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Original Article

Response of Different Grafted Eggplants in Protected Culture

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Abstract

The study has been conducted in a professional greenhouse where grafted seedlings and grafted eggplants have been produced. Two eggplant hybrids, 'Classic F1' and 'Black Pear F1' were used as scion and one of the *Lycopersicon* genus, 'Kaiser F1' and three *Solanum* genus, 'L1S', 'L23B' and 'Torpedo' were used as rootstocks, resulting in eight grafted combinations. It has been observed that for all grafting combinations the grafting percentage was ranging from 95% to 98%. The rootstocks utilized have influenced the vigour of the grafted plants. They influenced plant height which reached values of roughly 1.0 m and number of leaves resulting in values of 2.5-3.0 times higher in comparison to the ungrafted plants. Comparative to the ungrafted plants the grafting combinations also influenced the productivity of plants. The highest fructification potential has been observed at 'Classic F1' grafted on all eggplant rootstocks. Compared to ungrafted plants, which has yielded 2.46 kg per plant, the highest yield obtained from 'Classic F1' grafted on 'L23B' has been of 4.27 kg per plant, followed by 'Torpedo' rootstock with 4.1 kg per plant. 'Black Pearl F1' have been produced 4.15 kg per plant when grafted on the 'Kaiser F1' rootstock and 4 kg per plant when grafted on the 'Torpedo' rootstock. Regarding the production per hectare, the largest production augmentation, of 30%, was noted at 'Classic F1' grafted on the eggplant rootstock 'L23B'. The 'Black Pearl F1' grafted on the tomato rootstock 'Kaiser F1' registered a 20% increment in production. The rootstocks utilized have slightly influenced the content of the soluble dry substance on both hybrids grafted on 'Kaiser F1'. The result has been a 6% dry substance in comparison to the 5.3% at the ungrafted hybrids. The grafting has had an insignificant influence of the total amount of carbohydrates at all grafting combinations.

Keywords: greenhouse, production, rootstock, scion, seedlings

Introduction

Plant grafting has been practiced for more than 2000 years (Haroldsen *et al*., 2012). However, vegetables grafting is a much more recent practice which has been introduced in Europe at the end of the 20th century. From Europe it has been introduced in North America and over the last 50 years in East Asia as well, with grafting methods being continuously improved. Nowadays both conventional and organic vegetable gardeners are showing high interest for use of grafted plants (Kubota, 2008). Vegetable grafting is an alternative method to soil fumigation with methyl bromide (Echevarria, 2004; Miguel *et al*., 2004; Yetisir *et al*., 2003, 2007; Bogoescu *et al*., 2010) which has been banned according to the Montreal Protocol on Substances because of its negative impact on the ozone layer. Since 2005 Romania, as a signatory to this agreement, has prohibited the use of methyl bromide for soil disinfection by the Law 159/2000 (Bogoescu and Doltu, 2014).

Vegetable grafting is aimed to produce plants with higher resistance to soil diseases and pests but also to stress caused by abiotic factors. For tomatoes and eggplants it can be the technological solution for solving disease and pest

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problems (Leonardi and Giuffrida, 2006). Eggplants have a greater susceptibility to diseases and pests, especially to *Fusarium, Verticillium* and nematodes (Elekcioglu *et al*., 1994; Collonnier *et al*., 2001), causing yield loss of up to 78% in infested areas (Blestos *et al*., 2003). Eggplant production decreases significantly at the *Verticillium* attack, but the use of resistant rootstocks is an effective method of control upon this disease (Na Liu *et al*., 2009). Grafted seedlings have higher productivity and resistance to soil diseases *(Fusarium spp., Verticillium spp.*) and pests (nematodes) (Tarchoun *et al* 2005; Bogoescu *et al*., 2008). King *et al*. (2010) and Lee (1994) appreciated that grafting gives resistance to pathogens, soil pests, tolerance to abiotic stress, improves the absorption of water and nutrients and increases scion vigour. Blestos and Olympios (2008) showed that grafting on *Solanaceae* is an approach to reduce the incidence of disease and pest attack, similar to crop rotation.

Petran (2013) has noticed that tomatoes are compatible with *Solanum torvun* rootstocks obtained from seeds for which the survival percentage has been of 80-100%. Comparatively, the rootstocks obtained from cuttings showed a percentage of only 50%. The survival rate of grafted eggplants also depends on the environmental conditions. Thus, Johnson and Miles (2011) obtained an average survival rate for grafted eggplants of 82%. However the value has dropped from 90% to 60% when relative humidity has also decreased which proves that eggplants need a high relative humidity (98%).

