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ELICITATION AND CHARACTERIZATION OF NEWLY CANTALOUPE INBRED LINES (*Cucumis melo* var. *cantaloupensis*) USING SINGLE SEED DECENT

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ABSTRACT

This study was conducted under greenhouse conditions at Kaha Vegetable Research Farm (KVRF), Kalubia Governorate, Egypt through the period from 2011 to 2014. The objective of this work was to produce newly recombinant inbred lines (RILs) in cantaloupe using single seed decent (SSD) breeding method for seven successive generations. Four superior commercial hybrids of cantaloupe grown under Egyptian conditions *viz*., Primo, Mirella (galia type), Magenta and Kousto (charentais type) were utilized as a genetic materials in this work. The F_8 seeds of twenty five cantaloupe RILs were selected and sown in the open field during early summer season of 2014 at KVRF to be characterized the RILs that they were had distinctness, uniformity and stability (DUS). Also, the value for cultivation and use (VCU) was used to determine the value of RILs as a cantaloupe genetic resources. In addition, to estimate the coefficient of variance (CV %) within and between the selected RILs, gain of selection and broad sense heritability were used. The results confirmed that the SSD breeding was effective and time saving method in cantaloupe. It was produced 25 selected RILs. The selected RILs had DUS, high fruit quality and yield. The CV % within selected RILs was very low except for RIL 176, but between it was very high which confirmed the DUS test results. This indicated that the selected RILs had very high homogeneity within it and large genetic distance between it. All studied traits had high heritability which ranged from 69.52 to 93.64 %, as well as, most of these traits gave high gain of selection. High heritability indicates less environmental influence in the observed variation. Also, high heritability coupled with high gain of selection for given traits which indicated that it is governed by additive gene action to be provides the most effective condition for selection. Finally, these selected RILs considered as a best resources to be used for cantaloupe improvement.

Keywords : *Single seed decent, Selection, Coefficient of variance, Gain of selection, Heritability.*

INTRODUCTION

Cantaloupe (*Cucumis melo* var. *cantaloupensis*) is an important vegetable crop grown worldwide. It is a member of *cucurbitaceae* family (Abu-Goukh *et al.* 2011). So, Cultivar improvement in cross-pollinated varieties, such as melon, is accomplished by inducing genetic variability and then selectively recombining desirable genotypes. Selection is a process based on selecting individuals or groups of plants during suitable generations by inbreeding to increase homozygosity. There are many methods of selection, and breeders need to consider carefully which method will be most effective for their purposes. The efficiency of selection depends not only on the selection method, but also on the heritability of different traits in different species. The most commonly used selection methods are pedigree selection (PS), single seed decent (SSD) and the bulk method (BM). One advantage of the SSD method is the reduced requirement for land needed to segregate generations. The plants can be grown in dense populations and larger numbers can be kept under controlled conditions to speed up the generation time, since no selection was done until homozygosity has been achieved (Sarutayophat and Nualsri, 2010).

Haddad and Muehlbauer (1981) studied three lentil (*Lens culinaris*) populations and reported that the SSD method was an efficient and cost-saving method for advancing lentil populations and recommended it for lentil breeding. Ntare *et al.* (1984) compared selection methods in two crosses of cowpea, including PS, SSD and BM and concluded that the grain yielding of lines derived by the SSD procedure was good as those derived from early selection.

Also, the single seed descent breeding method provides the opportunity for advancing genotypes in winter nurseries or greenhouses, potentially reducing the time for inbred line development in cross and self pollinated varieties (Fehr, 1987). In addition, Miladinovic *et al* (2011) at the Institute of Field and Vegetable Crops in Novi Sad, Serbia, has been used successfully the SSD method of selection for more than 20 years and has resulted in 103 varieties registered in the home country and 43 in other European countries.

Vadivel and Bapu (1990), Rai *et al.* (1998) and Rodriguez- Burruezo *et al.* (2008) found that the evaluation of many local genotypes of eggplant showed high coefficient of variation values and this suggested sufficient genetic variability for a simple breeding method such as pure line selection. Abdel-Ghani and Atif (2014) reported that the low coefficient of variance in snake melon indicated high homogeneity within inbred lines. Solieman *et al* (2012) reported that the coefficient of variation of three eggplant cultivars before selection by mass selection and selfing with selection was very high, but after selection variability levels within the studied traits turned down as a result of practicing the two breeding methods, but with more severe reductions in the second selfed progenies, relative to the second cycle of mass selection populations. Also, Khatab *et al* (2013) stated that the predicted gain of selection (GS) were generally lower in value in the first selected generation (S1) than in the second selected one for all studied traits in eggplant. This result, clearly, reflected a slow progress in improvement of these traits.

