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Grafting parthenocarpic cucumber for yield and quality

Kunal Anand[1], Ajay Bhardwaj[1*], Randhir Kumar[1], Awadhesh Kr Pal[2], Tirthartha Chattopadhyay[3], Rajeev Padbhushan[4] and Paramveer Singh[1]

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Abstract

An experiment was conducted during 2019-20 to know the effect of grafting on parthenocarpic cucumber for yield and quality. The study included nine rootstocks viz., three from pumpkin, two of bottle gourd, two from sponge gourd, one from summer squash and one from monoecious cucumber grafted with parthenocarpic cucumber genotype adopting one cotyledon grafting method. The experiment was laid out in randomized block design with three replications and ten treatment combinations in the naturally ventilated polyhouse. The data was recorded for 22 quantitative and biochemical traits and when subjected to analysis of variance, all the traits showed significant variations except days to first harvest. The maximum graft survival (21 days after grafting) was recorded in the parthenocarpic cucumber (BRPCU-1) grafted on pumpkin (Chakor) rootstock and the least was in sponge gourd (Rajendra Nenua-1). The rootstock of monoecious cucumber (Swarna Sheetal) was observed with highest and significantly superior values for average fruit weight (120.48 g), fruit yield (3.19 Kg per vine) and fruit length (19.27 cm) than non grafted control. The graft combination of parthenocarpic cucumber scion (BRPCU-1) with rootstock of bottle gourd (Rajendra Chamatkar) recorded significantly higher total soluble solids whereas the pumpkin rootstock (Chakor) recorded significantly more ascorbic acid content than control. All the treatments of grafting revealed significantly superior total chlorophyll content than non-grafted control. It was concluded that the parthenocarpic cucumber grafted on monoecious cucumber rootstock (Swarna Sheetal) recorded the highest yield, whereas the bottle gourd rootstock (Rajendra Chamatkar) attributed the best performance in terms of quality.

Keywords: Grafting, Parthenocarpic cucumber, Rootstock & Scion, Yield, TSS, Ascorbic acid

[1]Dept. of Hort. (Veg. and Flori.); [2]Dept. of Biochemistry and Crop Physiology; [3]Dept. of Plant Breeding and Genetics; [4]Dept. of Soil Science and Agricultural Chemistry, BAU, Sabour

[*]Corresponding author, Email: bhardwaj.ajay.phd@gmail.com

Introduction

Cucumber (*Cucumis sativus* L.) is key cucurbitaceous vegetable crop which is widely used for table purpose and is eaten as salad almost everywhere in the world. Its importance doubles with the fact that it is one of the oldest vegetable crops i.e. more than 3000 years (De Candolle 1882) and its origin is confined in India (Harlan 1975). Cucurbitaceae family consists of 130 genera and 800 species (Jeffrey and De Wilde 2006). At present the cucumber and gherkins covers an area of 198518 ha in the world producing 75219440 tonnes with the productivity of 37.90 t/ha (FAO 2020) whereas in India cucumber is grown in an area of 109000 hectares with a production of 1696000 tonnes and productivity of 15.56 t/ha (NHB 2021). However, cucumber in Bihar state covers an area of 3,640 hectares with an annual production and productivity of 67,670 tonnes and 18.59 t/ha respectively (Anonymous 2019). The cucumber productivity of India/Bihar is almost half compared with the world's productivity. Hence there is a need to enhance the productivity of cucumber for competing at global level. To enhance the productivity, breeding techniques with high yielding varieties/hybrids or novel technologies *viz*., protected cultivation, vegetable grafting are needed for the hour. Parthenocarpy is a much desired trait in cucumber production as it minimizes yield irregularity, enhances total yield and makes the production possible under sub-optimal environmental conditions (Chaudhari et al. 2016). The yield potential of parthenocarpic cucumber is higher as they don't require pollination for the fruit setting and hence results in more yields. Moreover, the parthenocarpic cucumber hybrids are of gynoecious nature and thus every flower in the plant is pistillate which develops into a fruit with the influence of parthenocarpy.