Similar values of the stem diameters of scion and of rootstock are essential to obtain a high grafting percentage (McAvoy, 2005; Bogoescu *et al*., 2009; Doltu *et al.,* 2013). It ensures close contact between the two plant fragments (Assenza, 2004) and vascular continuity through the two of them (Yassin and Hussen, 2015). The growth rate of scions and rootstocks seedlings can be different. Therefore, different dates are recommended for the seeding of rootstocks and scions. Bogoescu *et al*. (2013) has observed that the rootstock 'Emperador' (genus *Lycopersicon*) needs to be seeded 5 days after the seeding of eggplant scion cultivars ('Aragon' and 'Luiza') and the 'Torvum vigor' rootstock (genus *Solanum*) 20 days before seeding the scion.

The results regarding fruit quality of grafted plants and yield value are controversial as it has been proved by several authors (Davis *et al*., 2008; Moncada *et al*., 2013). Bogoescu and Doltu (2015) have showed that the carbohydrate content (2.54-2.97%) at ungrafted eggplants has been higher in comparison to the grafted plants cultivated under the same technological conditions (1.92-2.00%). Romano and Paratore (2001) have showed that grafting impacts slightly the characteristics of fruits. The most popular rootstocks for eggplants are tomatoes (Ioannou, 2001) and the wild species *Solanum torvum* Sw., *Solanum integrifolium* Poir. and *Solanum sisymbriifolium* Lam. (Lee, 1994; Blestos *et al*., 2003). Vigorous eggplant of wild relatives and interspecific hybrids are increasingly used for eggplant (Kaushik *et al*., 2016). However, there are few results on the effect of *Solanum* rootstock and grafted eggplants yield and quality of fruit on uninfected soils (Çürük *et al*., 2005) and for *Verticillium* infected soils (Blestos *et al*., 2003; Çürük *et al*., 2009).

Eggplants cultivation in Romania is important for vegetable gardeners and consumers and thus the soil infestation with diseases and pests can produce significant prejudice. One of the solutions of loss reduction is the use of grafted seedlings on resistant rootstocks. The present study has been aimed to obtain grafting combinations of eggplant rootstocks and cuttings from the *Solanum* and *Lycopersicon* genus and to test them in culture in order to observe their growth and fructification in comparison to the ungrafted plants. The present paper asserts the results of the comparative study between grafted plants on several rootstocks and ungrafted plants.

Materials and Methods

Biological material

The study has been conducted between 2015 and 2016 at the Horting Institute Bucharest, Romania. The research involved two stages as it follows: the first phase consisted of producing grafted eggplant seedlings by using specific technology of vegetable grafting and the second phase consisted of comparing the grafted seedlings in a Venlo greenhouse in order to observe the growth and the production of plants.

The biological material used was represented by two eggplant hybrids, the 'Classic F1' and the 'Black Pearl F1', which were the scions and four rootstocks, one of the tomato genus, 'Kaiser F1' and three of eggplant, 'Torpedo', respectively 'L1S' and 'K23B' (two selections, obtained by VRDS Buzau Romania).

The study has been implemented in a randomized complete block design with four grafting combinations and the ungrafted control for each hybrid used. At every combination and at control 90 plants were used in 3 replications of 30 plants each resulting in the following experimental scheme, respectively variants: V1 - 'Classic F1' × 'L1S'; V2 - 'Classic F1' × 'Kaiser F1'; V3 - 'Classic F1' × 'L23B'; V4 - 'Classic F1' × 'Torpedo'; V5 – 'Classic F1' control (ungrafted); V6 – 'Black Pearl F1' × 'L1S'; V7 - 'Black Pearl F1' × 'Kaiser F1'; V8 - 'Black Pearl F1' × 'L23B'; V9 - 'Black Pearl F1' × 'Torpedo'; V10 - 'Black Pearl F1' control (ungrafted).

'Classic F1' has oval shaped fruits, dark indigo in color, with an up to 1.5 kg in weight and a length of 15 cm. The plant is vigorous, average in size and well adapted to field conditions and protected areas. The vegetation time is of 75 days.