At the same time, Singh and Kumar (2005) reported that heritability is an index for calculating the relative selection on the basis of general performance of their influence with environment on expression of genotypes. Sarutayophat and Nualsri (2010) reported that the efficiency of selection depends not only on the selection method, but also on the heritability of different traits in different species. Estimates of heritability alone failed to appear the response to selection. Therefore, estimates of heritability appeared to be more meaningful when accompanied by estimates of genetic advance as percentage over mean (Johnson *et al* 1955). Heritability provides an idea to the extent of genetic control for expression of a particular trait and the reliability of phenotype in predicting its breeding value (Tazeen *et al* 2009). High heritability indicates less environmental influence in the observed variation (Songsri *et al* 2008). It also gives an estimate of genetic advance to the breeder to be expect selection applied on population and to help in deciding what breeding method to choose (Hamdi *et al* 2003). Genetic advance estimated the degree of gain obtained under a selection pressure is another important parameter that guides the breeder in choosing a selection program (Shukla *et al* 2004). High heritability and high genetic advance indicates that it is governed by additive gene action and, therefore, provides the most effective condition for selection (panse 1957, Rakhi and Rajamony 2005, Torkadi *et al* 2007 and Tomar *et al* 2008).

However local melon genetic resources are currently being lost due to severe genetic erosion caused by the replacement of local varieties by modern varieties, as well as, improper management and inadequate regeneration procedures of germplasm collections. Therefore, making self-pollination to F_1 plants of desirable commercial hybrids under Egyptian conditions to obtain genetic variability is necessary to encourage rational management and selection programs to produce the melon inbred lines which use in local melon hybrid production (*Cucumis melo* L.).

So, the aim of the present study was to use single seed decent (SSD) selection method to produce recombinant inbred lines (RILs) of cantaloupe from four desirable commercial hybrids by self-pollinated without selection till the six generation. Also, calculate the gain of selection to determine the efficiency of SSD method in melon and the coefficient of variance between and within the RILs. Besides, evaluation and characterization of RILs in open field according to the UPOV description was used to determine the distinctness, uniformity and stability of RILs.

MATERIALS AND METHODS

This study was conducted during the period from 2011 to 2014. Four superior commercial hybrids of cantaloupe grown under Egyptian conditions were used. These hybrids named; Primo (galia type, Fitto seeds company, Spain), Mirella (galia type, Rijk Zwaan seed company, Netherlands), Magenta (charentais type, Nunhems, Netherlands) and Kousto (charentais type, Rijk Zwaan seed company, Netherlands). They were utilized as a plant materials to produce newly cantaloupe RILs using single seed decent (SSD) breeding method for seven successive generations (3 generations/year) under greenhouse conditions at Kaha Vegetable Research Farm (KVRF), Kalubia governorate, Egypt. These generations were sown with direct seed under greenhouse conditions from the first of September 2011 to December 31, 2013 as shown in Table 1.

Table 1. Steps of single seed decent (SSD) method.

Steps	Sowing dates	Details
F_1 generation	1[st] of September 2011	150 seeds of each F_1 grown, individually F_1 plant self pollinated, one fruit /plant harvested, seeds from 150 plants of each hybrid bulk harvested.
F_2 generation	1[st] of March 2012	150 F_2 seeds of each hybrid chosen randomly and grown. Individually F_2 plant self pollinated. One seed from F_3 seeds of each plant was harvested randomly and mixed. Collect a reserve sample of three seeds/plant.
F_3 generation	June 15, 2012	150 F_3 seeds of each hybrid are grown and harvested as above.
F_4 and F_5 generations	Sept. 15, 2012 and 1[st] of March. 2013	The similar procedure as above generation is carried out.
F_6 generation	June 15, 2013	150 F_6 seeds of each hybrid are planted. Select the superior plants from each hybrid and harvested separately.
F_7 generation	Sept. 15, 2013	The main point in this step is individual plant progenies are grown and selected plants are harvested in bulk.
F_8 generation	1[st] of Feb. 2014 for seed sowing and 1[st] of March 2014 for transplanting.	Finally, field trials were done in the open field and the quality tests were applied.