Vegetable grafting is a technique which can cater the needs of increasing productivity up to some levels. The main objective of vegetable grafting technology is to

increase yield under the influence of biotic and abiotic stresses. It is generally used to enhance the production and vigour of the horticultural crops. The vegetable grafting was first recorded in Japan in 1920 where watermelon (*Citrullus lanatus* L.) plant was first grafted onto bottle gourd (*Lagenaria siceraria* L.) to prevent the crop from *Fusarium* wilt (Kawaide 1985). Now a day, grafting is one among the popular methods of producing plants in cucurbitaceous and solanaceous vegetables in Japan, Korea, China and USA (Lee and Oda 2003). Among Asian countries, Japan, Korea, and China have major grafted seedlings production share while in the European continent, Spain is the leader in grafted seedlings production followed by Italy and France (Kubota et al. 2008). The inventors of the grafting techniques were Chinese ancestors and the records are found in an ancient book of first century BC. Grafting of vegetable crops was started during 19th century in solanaceous and cucurbitaceous crops but it is still in its infant stage (Kumar et al. 2015). Many public sector institutes are working on vegetable grafting in India viz., Indian Institute of Horticultural Research, Bengaluru; Department of Vegetable Crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore; National Bureau of Plant Genetic Resources (NBPGR) Regional Station, Thrissur, Kerala; Department of Vegetable Science and Floriculture, Chaudhary Sarwan Kumar Himachal Pradesh Krishi Viswavidyalaya, Palampur, Himachal Pradesh; Division of Vegetable Production, Indian Institute of Vegetable Research, Varanasi, Uttar Pradesh; Department of Vegetable Science, ASPEE College of Horticulture and Forestry, NAU, Navsari, Gujarat; Bidhan Chandra Krishi Viswavidyalaya, West Bengal, etc. Some of the private institutions are also involved in vegetable grafting and commercial production and supply of grafted plants to the farmers namely, VNR Seeds Pvt. Ltd., Raipur (Chhattisgarh); Namdhari Seeds Pvt. Ltd., Bangalore, Jarvi Seeds Pvt. Ltd., Bharuch, Gujarat, and 'Takii Seed India Private Limited', Bangalore etc.

The success of grafting is generally influenced by genetic background, growth characters, anatomy, physiological and biochemical factors (Fan et al. 2015). Grafting in cucumber is mainly done for cold tolerance, resistance against *Fusarium* wilt and also for improvement of fruit appearance, quality and yield. Cucumber is mainly grafted on fig-leaf gourd (*Cucumis ficifolia* Bouche), squash, interspecific hybrid squash and pumpkin (Dhall 2015) for various benefits. The grafting work on parthenocarpic gynoecious cucumber is very less and there is very less understanding on the productivity potential and parthenocarpic behaviour of grafted plants. Considering above facts, the present experiment was first time undertaken at BAU, Sabour to come up with a feasible rootstock which can thus increase the productivity of the parthenocarpic cucumber under the protected environment.

Materials and Methods

The present experiment was conducted at the Polyhouse complex, Department of Horticulture (Veg. and Flori.), Bihar Agricultural College, Sabour, Bhagalpur (Bihar) and was laid out in randomised block design (RBD) with three replications and each replication contained six grafted plants. The experiment was conducted with nine rootstocks *viz*. Pumpkin (*Cucurbita moschata*) var. Chakor, Mahy-1 and Swarna Amrit, Bottle gourd (*Lagenaria sicereria*) var. Narendra Rashmi and Rajendra Chamatkar, Sponge gourd (*Luffa cylindrica*) var. Rajendra Nenua-1, Patna local; and monoecious Cucumber (*Cucumis sativus*) var. Swarna Sheetal. The scion was parthenocarpic cucumber (BRPCU-1). The grafting method employed in the study was one cotyledon grafting. The treated seeds of rootstocks were sown in disposable plastic cups with soilless media containing 50 per cent each of coco-peat and vermicompost. Grafting was performed when the rootstock and scion attained the similar size of stem and fully developed cotyledonary leaves. For matching the graft union at stem portion, the rootstocks seeds were sown earlier than scion. The grafting was performed inside the naturally ventilated polyhouse in the morning hours with the help of shaving blade. One cotyledonary leaf was slantly cut in the rootstock and at the same angle stem portion of scion was cut inversely. The cut portions of both the rootstock and scion were then matched carefully and joined with the help of grafting clip. For support, a stick was inserted in the plastic cups without damaging the root system. The grafted plants were then misted with water and kept in the grafting chamber for healing. The temperature (25-30 ÚC) and humidity level was maintained (more than 90 %) by spraying the plants with water for preventing the wilting. In about 7-12 days the plants regained their strength and started bearing true leaves.

