ACTA AGROBOTANICA
Vol. 67 (2), 2014: 93–98
Original Research Paper
DOI: 10.5586/aa.2014.012

INFLUENCE OF THE QUALITY OF MOTHER PLANTS ON SELECTED PARAMETERS OF *Fragaria* x *ananassa* 'ELSANTA' DAUGHTER PLANTS

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Received: 12.03.2013

A b s t r a c t

High quality planting material is the basis for good strawberry yields. The productivity of strawberry mother plants depends on many factors, but there is little published work on the effects of type and initial size of mother plants on the quality of daughter plants. In the presented study, strawberry mother plants (cultivar 'Elsanta') were grown in an unheated tunnel in plastic pots filled with peat-based substrate (5 dm^3). The aim of the study was to evaluate the influence of type (fresh-dug plants and frigo) and initial size (A and A+ plants) of strawberry mother plants on selected parameters of daughter plants (crown diameter, fresh and dry weight as well as number and area of leaves). The study was carried out in 2006 and 2007. Strawberry mother plants were planted in the second decade of April and daughter plants were detached in the second decade of August. All measurements were performed on the second daughter plant on the mother plant runner. Statistical analysis showed that type of mother plants had a significant effect on number of leaves in daughter plants. Daughter plants obtained from mother plants established from fresh-dug plants had the highest number of leaves. The initial size of mother plants significantly influenced the fresh and dry weight of daughter plants. Smaller mother plants ("A-size") produced daughter plants with higher fresh and dry weight. The results obtained in the second year of the study were affected by high incidence of powdery mildew.

Key words: *Fragaria* x *ananassa*, soilless nursery, daughter plants, crown diameter, leaf number

INTRODUCTION

Results of many studies show that low quality of transplants is the main limiting factor of strawberry crops [1,2]. A number of components have influenced strawberry yield, including type of planting material [3–5], crown diameter [2,6], initial plant weight [3,7,8], and number of leaves [9].

New planting technologies, such as containerized (plug) plants which are grown from the rooted tips of runners (also called 'runner plants' or 'daughter plants') in cell-trays, have been developed for strawberry production and they are replacing traditional bare-root transplants [9–13]. The use of containerized plug transplants improves plant survival at planting [6]. They are also easier to plant, require less irrigation during crop establishment, and produce higher fruit yield [3,6,14]. According to H o c h m u t h et al. [3], not only less water is required to establish plug strawberry plants than bare-root plants, but also they grow and form flowers more rapidly. Additionally, plants propagated from plugs give higher early fruit yield [15,16] and also picking costs are reduced up to 40%, because more fruit can be harvested per unit time [9].

Due to problems with soil-borne diseases, soilless nursery production of strawberry plants has gained popularity in some countries [9,10]. Despite the importance of quality of young strawberry plants, there is little available information related to nursery techniques [17]. According to some researchers [10,13,18], fresh or frigo mother plants can be used for the production of runner tips. Micropropagated plants are also used for this purpose [19]. Soilless nurseries are established in spring or autumn [9,13].

Productivity of strawberry mother plants depends on many factors, such as cultivar [18,19], cultivation conditions [18], density of mother plants [12], kind of substrate [11,20], and use of biostimulants [21,22].

Reports on the relation of type and size of mother plants with quality of runner plants (daughter plants) are scarce in the literature. The aim of the study was to evaluate the influence of type (fresh-dug plants and frigo) and initial size (A and A+ plants) of strawberry mother plants on selected parameters of daughter plants

such as crown diameter, fresh and dry weight as well as number and area of leaves.

MATERIALS AND METHODS

The study consisted of two experiments which were conducted in an unheated plastic tunnel (6.5 x 30 m) in the years 2006 and 2007. The aim of the study was to evaluate the influence of type (fresh-dug plants and frigo) and initial size – crown diameter ("A" with a crown diameter of 10–15 mm and "A+" with a crown diameter > 15 mm) of strawberry mother plants on the crown diameter of daughter plants, their fresh and dry weight as well as number and area of leaves. Both experiments (Experiment I and Experiment II) were set up in a split-block design with 4 replications and 4 treatments (2 types of mother plants x 2 initial sizes of mother plants). From each experimental plot (with 30 plants), a sample of 5 daughter plants was collected to measure.