Twenty five cantaloupe RILs were selected after seven successive generations from self pollination of the four hybrids. The mean performance of some horticultural traits (obtained from previous evaluation trials) and the derived RILs for each commercial hybrid are presented in Table 2. In 2014, Feb. 1[st], F_8 seeds of twenty five selected RILs were sown in the greenhouse and transplanted on 1[st] of March 2014 in the open field using a drip-irrigation system during the early summer season at KVRF. A randomized complete block design (RCBD) with three replicates was applied. Each experimental plot (EP) consisted of 1 bed, 1m wide and 10 m long (EP area = 10 m^2). Plants were set 50 cm apart along the drip-irrigation tube and were given common agricultural practices. The various RILs were described according to international union for the protection of new plant varieties (UPOV) description, (Geneva 2006) to characterize RILs using plant variety testing. These tests are distinctness, uniformity and stability (DUS) to prove the RILs homogeneity and the value for cultivation and use (VCU) tests to determine the value of these RILs to the applied cultivation.

Table 2. The mean performance of some horticultural traits and the derived RILs for each superior commercial hybrid under Egyptian conditions.

Commercial hybrids	earliness	Total yield (ton/feddan)	Average fruit weight (gm)	Flesh colour	Fruit shape	TSS (%)	Derived RILs
Primo	Medium	20.60	955	Green	Oblate	12.4	175, 173, 188, 189, KZ_1, KZ_2, KZ_3
Mirella	Early	13.75	575	Greenish white	Circular	13.6	176, 180, 181, 182, 90T, 92T, 93T, PF_1, PF_4
Magenta	Late	11.35	925	Reddish orange	Broad elliptic	14.4	183F, 184F, 185F, 186F, 187F
Kousto	Medium	9.55	465	Orange	Circular	13.6	174, 91T, 94T, 95T

The characteristics of DUS test were carried out according to UPOV (Geneva, 2006) as follows;

Seedling: all observations on the seedling were done before the development of the first true leaf for all plants of each EP.

Leaf blade: all observations on the leaf blade were done on fully developed but not old leaves, between the 5^{th} and 8^{th} node when the plant has at least 11 nodes for all plants of each EP.

Petiole, sex expression and time of flowering : all observations on petiole were done on fully developed, but sex expression was done at full flowering, however, the time of flowering was recorded when the first male or female or perfect flower was occurred.

Young fruit: all observations on the young fruit were measured on green, unripe fruits, before the color change or when the fruit is half the final size. These observations were taken on one fruit/plant for all plants of each EP.

Ripening fruit: observations measured on ripened fruit including; the color not start to change to the over maturity color. These observations were taken on two fruits/plant for all plants of each EP.

Seed: all observations on the seed were done on fully developed and dry seeds, after washing and drying in the shade. These observations were taken on one fruit/plant for all plants of each EP.

In addition, the VCU test including fruit quality and yield was determined as follows;

Fruit quality: average fruit weight (AFW), seed cavity diameter and flesh thickness were determined as the mean of 15 fruits randomly chosen from each EP, fruit shape index (FSI) calculated as the ratio of fruit length to fruit diameter. Each EP was represented by 15 fruits. Fruits with a FSI less than 0.88 were classified as oblate, those with a FSI ranging from 0.88 to 1.1 were considered round, those with a FSI ranging from 1.1 to 1.5 were classified as cylindrical and those with a FSI above 1.5 were classified as oblong (Rashidi and Seyfi 2007). Total soluble solids (TSS) was determined in 15 yellow-ripe fruits of each EP using a hand refractometer.

Yield: early yield (EY) was measured as the yield of the first three pickings, total yield (TY) was measured as the weight of all fruits harvested at the yellow-netted ripe stage from each EP. Marketable yield (MY) as determined after excluding cracked, rotten and infected fruits with diseases and pests. The percentage of MY was calculated as the ratio of MY to TY for each RIL.

Statistical Analysis:

Obtained data for mean performance of RILs were subjected to analysis of variance and the mean comparisons according to Gomez and Gomez (1984). Coefficient of variability (C.V. %) was calculated within and between RILs for some important traits according to Steel and Torrie (1960). Heritability in broad sense (h^2bs) was estimated according to Falconer and Mackay (1996). Also, Gain of selection (GS) after 7 successive generations using SSD selection method was calculated as illustrated by Falconer (1989), using the following formula:

$$GS = k \, . \, \delta p \, . \, h^2bs$$

Where; k is the selection differential (at 0.10 selection intensity), δp is the phenotypic standard deviation and h^2bs was the heritability in broad sense.