The observations were recorded based on 22 characters *viz.,* graft survival rate (%), number of leaves per plant (20, 40, 60 days after transplanting and at final harvest), node number to first female flower, days to first female flower, days to first harvest, number of fruits per vine, fruit yield (Kg/vine), fruit weight (g), fruit length (cm), fruit girth (cm), root length (cm), root fresh weight (g), root dry weight (g), vine length (cm), total soluble solids (Úbrix), ascorbic acid content (mg/100g FW),

chlorophyll 'a' content (mg/g FW), chlorophyll 'b' content (mg/g FW) and total chlorophyll content (mg/g FW). The TSS of juice was estimated by using digital refractrometer. Ascorbic acid contents were estimated by titration method as described by AOAC (2001) and specified in mg/100g of fresh sample. The chlorophyll contents were estimated (Sadasivam and Manickam 1996) by taking five gram sample of fresh cut fruits and crushed in 10 ml of 80% acetone solution by using pestle and mortar and the samples were kept out for 48 hours under dark conditions. After 48 hours the samples were strained with the help of marking cloth or tea filter then readings were taken at wavelengths of 663 and 645 nm with the help of spectrophotometer.

Results and Discussion

The results for various traits are presented in Table 1a and Table 1b. In the present study, the graft survival rate was recorded 21 days after grafting. The maximum graft survival (94.45 %) was observed on pumpkin (Chakor) rootstock followed by the monoecious cucumber (Swarna Sheetal, 91.67 %). The rootstock of sponge gourd (Rajendra Nenua-1) recorded the minimum graft survival (58.33 %). The least graft survival might be observed due to the improper joint of vascular tissues or due to the graft incompatibility which led to improper graft union. Similar to these findings, Rojas and Rivero (2001) also opined that varietal variation is a significant factor in graft survival. Similar results were also reported in bitter gourd grafted on rootstock of fig-leaf gourd (Tamilselvi et al. 2013).

Early flowering is always favoured in any crop production programme, as it approximate that how much earlier we will get fruits ready for the market and fetch more profit. There is also a correlation between the early flowering and nodes to first female flower. Days to first harvest too holds its position in altering the yield by stretching the harvesting period of crop. Over all for all the earliness related traits, grafting combinations were observed with lower days to come in blooming on lower nodes than the non grafted control in the present study. The graft combination of parthenocarpic cucumber (BRPCU-1) and sponge gourd rootstock (Patna Local and Rajendra Nenua-1) produced first female flower at 2.42 and 2.58 nodes, respectively and were found significantly superior than control. The treatment combination of sponge gourd rootstocks (Patna Local and Rajendra Nenua-1) were earlier to flower (44.33 and 46 days, respectively) and were significantly superior than non-grafted control (52.67 days). Similar to our findings, Aslam et al. (2020) got ten days advance flowering in greenhouse grown cucumber grafted on different cucurbitaceous rootstocks than non grafted plants. The variation observed in the treatments might be due to graft compatibility issues and the variation observed in variety and rootstock affected the performance of grafting combinations (Rojas and Rivero 2001).

Leaves are the important organ for producing photo assimilates for the plants. They contain stomata on their surfaces through which absorption of carbon dioxide takes place which helps in photosynthesis. The larger and more the surface area more will be the photosynthesis. In the present study, the scion grafted on monoecious cucumber (Swarna Sheetal) rootstock gave significantly maximum number of leaves in