'Black Pearl F1' has semi-long fruits, dark indigo in color, shiny, firm, homogenous and transport resistant. It is a productive hybrid, with a compact habitus, highly recommended for field culture and protected areas.

'Torpedo' is an eggplant rootstock very vigorous which is highly compatible with grafting and very resistant to the nematodes *Fusarium* and *Verticillium*.

'Kaiser F1' is a tomato rootstock very vigorous which impacts the grafted plant with a harmonious growth. It is recommended for protected areas. Is it very resistant to the attack of the nematodes *Fusarium* sp., *Verticillium*, Wilt and ToMV.

'L1S' and 'L23B' are eggplant hybrids from the *Solanum melongena* species obtained at VRDS Buzau, Romania

(Vegetable Research-Development Station) and are being tested as rootstocks at Horting Bucharest. They are homogenous, have genetic stability and high tolerance for the diseases and pests present in soil (Vînătoru *et al*., 2013).

Producing grafted seedlings

The seedlings have been produced in a 1450 m^2 professional greenhouse covered with a double plastic film with underpressure air filling and equipped with heating, ventilation, shading and cooling systems.

The scions and rootstocks has been made in 70 alveolar plates with a capacity of 50 ml per alveolus, using as substrate a peat with a grain size of 0-10 mm, 1 kg m^{-3} content in NPK, microelements B, Mg, Cu, Mn, Zn, Fe and S (0.050 kg m^{-3}), limestone (4-7 kg m^{-3}), pH 6 and humidification agent 100 ml m^{-3}. Scion eggplants hybrids ('Classic F1' and 'Black Pearl F1') have been seeded at the same time but the rootstocks have been seeded at different dates. *Lycopersicon* genus rootstock ('Kaiser F1') has been seeded 5 days after the scion because they grow faster and *Solanum* genus rootstocks ('L1S', 'L23B' and 'Torpedo') have been seeded 20 days earlier than scions. Grafting has been made when both scion and rootstock plants have had stem diameters of 2-3 mm thick because grafting compatibility is dependent on similar values of thickness. The grafting method utilized in the experiment has been in simple copulation by performing a 45° cut on the rootstock stem. A silicone sleeve has been applied over the cut; the scion was cut at 45° and placed in the silicone sleeve, ensuring that the overlapping of the two cuts was perfect and also ensuring a close contact between scion and rootstock. After grafting the plants have been placed in callus tunnels for a period of 7 days at a temperature of 25-26 °C, humidity of 98-99%, in the absence of light for the first 3 days. After that they have been gradually exposed to light. Seedlings have been managed by following specific technology for producing vegetable seedlings until they were planted in the greenhouse. The number of seedlings studied was of 140 for each grafting combination, respectively 2 alveolar pallets of 70 plants each.

Culture foundation and experimental design

The culture was founded at the end of June in a 3.5 m Venlo greenhouse, without heating systems, with a metallic structure, covered in glass. Following soil preparation the fertilization was made with fertilizer complex 18:18:18 (N:P:K), 300 kg ha^{-1}, and then manure embedment, crumbling and levelling the soil have been performed. At grafted plants the planting was made on a flat surface in rows at 100 cm apart and at 55 cm in between plants per row, resulting in a density of 18,000 plants ha^{-1}. At ungrafted plants the planting distance was of 100 cm in between rows and 40 cm in between plants, resulting in a density of 24,000 plants ha^{-1}, thus having a lower vigour than the grafted ones.

During the vegetation time specific eggplant culture works in protected areas have been applied. The watering has been made through dropping, maintaining soil humidity at 80% from total water potential of field. The fertilization in phases has been made at every 10 days with complex fertilizer 15:15:15 (N:P:K) using 1 g per plant. The temperature was maintained at normal degrees (25-30 °C) through mechanical ventilation and shading. Fruit harvesting started in the first decade of September for 'Black Pearl F1' and in mid-September for 'Classic F1', continuing until the beginning of November.

Plant sampling and biometrical determinations

The percentage of successful grafted plants was obtained by comparing the number of healthy grafted seedlings to the total grafted plants for each grafting combination.

Biometric measurements concerning plant growth (i.e. height and number of leaves) and fructification (i.e. number of fruits per plant, average weight of fruits, total yield on the plant and per hectare) have been performed during the cropping period. Five randomly selected plants per plot were chosen at the beginning of the cropping season to determine the growth parameters.