RESULTS AND DISCUSSION

Characterization of selected RILs

Seedling

Data obtained on seedling traits are presented in Table 3. The length of hypocotyls varied greatly from very short, short, medium, long to very long between the selected RILs. Also, the size of cotyledon varied greatly from very small, small, medium, large to very large between the selected RILs. In the same time, the intensity of green color of cotyledon varied greatly from light, medium to dark between the selected RILs. On the other hand, the length of hypocotyls, size of cotyledon and intensity of green color of cotyledon were uniformity within each of selected RIL. These results agreed with Jester *et al.* (2005), who found that the size of cotyledon in many different cultivars of melon varied from small to large.

Table 3. Seedling traits of newly developed RILs evaluated in the open field during early summer season.

Selected RILs	Seedling		
	Length of hypocotyls	Size of cotyledon	Intensity of green color of cotyledon
180	Very short	Very small	Light
175	Medium	Large	Medium
174	Long	Large	Dark
173	Medium	Medium	Medium
176	Long	Small	Light
181	Long	Large	Medium
182	Very long	Medium	Light
183F	Very short	Small	Light
184F	Short	Small	Dark
185F	Short	Small	Light
186F	Short	Small	Light
187F	Medium	Medium	Dark
90T	Short	Small	Light
91T	Medium	Small	Dark
92T	Very short	Small	Light
93T	Very short	Medium	Medium
94T	Short	Medium	Dark
95T	Very short	Small	Medium
188	Short	Small	Light
189	Short	Small	Light
KZ1	Short	Very large	Dark
KZ2	Short	Medium	Light
KZ3	Medium	Medium	Light
PF1	Short	Small	Light
PF4	Short	Small	Medium

Leaf blade

Data obtained on seedling traits are presented in Table 4. It was appeared that between the selected RILs, the leaf blade size varied greatly from small, medium to large. However, the intensity of green color varied greatly from light, medium to dark, as well as, the development of lobes varied greatly from weak, medium to strong. The length of terminal lobe varied greatly from short, medium to long, as well as, both the dentations of margin and blistering varied greatly from weak, medium to strong. On the contrary, all leaf blade traits were uniformity within each of selected RIL.

Table 4. Leaf blade traits of newly developed RILs evaluated in the open field during early summer season.

Selected RILs	Leaf Blade					
	Size	Intensity of green color	Development of lobes	Length of terminal lobe	Dentations of margin	Blistering
180	Medium	Light	Medium	Short	Weak	Weak
175	Medium	Medium	Strong	Medium	Medium	Weak
174	Large	Light	Medium	Short	Medium	Medium
173	Medium	Medium	Weak	Short	Strong	Strong
176	Medium	Dark	Medium	Long	Weak	Weak
181	Medium	Light	Weak	Medium	Strong	Strong
182	Small	Medium	Weak	Short	Medium	Medium
183F	Small	Light	Weak	Short	Weak	Strong
184F	Large	Dark	Medium	Short	Strong	Strong
185F	Small	Medium	Weak	Medium	Weak	Strong
186F	Large	Medium	Weak	Short	Strong	Medium
187F	Large	Dark	Weak	Short	Medium	Strong
90T	Small	Medium	Strong	Long	Weak	Strong
91T	Small	Medium	Strong	Medium	Weak	Strong
92T	Small	Dark	Medium	Short	Weak	Strong
93T	Medium	Dark	Strong	Medium	Weak	Strong
94T	Medium	Dark	Medium	Short	Weak	Strong
95T	Medium	Dark	Medium	Short	Weak	Strong
188	Medium	Light	Weak	Short	Weak	Weak
189	Medium	Light	Weak	Medium	Medium	Strong
KZ1	Medium	Medium	Medium	Medium	Medium	Strong
KZ2	Medium	Light	Medium	Long	Weak	Medium
KZ3	Small	Light	Weak	Medium	Weak	Weak
PF1	Large	Medium	Weak	Short	Weak	Strong
PF4	Small	Dark	Strong	Long	Strong	Strong