Table 1a: Mean performance for growth, yield and biochemical characters

Treatment	GS%	NFFF	DFF	LPP (20 DAT)	LPP (40 DAT)	LPP (60 DAT)	LPP (FH))	DFH	FW	FL (cm)	FG (cm)	FY (kg/vine)
BG_1 (Narendra Rashmi)	88.89	3.58	48.33	10.17	28.42	47.67	63.58	56.67	99.04	16.18	9.73	2.36
BG_2 (Rajendra Chamatkar)	83.33	3.00	54.33	10.33	28.17	43.25	61.58	59.00	115.81	14.60	10.80	2.68
P_1 (Chakor)	94.45	4.83	51.33	11.58	29.67	52.67	71.58	57.33	102.98	15.53	9.50	2.36
P_2 (Mahy-1)	83.33	3.58	52.67	12.00	31.42	53.83	75.17	58.67	103.42	15.43	9.90	2.52
P_3 (Swarna Amrit)	62.50	3.25	52.00	10.83	22.25	38.83	56.08	59.00	108.00	13.37	9.63	2.36
SG_1 (Rajendra Nenua-1)	58.33	2.58	46.00	7.42	18.25	30.17	42.42	56.00	109.12	14.90	9.60	2.30
SG_2 (Patna Local)	65.28	2.42	44.33	7.42	16.25	28.58	45.17	54.67	111.02	16.10	8.57	2.30
SQ (Jammu Local)	81.94	3.67	48.00	11.42	29.17	52.42	70.58	57.00	108.95	12.87	9.73	2.28
MC_1 (Swarna Sheetal)	91.67	3.67	52.00	13.75	32.83	49.17	71.42	55.33	120.48	19.27	12.10	3.19
Control- BRPCU-1 (Non-grafted)	100.00	4.00	52.67	12.08	28.08	47.08	67.08	57.33	109.00	14.60	10.10	2.90
C.D. ($P \leq 0.05$)	8.49	0.94	4.94	1.30	3.10	3.82	3.70	NS	9.24	1.10	0.97	0.16
SE(m) ±	2.84	0.31	1.65	0.43	1.04	1.28	1.24	1.04	3.09	0.37	0.33	0.05
C.V. (%)	6.06	15.69	5.70	7.03	6.78	4.98	3.43	1.46	4.91	4.16	5.65	3.66

SE (m) ± = Standard error (mean); CD (P d" 0.05) = Critical difference at 5% level of significance; CV (%) = coefficient of variation; GS = graft survival rate; NFFF = node to first female flower; DFF = days to first flowering; DFH = days to first harvest; LPP = number of leaves per plant; DAT = days after transplanting; FH = at final harvest; FW = fruit weight;; FY = fruit yield per vine; FL = fruit length; FG = fruit girth; NS=non-significant

Table 1b: Mean performance for growth, yield and biochemical characters

Treatment	NFV	VL (cm)	RL (cm)	RFW (g)	RDW (g)	TSS (°brix)	AA (mg/100 g FW)	CHL 'a' (mg/g FW)	CHL 'b' (mg/g FW)	Total CHL (mg/g FW)
BG_1 (Narendra Rashmi)	23.92	243.34	7.87	7.62	0.56	3.57	8.97	0.012	0.009	0.021
BG_2 (Rajendra Chamatkar)	23.17	228.68	7.70	6.23	0.34	4.37	9.00	0.016	0.015	0.030
P_1 (Chakor)	23.00	147.48	13.47	5.66	0.23	4.10	15.90	0.012	0.010	0.022
P_2 (Mahy-1)	24.33	154.15	13.30	3.61	0.15	3.13	9.27	0.014	0.012	0.026
P_3 (Swarna Amrit)	21.92	142.68	13.53	3.65	0.27	3.13	9.43	0.015	0.011	0.026
SG_1 (Rajendra Nenua-1)	21.08	145.43	11.23	3.69	0.31	2.87	9.33	0.008	0.009	0.017
SG_2 (Patna Local)	20.75	145.62	11.73	4.85	0.37	3.13	6.23	0.010	0.010	0.021
SQ (Jammu Local)	21.83	209.43	4.77	2.99	0.17	3.17	8.63	0.011	0.010	0.021
MC_1 (Swarna Sheetal)	26.50	253.45	14.17	5.06	0.38	3.23	11.30	0.013	0.012	0.026
Control- BRPCU-1 (Non-grafted)	22.90	255.55	15.40	7.23	0.65	3.13	11.03	0.009	0.009	0.018
C.D. ($P \leq 0.05$)	1.39	16.91	0.72	0.89	0.07	0.42	1.13	0.001	0.001	0.002
SE(m) ±	0.46	5.65	0.24	0.30	0.02	0.14	0.38	~0.000	~0.000	0.001
C.V. (%)	3.50	5.08	3.67	10.16	12.02	7.11	6.60	5.756	6.116	4.504