Fruit sampling and chemical analysis

The analysis has been performed at Horting Bucharest using five fruits per variant when they were roughly 20 cm long and with high elasticity. The soluble dry substance has been determined using the WM-7 digital refractometer with a precision of ±0.1% by ATAGO, with a drop of fruit juice and the result has been displayed on a graduated scale; after each sample the sample area has been washed with distilled water.

Total carbohydrates amount has been determined by the Bertrand method which consists of extracting the carbohydrates from the product with the help of water, purifying the plant extract and dosing reducing sugars in the purified extract (Gardner and Maclean, 1914; Alexe *et al.,* 2012).

Statistical analysis

In what regards the production the results obtained have been statistically processed by the variant analysis method. The calculation has been made for 3 levels of significance: 0.05, 0.01 and 0.001. The regression equation and measurement coefficient has been calculated for each hybrid to highlight the correlation between production and dry substance on one hand and between production and carbohydrates on the other. Moreover, the Duncan test has also been used to determine the 0.05 significance level.

Results and Discussion

Plant development

The grafting percentage has been observed to be between 95% and 98%, which showed a very good compatibility between scion and rootstock, both being from the same botanical family (Table 1). Plant compatibility at grafting has also been influenced by their diameter (McAvoy, 2005; Bogoescu *et al*., 2009; Doltu *et al*., 2013) which had values of 2-3 mm both at scion and rootstock, thus ensuring a perfect cover of the grafting area and a continuing vascularisation. The highest grafting percentage was recorded at the 'Classic F1' grafted on 'L23B' (98%) and the lowest at 'Classic F1' grafted on 'L1S' (95%); similar

Table 1. The percentage of plants resulted from grafting combinations (%)

Rootstock	Scion	
	'Classic F1'	'Black Pearl F1'
'L1S'	95b	96a
'Kaiser F1'	97ab	97a
'L23B'	98a	97a
'Torpedo'	96ab	97a

Note: Different letters between variants denote significant differences (Duncan test, $p < 0.05$).

grafting percentages were recorded at the 'Black Pear F1', 96% grafted on 'L1S' and 97% on the other rootstocks used.

The height of the eggplant plants has been influenced by the rootstocks, leading to a higher plant growth (Fig. 1). At the 'Classic F1' hybrid, the influence of 'L23B' and 'Torpedo' rootstocks has been visible, the plants being 121.5 and 119.9 cm high in comparison to 93.2 cm at control. At the 'Black Pear F1' the results were similar but at this hybrid the influence of the *Lycopersicon* genus rootstock has impacted the height of plants. The height was 119.4 cm for the plants grafted on the 'Kaiser F1' rootstock and for the plants grafted on the 'Torpedo' rootstock of 120.1 cm, compared to 89.1 cm at control.

The vigour of plants has also been determined through the number of leaves formed. It has been observed that at grafted plants at both hybrids studied the number of leaves was 2.5-3 times higher than at control, which demonstrates that eggplant grafting is a good method of producing planting material in order to obtain vigorous plants with high productive potential (Fig. 2).

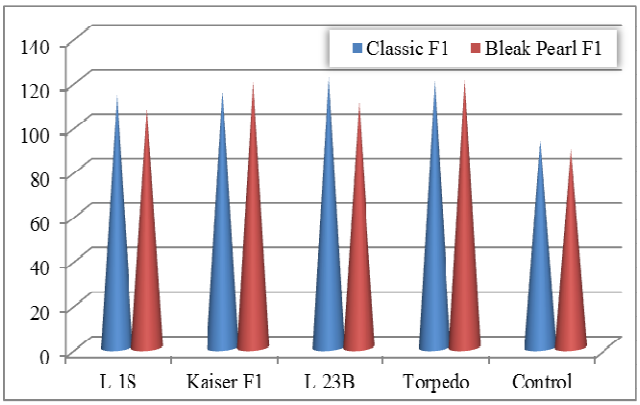

Fig. 1. Influence of rootstock on plant height (cm)