Petiole, sex expression and flowering time

Data obtained on petiole, sex expression and flowering time are presented in Table 5. Between the selected RILs, all RILs had horizontal petiole except both RILs 183F and 189 which were erect, as well as, each of 173, 186F, 91T, 95T, 188 and PF4 were semi erect. The petiole length for most of RILs was medium, but short for both 183F and 189 and long for 175, 173, 176, 188 and KZ_1. The sex expression for all RILs was andromonoecious except each of 93T, 94T, 95T and PF_1 which were monoecious. All RILs gave early male flowering except 173 which was medium, but the female or hermaphrodite flowering varied greatly from early, medium to late. The petiole traits and sex expression were uniformity within each selected RIL, while the time of flowering was partial uniformity within each of them. This may be due to the flowering time × environment interaction. These results coincided with Jester et al (2005) who found that the flowering time of hermaphrodite flowers in many different cultivars of melon varied from early, medium to late.

Table 5. Petiole, sex expression and time of flowering of newly developed RILs evaluated in the open field during early summer season.

Selected RILs	Petiole		Sex expression	Time of flowering		
	Attitude	Length		Male*	Female**	Hermaphrodite**
180	Horizontal	Medium	Andromonoecious	Early	00	Early
175	Horizontal	Long	Andromonoecious	Early	00	Medium
174	Horizontal	Medium	Andromonoecious	Early	00	Medium
173	Semi erect	Long	Andromonoecious	Medium	00	Late
176	Horizontal	Long	Andromonoecious	Early	00	Late
181	Horizontal	Medium	Andromonoecious	Early	00	Medium
182	Horizontal	Medium	Andromonoecious	Early	00	Medium
183F	Erect	Short	Andromonoecious	Early	00	Late
184F	Horizontal	Medium	Andromonoecious	Early	00	Medium
185F	Horizontal	Medium	Andromonoecious	Early	00	Early
186F	Semi erect	Medium	Andromonoecious	Early	00	Medium
187F	Horizontal	Medium	Andromonoecious	Early	00	Medium
90T	Horizontal	Medium	Andromonoecious	Early	00	Early
91T	Semi erect	Medium	Andromonoecious	Early	00	Medium
92T	Horizontal	Medium	Andromonoecious	Early	00	Late
93T	Horizontal	Medium	Monoecious	Early	Medium	00
94T	Horizontal	Medium	Monoecious	Early	Early	00
95T	Semi erect	Medium	Monoecious	Early	Early	00
188	Semi erect	Long	Andromonoecious	Early	00	Early
189	Erect	Short	Andromonoecious	Early	00	Late
KZ1	Horizontal	Long	Andromonoecious	Early	00	Late
KZ2	Horizontal	Medium	Andromonoecious	Early	00	Early
KZ3	Horizontal	Medium	Andromonoecious	Early	00	Early
PF1	Horizontal	Medium	Monoecious	Early	Late	00
PF4	Semi erect	Short	Andromonoecious	Early	00	Early

* early ≤ 35 and 45 ≥ medium ≥ 36 days from sowing till the first male flower.
** early ≤ 40, 50 ≥ medium ≥ 41 and late ≥ 51 days from sowing till the first female or hermaphrodite flower.
00 = This trait was absent.

Young fruit

Data obtained on young fruit traits are presented in Table 6. The selected RILs were different between each of them in all young fruit traits. The range between these differences was very large except the extension of darker area around peduncle. All selected RILs didn't have the extension of darker area around peduncle except both 181 and 188 which were medium. However, 93T was large and 183F was a small darker area around peduncle. Meanwhile, within the selected RILs, all young fruit traits of each RIL were uniformity and homogeneous. These results agreed with Jester et al (2005) who found that the extension of darker area around peduncle in many different cultivars of melon varied from none to extensive.

Table 6. Young fruit traits of newly RILs evaluated in the open field during early summer season.