In the second decade of April (Experiment I in 2006 and Experiment II in 2007), cv. 'Elsanta' strawberry mother plants were planted in plastic pots filled with 5 dm^3 of a peat-based substrate. There were 2 plants in each pot. Pots with plants were placed on a black polypropylene soil cover in 4 rows, approximately 1.5 m apart. Plants were fertigated with the liquid multi-nutrient fertilizer Kristalon Blue Label ($N:P_2O_5:K_2O$ 19:6:20 + microelements) at a concentration of 0.15%. The fertilizer was delivered via a drip system, controlled by a 'Galcon' electronic time-controller. One drip emitter was placed in the center of each pot. Flowers were removed as they formed on all mother plants.

The measurements in both experiments were conducted in the second decade of August (2006 and 2007) on the second daughter plant on the mother plant runner. Crown diameter of daughter plants was measured exact to 1 mm with a slide caliper. Dry weight was determined by the weighing method after drying the plants at a temperature of 105°C until constant mass was achieved. Leaf area per daughter plant was calculated using a scanner and 'Skwer' program.

The results were statistically evaluated by analysis of variance and comparison of means was done at $P \leq 0.05$ with the Newman-Keuls test.

RESULTS

The selected parameters of strawberry daughter plants, such as crown diameter, fresh and dry weight as well as number and area of leaves, were measured to estimate the influence of type (fresh-dug plants and frigo) and initial size (A and A+ plants) of mother plants. The results are presented in Tables 1–5.

Based on statistical analysis of the results, the study found that the quality of mother plants had a significant effect on some parameters of strawberry runner plants.

The initial size of strawberry mother plants influenced significantly fresh and dry weight of daughter plants (Tables 1 and 2). Smaller mother plants ("A-size") produced daughter plants with higher fresh and dry weight. The fresh weight of daughter plants varied from 5.22 to 12.24 g (Table 1) and the dry weight from 1.15 to 2.61 g (Table 2).

The type of mother plants significantly affected only the number of leaves in daughter plants (Table 4). Mother plants established from fresh-dug plants produced daughter plants with a higher number of leaves (3.95) than mother plants established from frigo plants (3.61).

The crown diameter and leaf area of daughter plants were unaffected by the quality of mother plants. They ranged 7.3–8.8 mm and 141–273 cm^2, respectively, as illustrated in Table 3 and Table 5.

The results obtained in the second year of the study were affected by high incidence of powdery mildew.

Table 1
Influence of type and initial size of 'Elsanta' strawberry mother plant on daughter plant fresh weight

Type of mother plant	Size of mother plant	Fresh weight of daughter plant [g]		Mean
		2006	2007	
Frigo	A+	9.53a*	5.25b	7.39A**
	A	11.25a	5.86b	8.55A
Fresh-dug	A+	10.55a	5.22b	7.89A
	A	12.24a	6.12b	9.18A
Mean for frigo plants		10.39a	5.56b	7.97A
Mean for fresh-dug plants		11.40a	5.67b	8.54A
Mean for A+ plants		10.04b	5.24c	7.64B
Mean for A plants		11.74a	5.99c	8.87A
Mean for years		10.89a	5.62b	

*Values in each part of the table followed by the same letter are not significantly different at α=0.05
**Values with capital letters should be compared separately

Table 2
Influence of type and initial size of 'Elsanta' strawberry mother plant on daughter plant dry weight

Type of mother plant	Size of mother plant	Dry weight of daughter plant [g]		Mean
		2006	2007	
Frigo	A+	1.84b*	1.08c	1.46B**
	A	2.30ab	1.19c	1.75AB
Fresh-dug	A+	2.27ab	1.15c	1.71AB
	A	2.61ab	1.33c	1.97A
Mean for frigo plants		2.07b	1.14c	1.60A
Mean for fresh-dug plants		2.44a	1.24c	1.84A
Mean for A+ plants		2.06b	1.12c	1.59B
Mean for A plants		2.46a	1.26c	1.86A
Mean for years		2.26a	1.19b	