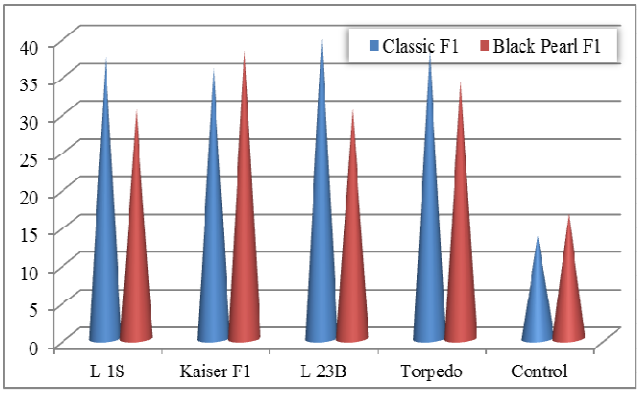

Fig. 1. Influence of rootstock on plant height (cm)

Fructification

The productive capacity of grafted plants studied through several indicators has been influenced by the rootstock used to produce seedlings. At the 'Classic F1' it has been noted that grafted plants formed more fruits than the control (Table 2). The 'Classic F1' grafted on 'L23B' and 'Torpedo' has formed over 10 fruit per plant and grafted on 'L1S' produced 9.76 fruits. Very good results have also been obtained at grafted plants on tomato rootstock 'Kaiser F1', with 9.49 fruits. Data from the specialty literature has showed that the cultivar 'Rima' grafted on the tomato rootstock formed 53% and 60% more fruits respectively in comparison to control in greenhouse and in field (Khah, 2005). Average fruit weight, 400 g, has been higher for those obtained from plants grafted on 'Torpedo' and the smallest fruit average weight has been obtained from control, 375 g. Regarding production obtained on plant the rootstock used has had a large influence. Thus, the 'L23B' and 'Torpedo' rootstocks have determined the largest fruit production of over 4 kg of fruit per plant, followed by 'Kaiser F1' tomato rootstock with 3.78 kg per plant, compared to the same control on which fruit production per plant was 2.46 kg. The absolute difference in plant production due to rootstock influence has been between 1.27 kg for 'L1S' and 1.80 kg for 'L23B' rootstock. Translated as a percentage, this difference has been between 51.66% for the 'LS1' rootstock and 73.58% for the 'L23B' rootstock. Eggplant production at hectare was higher at grafted plants than at control, ranging from 67.2 tons to 76.9 tons, compared to 59.1 tons at control. A small difference in production between the grafted and the control was due to a larger number of control at the surface unit (hectare). The highest yield per hectare, 30%, has been obtained at grafted plants on the 'L23B' rootstock. Analyzing the results obtained, statistically, it has been observed that at both productionplant^{-1} and production ha^{-1} the rootstock has had a significant positive influence.

Plant grafting has stimulated the formation of a larger number of fruits. At 'Black Pearl F1' the difference was 26% higher in comparison to control (Table 3). It has been observed that the largest number of fruits has been obtained at grafted plants on tomato rootstock 'Kaiser F1' with 9.92, followed by 'Torpedo' with 9.66 fruits, 'L23B' with 9.41 fruits and 'L1S' with 9.34 fruits, all compared to 6.67 fruit at control. The average fruit weight has slightly been influenced by the rootstock used, 'Kaiser F1' and 'Torpedo', resulting in an average weight of 417.59 g and respectively 414.34 g. Fruit production per plant has greatly been influenced by the rootstock. The largest production was obtained at grafted plants on the tomato rootstock 'Kaiser F1', 4.15 kg. Large production was also obtained at the grafted plants on the 'Torpedo' rootstock, 4.00 kg, followed by the 'L1S' and 'L23B' rootstock with 3.62 kg. From a

Table 2. Productive capacity of 'Classic F1' grafted on different rootstocks

Variant	Number of fruits per plant	Average fruit weight (g)	Average production (kg plant^{-1})	Difference of production per plant		Average production (t ha^{-1})	Difference of production per ha	
				kg	%		t	%
V 1	9.76c	382.36b	3.73***	1.27	151.66	67.2***	8.1	113.71
V 2	9.49d	398.62a	3.78***	1.32	153.66	68.1***	9.0	115.23
V 3	11.22a	380.71b	4.27***	1.81	173.58	76.9***	17.6	130.12
V 4	10.25b	400.04a	4.10***	1.64	166.67	73.8***	14.7	124.88
V 5 (Ct)	6.56e	375.03b	2.46	0	100	59.1	0	100
LSD 5%			0.15			0.5		
LSD 1%			0.23			0.7		
LSD 0,1%			0.34			1.1		

Note: Different letters between variants denote significant differences (Duncan test, $p < 0.05$).
* = significant at 5%; ** = significant at 1%; *** = significant at 0.1%