Selected RILs	Young fruit					
	Hue of green color of skin	Intensity of green color of skin	Density of dots	Size of dots	Contrast of dot color / ground color	Conspicuous ness of groove coloring
180	Greyish green	Medium	Absent	00	00	Strong
175	Greyish green	Medium	Absent	00	00	Absent
174	Yellowish green	Light	Sparse	Medium	Weak	Weak
173	Green	Light	Absent	00	00	Absent
176	Yellowish green	Light	Medium	Large	Medium	Absent
181	Green	Very dark	Very dense	Small	Weak	Absent
182	Greyish green	Very dark	Very dense	Small	Weak	Weak
183F	Greyish green	Medium	Medium	Small	Strong	Medium
184F	Whitish green	Light	Absent	00	00	Medium
185F	Greyish green	Dark	Very dense	Small	Strong	Very strong
186F	Yellowish green	Light	Absent	00	00	Absent
187F	Yellowish green	Medium	Absent	00	00	Absent
90T	Greyish green	Dark	Medium	Medium	Strong	Very strong
91T	Yellowish green	Very light	Absent	00	Strong	Very strong
92T	Whitish green	Very light	Medium	Medium	Weak	Very strong
93T	Greyish green	Medium	Medium	Medium	Weak	Weak
94T	Greyish green	Medium	Medium	Small	Strong	Very strong
95T	Green	Medium	Medium	Small	Weak	Strong
188	Green	Medium	Dense	Small	Medium	Absent
189	Yellowish green	Very light	Absent	00	00	Absent
KZ1	Whitish green	Very light	Absent	00	00	Medium
KZ2	Green	Very dark	Very dense	Small	Strong	Absent
KZ3	Green	Very dark	Dense	Small	Strong	Absent
PF1	Yellowish green	Light	Absent	00	00	Strong
PF4	Greyish green	Medium	Medium	Small	Weak	Medium

Table 6.continued.

Selected RILs	Young fruit				
	Intensity of groove coloring	Length of peduncle	Thickness of peduncle 1cm from fruit	Extension of darker area around peduncle	Change of skin color from young fruit to maturity
180	Dark	Medium	Medium	Absent	Early
175	00	Medium	Medium	Absent	Late
174	Light	Short	Medium	Absent	Late
173	00	Long	Medium	Absent	Late
176	00	Medium	Medium	Absent	Very late
181	00	Long	Thin	Medium	Late
182	Light	Medium	Medium	Absent	Late
183F	Light	Short	Thin	Small	Late
184F	Medium	Medium	Thin	Absent	Very late
185F	Medium	Medium	Medium	Absent	Late
186F	00	Long	Thin	Absent	Very late
187F	00	Long	Thin	Absent	Very late
90T	Medium	Long	Medium	Absent	Early
91T	Light	Long	Thick	Absent	Early
92T	Medium	Long	Thin	Absent	Very late
93T	Light	Medium	Thick	Large	Very late
94T	Dark	Long	Thick	Absent	Late
95T	Dark	Long	Thick	Absent	Very late
188	00	Short	Thick	Medium	Early
189	00	Short	Medium	Absent	Late
KZ1	Medium	Long	Medium	Absent	Very late
KZ2	00	Medium	Medium	Absent	Late
KZ3	00	Medium	Medium	Absent	Early
PF1	Medium	Long	Thick	Absent	Very late
PF4	Medium	Medium	Thin	Absent	Very late

00 = This trait was absent.

Ripening fruit

Data obtained on ripening fruit traits are presented in Table 7. Between the selected RILs, the fruit length varied greatly from very short, short, medium to long, but most of selected RILs had medium fruit diameter except for 186F (which was narrow), 173, 92T, 93T,188, KZ_1 and KZ_3 (which were broad) and KZ_2 (which was very broad). Meanwhile, the ratio L/D varied from small to medium, medium, medium to large, large to large to very large. While the position at maximum diameter was at middle of the all selected RILs except for 176 which was toward stem end. The shape in longitudinal section varied greatly from oblate, circular, medium elliptic, broad elliptic, obovate, ovate to elongated. These results agreed with Jester et al (2005) who found that the fruit shape in many different cultivars of melon varied from asymmetrical, elliptical, oval, oblong and round.

Table 7. Ripening fruit traits of newly RILs evaluated in the open field during early summer season.

Selected RILs	Ripening fruit				
	Length	Diameter	Ratio L / D	Position at maximum diameter	Shape in longitudinal section
180	Medium	Medium	Medium	At middle	obovate
175	Long	Medium	Large	At middle	Ovate
174	Short	Medium	Medium	At middle	Circular
173	Very short	Broad	Small to medium	At middle	Circular
176	Long	Medium	Large	Toward stem end	Broad elliptic
181	Long	Medium	Large	At middle	Elongated
182	Medium	Medium	Medium	At middle	Medium elliptic
183F	Very short	Medium	Small to medium	At middle	Oblate
184F	Medium	Medium	Medium	At middle	Circular
185F	Very short	Medium	Small to medium	At middle	Oblate
186F	Long	Narrow	Large	At middle	Medium elliptic
187F	Medium	Medium	Medium to large	At middle	Broad elliptic
90T	Short	Medium	Medium	At middle	Circular
91T	Long	Medium	Large	At middle	Ovate
92T	Very short	Broad	Small to medium	At middle	Oblate
93T	Short	Broad	Medium to large	At middle	Circular
94T	Long	Medium	Large	At middle	Ovate
95T	Medium	Medium	Medium	At middle	Ovate
188	Very short	Broad	Small to medium	At middle	Oblate
189	Medium	Medium	Small to medium	At middle	Ovate
KZ1	Medium	Broad	Medium to large	At middle	Circular
KZ2	Medium	Very broad	Medium to large	At middle	Circular
KZ3	Short	Broad	Large to very large	At middle	Circular
PF1	Short	Medium	Small to medium	At middle	Oblate
PF4	Medium	Medium	Medium to large	At middle	Broad elliptic