*, **See Table 1

Table 3
Influence of type and initial size of 'Elsanta' strawberry mother plant on daughter plant crown diameter

Type of mother plant	Size of mother plant	Crown diameter of daughter plant [mm]		Mean
		2006	2007	
Frigo	A+	8.15abcd*	7.30d	7.72A**
	A	8.80a	7.50cd	8.15A
Fresh-dug	A+	8.40abc	7.55cd	7.97A
	A	8.55ab	7.80bcd	8.17A
Mean for frigo plants		8.47a	7.40b	7.94A
Mean for fresh-dug plants		8.47a	7.67b	8.07A
Mean for A+ plants		8.27a	7.42b	7.85A
Mean for A plants		8.67a	7.65b	8.16A
Mean for years		8.47a	7.54b	

*, **See Table 1

Table 4
Influence of type and initial size of 'Elsanta' strawberry mother plant on daughter plant leaf number

Type of mother plant	Size of mother plant	Leaf number of daughter plant		Mean
		2006	2007	
Frigo	A+	3.80bc*	3.25c	3.52B**
	A	3.80bc	3.60bc	3.70AB
Fresh-dug	A+	4.25ab	3.45c	3.85AB
	A	4.55a	3.55bc	4.05A
Mean for frigo plants		3.80b	3.42b	3.61B
Mean for fresh-dug plants		4.40a	3.50b	3.95A
Mean for A+ plants		4.02a	3.35b	3.68A
Mean for A plants		4.17a	3.57b	3.87A
Mean for years		4.10a	3.46b	

*, **See Table 1

Table 5
Influence of type and initial size of 'Elsanta' strawberry mother plant on daughter plant leaf area

Type of mother plant	Size of mother plant	Leaf area of daughter plant [cm^2]		Mean
		2006	2007	
Frigo	A+	206bc*	140d	173A**
	A	254ab	160cd	207A
Fresh-dug	A+	236ab	141d	189A
	A	273a	154cd	214A
Mean for frigo plants		230a	150b	190A
Mean for fresh-dug plants		255a	148b	201A
Mean for A+ plants		221b	141c	181A
Mean for A plants		263a	157c	210A
Mean for years		242a	149b	

*, **See Table 1

DISCUSSION

According to D'Anna and Iapichino [23], the rooting of strawberry runner tips can be successfully accomplished by using tips located at different positions along the runner. The results of several studies show that there is no consistent significant effect of the runner plant order on strawberry fruit production [7,23–26]. In our study, secondary runner plants were used for the measurements.

There is a lack of information in the literature concerning the relation of type and initial size of strawberry mother plants with the quality of runner plants. On the basis of the obtained results it was found that the quality (type and initial size) of mother plants had a significant effect on some parameters of strawberry daughter plants. In contrast to these results, [13] the study did not find the type and initial size of strawberry mother plants to be correlated with the quality of daughter plants.

According to Bish et al. [27,28], daughter plants with greater leaf development increased root growth during transplant propagation. In our study, the type of mother plants significantly influenced only the number of leaves in daughter plants. Daughter plants obtained from mother plants established from fresh-dug plants had the highest number of leaves.

In the present study, the initial size of mother plants significantly affected the fresh and dry weight of daughter plants. Smaller mother plants ("A-size") produced daughter plants with higher fresh and dry weight. In our study daughter plants varied in weight from 5.2 to 12.2 g. The average weight of a secondary daughter plant in the study conducted by Takeda et al. [7] was 6.7 g. These authors also proved that daughter plant weight declines with the increasing position of a runner plant on the runner. Their studies and other reports [14] showed a significant effect of daughter plant weight on plant yield. Kehoe et al. [29] demonstrated that the average fruit weight was higher from plants grown from large daughter plants. This is in contrary to the findings of Jansen [30] and Lieten [9].