SE (m) ± = Standard error (mean); CD (P d" 0.05) = Critical difference at 5% level of significance; CV (%) = coefficient of variation; VL = vine length; NFV = number of fruits per vine; RL = root length; RDW = root dry weight; RFW = root fresh weight; TSS = total soluble solids; AA = ascorbic acid content; CHL = chlorophyll content

comparison with non-grafted control in earlier stages (20 and 40 days after transplanting). But at the later stages of crop growth, the pumpkin rootstocks (Chakor and Mahy-1) produced significantly maximum number of leaves. The variable performance for number of leaves was also reported by Noor et al. (2019), they found maximum and significantly higher number of leaves in bottle gourd rootstocks than ridge gourd, bitter gourd and pumpkin rootstocks grafted with cucumber scion with splice grafting when comparing with non grafted cucumber. Cucurbitaceous crops are known for their viny growth habit which is an important indicator of plant vigour and growth. The results obtained in present study indicate that none of the grafting treatments were able to surpass the vine length than the non grafted control. The treatment combinations of monoecious cucumber (Swarna Sheetal) followed by bottle gourd (Narendra Rashmi) were found comparable with non grafted control for vine length in statistical terms. Rest all the treatment combinations revealed significantly lower vine length. Contrary to our results, various researchers reported that grafting results in taller vegetable plants namely, Aslam et al. (2020) in grafted cucumber; Tamilselvi (2014) in grafted bitter gourd). Though ShengPing et al. (2006) observed intermediate results for plant height when cucumber was grafted on bur cucumber than pumpkin and non grafted plants. Root length, root fresh weight and root dry weight are the important criteria to judge the bond of graft union and thereby translocation of nutrients and water to the scion. In general, for all these parameters lower values were observed in all the treatments including non grafted control, which might be due to the hindrance of biotic factors (nematode or *fusarium* infestation inside the polyhouse). Krishnaveni and Subramanian (2002) too reported significant decrease in root length of cucumber in presence of *M. incognita* inoculums in the field.

In any improvement programme, fruit yield, number of fruits, fruit weight, fruit length and fruit girth are the traits which are given special recognition as the performance of different genotypes and technologies (graft combinations) for these traits have a direct bearing on liking by the consumers and monetary returns to the growers. In the present study, the graft combination of monoecious cucumber (Swarna Sheetal) rootstock and parthenocarpic cucumber (BRPCU-1) recorded significant and maximum values for all the yield related traits than non grafted control. Zhen et al. (2011) also corroborated that the self grafted cucumber was better for yield related traits. Along with this, results also revealed significant differences in grafting treatments for all the yield related parameters. For fruit yield, all the grafting rootstocks except monoecious cucumber rootstocks showed significant lower yields. Guan et al. (2020) observed significant lower yield in grafted cucumbers on fig leaf gourd rootstocks than non grafted cucumbers. Whereas for number of fruits per vine, all the grafting combinations were observed with at par and significant superior values except for both the rootstocks of sponge gourd (Rajendra Nenua-1 and Patna Local). On an average all the treatments resulted in longer fruits and intermediate girth of fruits. The results obtained in the present study for fruit length and fruit girth are in line with the earlier reports of grafted musk melon (Bie et al. 2010) and watermelon (Mohamed et al. 2012). The weight of fruit was also on the higher side in almost all the grafting combinations. Velkov and Pevicharova (2019), Noor et al. (2019) and Aslam et al.

(2020) in grafted cucumber also opined similar findings for these traits.

Now-a-days people are more concerned for the nutritional aspects. The nutritional merits of cucumber vary with cultivar to cultivar. Many researchers claim that quality characters are not significantly influenced through grafting (Hoyos 2001; Salam et al. 2002; Zhong and Bie 2007; and Bruton et al. 2009). On the contrary, Tamilselvi (2014) opined that rootstock may alter the quality parameters. There are many conflicting reports on alteration of quality parameters through grafting techniques. The differences may be attributed to variable environments, rootstock and scion combination and most importantly the harvesting time. Total soluble solid (TSS) is one of the most important qualitative traits taken in wide range of crops and for it, high values are always desirable. In the present study, the bottle gourd (Rajendra Chamatkar) rootstock grafted with the scion of parthenocarpic cucumber revealed significant and high TSS than non grafted control. Similar to these results Aslam et al. (2020) too observed higher TSS in bottle gourd rootstocks (5.17 $^{R"}$brix) than non-grafted cucumbers (4.65 $^{R"}$brix). Cucumber is a fair resource of ascorbic acid content and other antioxidants with neutracuetical values. The present study showed that the pumpkin rootstock (Chakor, 15.90 mg) recorded significantly superior ascorbic acid content than non grafted parthenocarpic cucumber control (11.03 mg). These results are corroborated with the findings of Tamilselvi (2014) in grafted bitter gourd. Cucumber fruit serves both roles as a sink and source organ for its photosynthesis and thus lowers the carbon losses which ultimately affects the fruit growth (Sui et al. 2017). Apart from photosynthesis the chlorophyll also plays an important role in developing attractive colour and is being utilized by extraction for various nutraceutical and pharmaceutical uses. In the present study the chlorophyll content in general for all the grafting combinations was significantly superior to the non-grafted control. The bottle gourd (Rajendra Chamatkar) rootstock combination recorded highest chlorophyll 'a', chlorophyll 'b' and total chlorophyll content. In the findings of Liu et al. (2011), it was also observed that grafting improved photosynthesis and carbohydrate metabolism and thereby increased chlorophyll 'a', chlorophyll 'b' and total chlorophyll content in muskmelon and also corroborated that the ratio of chlorophyll 'a', chlorophyll 'b' and total chlorophyll content not alters. Significant differences were also observed among the graft combinations with respect to total chlorophyll contents of leaves in grafted bitter gourd (Tamilselvi 2014).

