Solanumcapsicoides*with Dhruva (87.43%, 81.62%) and CO2 (85.36%, 79.21%) and *Solanumchrysotrichum*with Dhruva (85.11%, 80.71%) and CO 2 (83.46%, 79.14%) respectively. The success of a graft combination is determined by cell division at the graft union site followed by formation of new vascular connection as reported in grafted bitter gourd by Tamilselvi and Pugalendhi(2017). Grafting success percentage was recorded the lowest in *Solanumviolaceum*when grafted with Dhruva (78.94%, 57.89%) and CO2 (70.83%, 53.12%). This is confirmed by high mortality rate of the plants during the experiment at 15 DAG and 30 DAG.

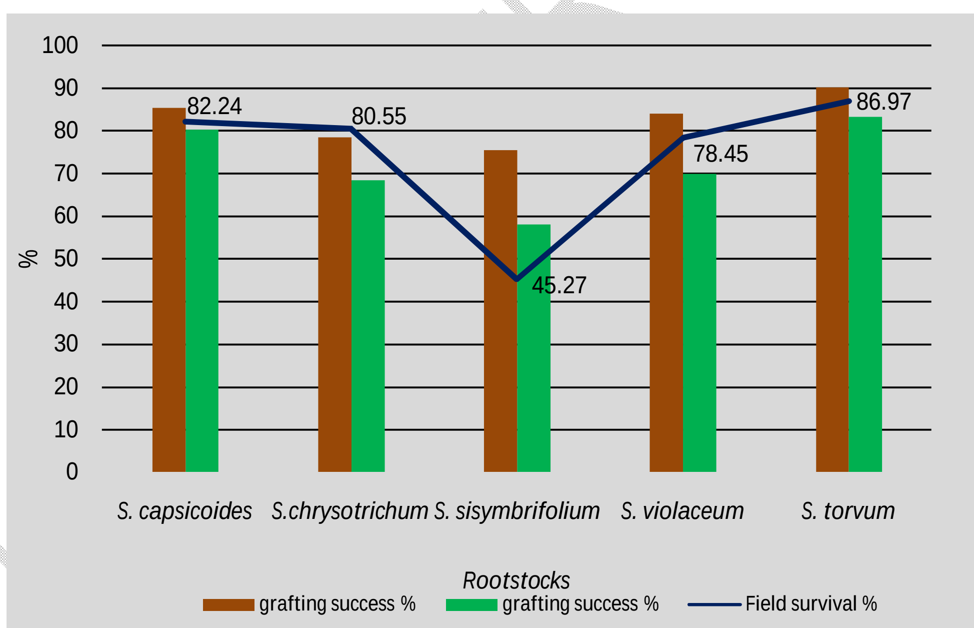


Figure 2. Effect of rootstocks on grafting success % in brinjal scions at 15 and 30 days after grafting (DAG) and field survival % at 30 days after transplanting (DAT)

Table 1. Performance of grafted plants on graft compatibility characters and growth of brinjal plants

Treatments	Days taken for graft union	Grafting success %		Field Survival rate %	Plant height (cm) 90* DAT	No. of primary br/pl 90* DAT
		15 DAG	30 DAG	30 DAT		
CO. 2 grafted on *Solanumcapsicoides*	12.20	85.36 (67.50)	79.21 (62.87)	81.03 (64.18)	32.67	3.50
Dhruva grafted on *Solanumcapsicoides*	11.25	87.43 (69.24)	81.62 (64.61)	83.45 (66.00)	39.17	4.07
CO. 2 grafted on *Solanumchrysotrichum*	10.95	83.46 (66.01)	79.14 (62.83)	79.43 (63.03)	76.05	7.27
Dhruva grafted on *Solanumchrysotrichum*	11.03	85.11 (67.30)	80.71 (63.95)	81.67 (64.65)	85.53	8.51
CO. 2 grafted on *Solanumsisymbrifolium*	18.36	71.87 (57.97)	56.18 (48.55)	38.82 (38.54)	45.54	4.52
Dhruva grafted on *Solanumsisymbrifolium*	17.52	80.23 (63.60)	63.30 (52.71)	51.73 (45.99)	49.42	4.67
CO. 2 grafted on *Solanumviolaceum*	14.53	70.83 (57.31)	53.12 (46.79)	75.83 (60.55)	73.67	7.05
Dhruva grafted on *Solanumviolaceum*	15.47	78.94 (62.69)	57.89 (49.54)	80.66 (63.91)	81.59	8.19
CO. 2 grafted on *Solanumtorvum*	10.54	89.17 (70.79)	82.08 (64.96)	85.20 (67.38)	80.17	7.29
Dhruva grafted on *Solanumtorvum*	10.36	90.32 (71.87)	83.42 (65.97)	88.75 (70.41)	90.52	9.15
CO 2	-	-	-	-	73.22	6.51
Dhruva	-	-	-	-	81.18	8.04
Mean	13.22	65.43	58.28	60.46	67.29	6.56
S. Ed	0.87	0.78	0.67	0.62	1.47	0.61
CD (*P*=0.05)	1.81	1.63	1.41	1.31	3.05	1.26

DAG – Days after grafting; DAT – Days after transplanting
(Figures in parentheses are arc sine transformed values)