In the present study, the crown diameter of secondary daughter plants cv. 'Elsanta' ranged from 7.3 to 8.8 mm (Table 3). This is similar to the findings of Szymajda et al. [18] who reported 9.6 mm for 'Camarosa' and 8.3 mm for 'Dukat'.

Daughter plants in our study had a leaf area of 140–273 cm^2 (Table 5). In the study conducted by Szymajda et al. [18], the leaf area of secondary daughter plants was smaller. Comparing the cultivars 'Camarosa' and 'Dukat' grown in a plastic tunnel, these authors found their leaf area to be 100.2 cm^2 and 67.2 cm^2, respectively. This can be explained by the results of Perez de Camacaro et al. [31] who reported that 'Elsanta' produced relatively large leaves.

According to Żurawicz [32], 'Elsanta' is very susceptible to powdery mildew. In 2007 mother plants in all treatments were affected by this disease. The different results between the years of the study might be due to high incidence of this pathogen.

CONCLUSIONS

1. The type of mother plants affects the number of leaves in daughter plants. The highest number of leaves is observed for daughter plants produced by mother plants established from fresh-dug plants.
2. The initial size of mother plants significantly influences the fresh and dry weight of daughter plants. Smaller mother plants ("A-size") produce daughter plants with higher fresh and dry weight.

Authors' contributions

The following declarations about authors' contributions to the research have been made: concept of the study: JL; field research: JL, TS, AK; data analyses: JL, WK; writing of the manuscript: JL; comments on the manuscript: BF.

Acknowledgements

The research was financed by the Ministry of Science and Higher Education of Poland (grant no. 2 PO6R 081 30).

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Wpływ jakości roślin matecznych na wybrane cechy roślin potomnych *Fragaria* x *ananassa* 'Elsanta'

Streszczenie

Wysokiej jakości sadzonki stanowią podstawę dobrego plonowania truskawki. Liczne badania wskazują, że produktywność roślin matecznych truskawki zależy od wielu czynników, ale w literaturze niewiele jest wyników badań dotyczących wpływu typu i wielkości początkowej roślin matecznych na liczbę i jakość pozyskiwanych z nich sadzonek rozłogowych. Celem niniejszych badań było określenie wpływu typu (świeże i frigo) oraz średnicy sadzonek (A+ i A) wykorzystanych do założenia matecznika na wybrane cechy (świeża i sucha masa, średnica korony, liczba i powierzchnia liści) roślin potomnych truskawki.

Badania przeprowadzono w latach 2006–2007 w nieogrzewanym tunelu foliowym. Rośliny mateczne truskawki odmiany 'Elsanta' uprawiano w doniczkach plastikowych o pojemności 5 dm^3, wypełnionych mieszaniną substratu torfowego i perlitu. W każdym roku badań rośliny mateczne sadzono w drugiej dekadzie kwietnia, a sadzonki pobierano w drugiej dekadzie sierpnia. Pomiary przeprowadzono na drugiej w kolejności sadzonce na rozłogu rośliny matecznej.

W przeprowadzonych badaniach stwierdzono istotny wpływ obydwu czynników, tj. typu i wielkości sadzonek wykorzystanych do założenia matecznika na niektóre cechy roślin potomnych. Typ roślin matecznych miał istotny wpływ na liczbę liści sadzonek. Większą liczbą liści charakteryzowały się sadzonki uzyskane z roślin matecznych uprawianych z sadzonek świeżych. Średnica sadzonek matecznych wpłynęła istotnie na świeżą i suchą masę sadzonek potomnych. Większą świeżą i suchą masą charakteryzowały się sadzonki uzyskane z sadzonek klasy A. Na wyniki uzyskane w drugim roku badań wpływ mogło mieć wystąpienie na roślinach mączniaka prawdziwego truskawki.

Handling Editor: Elżbieta Weryszko-Chmielewska