Table 3. Productive capacity of 'Black Pear F1' grafted on different rootstocks

Variant	Number of fruits per plant	Average fruit weight (g)	Average production (kg plant^{-1})	Difference of production per plant		Average production (t ha^{-1})	Difference of production per ha	
				kg	%		t	%
V 6	9.34c	387.87b	3.62***	1.03	139.77	65.2 ns	3.0	104.83
V 7	9.92a	417.59a	4.15***	1.56	160.24	74.7 ***	12.2	120.10
V 8	9.41c	384.76bc	3.62***	1.03	139.77	65.2 ns	3.0	104.83
V 9	9.66b	414.34ab	4.00***	1.41	154.44	72.0 **	9.8	115.76
V10 (Ct)	6.67d	388.26b	2.59	0	100	62.2	0	100
LSD 5%			0.35			5.2		
LSD 1%			0.51			7.6		
LSD 0.1%			0.77			11.4		

Note: Different letters between variants denote significant differences (Duncan test, $p < 0.05$).
* = significant at 5%; ** = significant at 1%; *** = significant at 0.1%

statistical point of view, all the grafted variants were significantly positive. The absolute production difference per plant was between 1.03 kg at plants grafted on 'L1S' and 'L23B' and 1.56 kg at plants grafted on 'Kaiser F1' rootstock. Production difference per plant has highlighted the 'Kaiser F1' rootstock providing a 60.24% increase compared to the same control. The highest production yield obtained per hectare, 20%, has been noted at plants grafted on the 'Kaiser F1' rootstock. From a statistical point of view the results were very positive for plants grafted on the 'Kaiser F1' rootstock and distinctly positive for grafted plants on the 'Torpedo' rootstock. The others were insignificant.

By comparing the production capacity of the two studied hybrids it has been showed that both hybrids have had very good results, the values obtained being similar (Table 4). The 'Classic F1' has had a slightly larger number of fruit per plan 9.45, which to a certain extent has influenced production per hectare. The 'Black Pearl F1' has been noted for a higher average fruit weight, 398.56 g and a slightly larger plant production, 3.59 kg respectively.

Fruits quality

The fruit content of soluble dry substance has had similar values at all variants (Table 5). It has been registered that fruits produced from grafted plants have had slightly higher dry matter content than those from control. However, according to some authors dry matter has decreased in grafted fruits (Çürük *et al.,* 2005; Davis *et al*., 2008). At both hybrids, the 'Kaiser F1'rootstock has directly influenced the content of the soluble dry substance. According to literature data (Gherghi *et al*., 2001) carbohydrate content has been slightly higher in fruits produced from grafted plants in comparison to the ones from ungrafted plants.

Analyzing the dependence between fruit production and soluble dry matter content, a small negative dependence was observed at both hybrids, $r^2 = 0.414$ 'Classic F1' $r^2 = 0.389$ hybrid on the 'Black Pear F1' (Figs. 3 and 4). Between fruit production per hectare and the total carbohydrate content the coefficient of determination was very weakly positive at 'Classic F1', $r^2 = 0.064$ (Fig. 5), and negative, more pronounced, at 'Black Pear F1', $r^2 = 0.508$ (Fig. 6).

Table 4. Hybrid influence on the production capacity at eggplants

Variant	Number of fruits per plant	Average fruit weight (g)	Average production (kg plant^{-1})	Average production (t ha^{-1})
'Classic F1'	9.45	387.35	3.52	6.90
'Black Pearl F1'	9.00	398.56	3.59	6.77

Table 5. Content of dry substance and total carbohydrates amount at eggplant fruits

Hybrid	Variant	Soluble dry substance %	Total carbohydrates (%)
'Classic F1'	V 1	5.80a	2.40a
	V 2	6.03a	2.50a
	V3	5.81a	2.43a
	V4	5.90a	2.47a
	V 5 (Ct)	5.30b	2.42a
	V 6	5.83a	2.54a
	V 7	6.00a	2.52a
'Black Pearl F1'	V 8	5.83a	2.54a
	V 9	5.95a	2.53a
	V10 (Ct)	5.32b	2.42a

Note: Different letters between variants denote significant differences (Duncan test, $p < 0.05$).