It can be concluded that the graft combination of monoecious cucumber (Swarna Sheetal) as rootstock and parthenocarpic cucumber as scion was the best for yield, and the rootstock bottle gourd (Rajendra Chamatkar) for quality purpose. From the study it was found that genotypic variability in selection of rootstock shows significant different results. Hence, to avail maximum benefits, the specific rootstocks can be identified before adopting the grafting technique at commercial level.

सारांश

उपज और गुणवत्ता के लिए पार्थेनोकार्पिक खीरे पर ग्राटिग के प्रभाव को जानने के लिए वर्ष 2019–20 के दौरान एक प्रयोग किया गया। इस अध्ययन में 9 मूलांकुर सम्मिलित किये गया जिनमें कद्दू से तीन, लौकी से दो, तुरई से दो, समर स्क्वैश से एक और द्विलिंगी खीरे की एक प्रभेद रखे गये। पार्थेनोकार्पिक खीरे को एकल बीज पत्र (कोटिलेडोन) ग्राटिग विधि अपनाकर मूलांकुर के रूप में उपयोग किया गया। प्राकृतिक रूप से हवादार पॉलीहाउस में 3 बार प्रतिकृति और 10 उपचार संयोजनों के साथ यादृच्दिक खण्ड आकार (आर. बी.डी.) में प्रयोग किया गया। कुल आंकड़ें 22 मात्रात्मक और जैव–रासायनिक लक्षणों के लिए दर्ज किया गया और विश्लेषण के अधीन, सभी लक्षणों ने पहली फसल तुड़ाई के दिनों को छोड़कर महत्त्वपूर्ण भिन्नताएं प्रदर्षित की। अधिक ग्राट जीवित (ग्राटिग के 21 दिनों बाद) कद्दू (चकोर) के मूलांकुर पर ग्राट किए गए पार्थेनोकार्पिक ककड़ी (बी.आर.पी.सी.यू.–1) में दर्ज किया गया और सबसे कम तुड़ाई (राजेन्द्र नेनुआ–1) में दर्ज किया गया। द्विलिंगी खीरे किस्म स्वर्ण शीतल मूलांकुर से औसत फल वजन (120.48 ग्राम), फल उपज (3.19 किग्रा. प्रति पौध) और फलों की लम्बाई (1927 सेमी.) के लिए गैर–ग्राटेड नियंत्रण की तुलना में उच्चतम और महत्त्वपूर्ण रूप से बेहतर मूल्यों के साथ पाया गया। लौकी की किस्म राजेन्द्र चमत्कार के मूलांकुर के साथ पार्थेनोकार्पिक खीरे का सांकुर (बी.आर.पी.सी.यू.–1) के ग्राट संयोजन में कुल घुलनशील ठोस पदार्थ की मात्रा काफी अधिक पायी गयी जबकि कद्दू मूलांकुर (चकोर) में नियंत्रण की तुलना में काफी बेहतर कुल एस्कार्बिक एसीड मात्रा पायी गयी। ग्राटिंग के सभी उपचारों ने गैर–ग्राटेड नियंत्रण की तुलना में काफी बेहतर कुल क्लोरोफिल मात्रा को प्रदर्शित किया। इस प्रयोग से यह निष्कर्ष निकाला गया कि द्विलिंगी खीरे के मूलांकुर (स्वर्ण शीतल) पर ग्राट किए गए पार्थेनोकार्पिक खीरे ने उच्चतम उपज दर्ज की जबकि लौकी के रूटस्टॉक (राजेन्द्र चमत्कार) में गुणवत्ता के मामले में सर्वश्रेष्ठ प्रदर्शन किया।

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