Among the five rootstocks used for grafting, Dhruva (88.75%) and CO 2 (85.20%) grafted onto*Solanumtorvum* recorded the highest survival rate under open field conditionS followed by Dhruva (83.45%) and CO 2 (81.03%) grafted onto *Solanumcapsicoides*and Dhruva (81.67%) and CO 2 (79.43%) grafted onto *Solanumchrysotrichum.* Significantly lower survival rate was observed in Dhruva (51.73%) and CO 2 (38.82%) grafted onto *Solanumsisymbrifolium*as shown in Fig 2. (Average on performance of rootstock). The findings were in line with Sherly (2011) that *Solanumtorvum*grafted onto COBH 2 recorded high survival rate and robust growth of the plant in open field and Dhivya (2013) when *Solanumtorvum*grafted on tomato recorded better growth and survival followed by *Solanumincanum.* The establishment of wound repair mechanism between scion and rootstock might have contributed in recording high survival rate after transplanting.

While Tamilselvi (2013) reported that lower survival rate might be caused by anatomical mismatching, resulting in themisalignment of cambial regions of rootstock and scion. This misalignment led to tissue death in the wounded areas of the rootstock, scion and subsequent scion death. Similar findings by Mahbou *et al.* (2022) andSurve*et al.* (2020) reported that, despite the high graft success percentage at nursery level, lower survival rate in open field condition might be due to theavailability of more congenial conditions in the establishment of seedlings/grafts under nursery condition.

The mean performance of plantis considered as the key parameter to assess the potential of different graft combinations under open field condition. The analysis of variance for the grafted plants exhibited significant differences for plant height and number of primary branches per plant than non-grafted plants.The morphological parameters especially plant height and number of primary branches per plant were substantially better for most of the grafted combinations than non-grafted control as shown in Table 1. Vigorous plant growth wasobserved in most of the grafts, as reflected in maximum plant height and more no. of primary branches per plant than non-grafted plants. This could be attributed by larger and vigorous root growth of the rootstock which ensured better plant height and vigorous growth through absorption of optimal level of water and nutrients (Musa *et al.,* 2020).

The maximum plant height was recorded in Dhruva (90.52cm) and CO 2 (80.17cm) grafted onto *Solanumtorvum*followed by *Solanumchrysotrichum*with Dhruva (85.53cm) and CO2 (76.05cm) and *Solanumviolaceum*with Dhruva (81.59cm) and CO 2 (73.67cm). Though grafting success percentage and survival rate was higher in *Solanumcapsicoides,* it recorded poor growth in open field condition. This might be due to the morphology of the rootstock which grows only 0.50-1m in height (herbaceous shrub) (Dharman and Anilkumar, 2018). The result showed that the vigor of the rootstock is essential in conferring scion vigor. Gisbert*et al.* (2011) reported that vigorous root system of the rootstock enhances the ability to absorb water and nutrients compared to the non-grafted plants while serving as a better supplier of endogenous plant hormones.Similarly rootstocks has varying levels of GA_3 which cause diferences in vegetative growth and vigor of scion in grafted plants (Qureshi *et al.,* 2022).

Similarly, Dhruva (9.15) and CO 2 (7.29) grafted onto *Solanumtorvum*recorded higher number of primary branches per plant followed by *Solanumchrysotrichum*with Dhruva (8.51) and CO2 (7.27) and *Solanumviolaceum*with Dhruva (8.19) and CO 2 (7.05). The effect of rootstock on the mineral content in the aerial portion of the plant may be related to the physical properties of the root system, such as lateral and vertical development. This may lead to improved uptake ofwater and minerals, thereby resulting in a greater number of branches in grafted plants(Khah*et al.,* 2011). While number of primary branches per plant was lower in Dhruva (4.07) and CO 2 (3.50) grafted onto *Solanumcapsicoides.* Sherly (2011) reported that brinjal grafted onto *Solanumtorvum*exhibited maximum plant growth than non-grafted plants. Similar findings were reported by Dhivya (2013) and Bharathi*et al.,* (2021) when tomato was grafted to *Solanumtorvum.*

Though *Solanumviolaceum*performed well under open field condition with low grafting success percentage Dhivya*et al*. (2016) reported that this species is highly susceptible to root-knot nematode infestation. Hence this species can be narrowly used in areas where root-knot nematode infestation is devoid. Whereas *Solanumtorvum*is highly resistant to root-knot nematode and exhibited high grafting success percentage with field survival capacity.

4. CONCLUSION

The results shows that grafting in brinjal can contribute to significant improvement in production and provide resistance to soilborne pathogens and diseases or to enhcance the vigor of the scion. Grafting of CO 2 and Dhruva with five wild *Solanum*rootstocks revealed that *Solanumtorvum*exhibited less no. of days for graft union, higher graft success percentage, field survival rate, plant height and no. of primary branches per plant. Though *Solanumcapscicoides*recorded higher graft success percentage and field survival rate than *Solanumchrysotrichum,* it exhibited poor growth performance in open field condition. Finally the result of the study indicated that *Solanumtorvum* and *Solanumchrysotrichum* can be the most compatible rootstock for brinjal grafting. The study can be extended to select rootstocks and resistant species which allow production in infested soils.

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