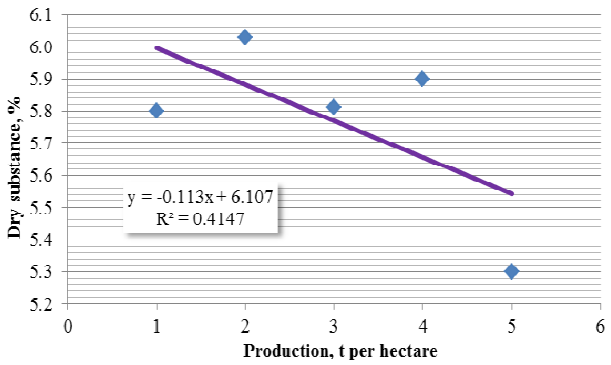

Fig. 3. The regression equation between production (t per hectare) and dry substance at 'Classic F1'

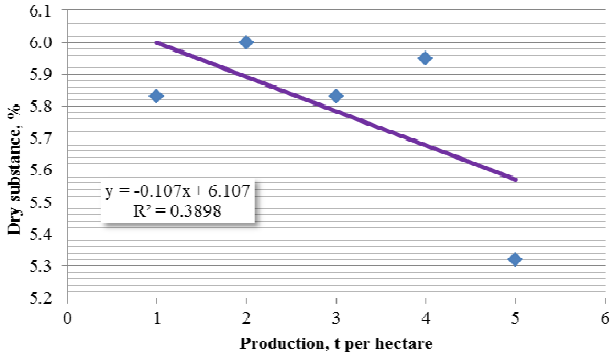

Fig. 4. The regression equation between production (t per hectare) and dry substance at 'Black Pear F1'

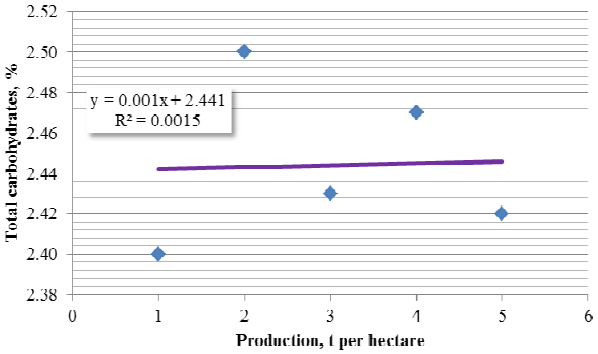

Fig. 5. The regression equation between production (t per hectare) and total carbohydrates at 'Classic F1'

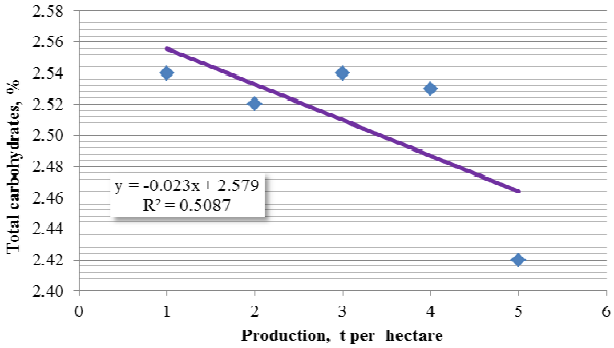

Fig. 6. The regression equation between production (t per hectare) and total carbohydrates at 'Black Pear F1'

Conclusions

Research on the production and cultivation of grafted eggplants has shown that this technique leads to producing plants with superior attributes compared to the ungrafted ones. Analyzing the influence of rootstock on the growth and fructification capacity of the grafted eggplants it has been found that all the rootstocks used have had a positive influence on plant growth. Grafted plants have exceeded the height of 1.0 m and the number of leaves has been 2.5 and 3.0 times larger than at control. In terms of average fruit weight there have been small differences between grafted and control, but at 'Classic F1' in all grafted variants the fruits have been larger than at control. 'Black Pear F1' grafted on 'L1S' and 'L23B' has formed slightly smaller fruits. The 'Classic F1' grafted on 'L23 B' and 'Torpedo' eggplant rootstocks has had a higher fructification capacity compared to control. The 'Black Pear F1' grafted on 'Kaiser F1' and 'Torpedo' has had the highest fructification capacity. In terms of production per hectare it has been higher at grafted plants. The largest production increment per hectare was of 30% for the 'Classic F1' grafted on 'L23B' and 20% for the 'Black Pear F1' grafted on 'Kaiser'. From the point of view of the biochemical composition of fruits there have been no differences between the grafted and control plants.

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