Also, between the selected RILs, the fruit ground color of skin varied greatly from white, yellow, green to grey. The intensity of fruit ground color of skin was light in all selected RILs except each of 175, 176, 181, 185F, 95T, PF_4 which were medium. The hue of ground color of fruit skin varied greatly from absent, whitish, yellowish to greenish. Most of the selected RILs didn't have dots on fruits, but the density of dots was sparse in each of 175, 173, 181, 182, 185F, 90T and 92T, as well as, medium only in 183F and dense only in PF_4. The size of dots was small in each of 175, 173, 181, 182, 183F and 92T, but it was medium in each of 185F, 90T and PF_4. The color of dots was green in each of 173, 181, 182, 183F, 92T and PF_4, but yellow in each of 175, 185F and 90T. Also, the intensity of dots color was light in each of 175, 181, 182 and 183F, but medium in each of 173, 185F, 90T, 92T and dark only in PF_4. These results were partial agreed with Hussein and Selim (2015), who stated that the fruit skin color varied from green, light yellow, yellow, deep yellow and orange in the sweet melon.

Table 7. Continued.

Selected RILs	Ripening fruit						
	Ground color of skin	Intensity of ground color of skin	Hue of ground color of skin	Density of dots	Size of dots	Color of dots	Intensity of color of dots
180	White	Light	Whitish	Absent	00	00	00
175	Yellow	Medium	Yellowish	Sparse	Small	Yellow	Light
174	Yellow	Light	Yellowish	Absent	00	00	00
173	Yellow	Light	Yellowish	Sparse	Small	Green	Medium
176	White	Medium	Whitish	Absent	00	00	00
181	Yellow	Medium	Yellowish	Sparse	Small	Green	Light
182	Yellow	Light	Yellowish	Sparse	Small	Green	Light
183F	Yellow	Light	Yellowish	Medium	Small	Green	Light
184F	Yellow	Light	Whitish	Absent	00	00	00
185F	Yellow	Medium	Yellowish	Sparse	Medium	Yellow	Medium
186F	White	Light	Whitish	Absent	00	00	00
187F	White	Light	Whitish	Absent	00	00	00
90T	Yellow	Light	Absent	Sparse	Medium	Yellow	Medium
91T	White	Light	Whitish	Absent	00	00	00
92T	Green	Light	Yellowish	Sparse	Small	Green	Medium
93T	Grey	Light	Absent	Absent	00	00	00
94T	Yellow	Light	Yellowish	Absent	00	00	00
95T	Green	Medium	Absent	Absent	00	00	00
188	White	Light	Whitish	Absent	00	00	00
189	Yellow	Light	Absent	Absent	00	00	00
KZ1	Green	Light	Greenish	Absent	00	00	00
KZ2	Yellow	Light	Yellowish	Absent	00	00	00
KZ3	White	Light	Whitish	Absent	00	00	00
PF1	Green	Light	Absent	Absent	00	00	00
PF4	White	Medium	Whitish	Dense	Medium	Green	Dark

00= This trait was absent.

Between the selected RILs, all of them didn't have patches on the fruits except for KZ_1. The density of patches was sparse and the size of patches was small on its fruits. The fruit warts was absent in all of the selected RILs except for 176. The strength of attachment of peduncle at maturity varied greatly from weak, medium, strong to very strong. Also, both the shape of base and apex varied greatly from pointed, rounded to truncate. The size of pistil scar varied greatly from small, medium to large. These results coincided with Jester et al. (2005), who reported that the size of pistil scar in many different cultivars of melon varied from small to large.

Table 7. Continued.

Selected RILs	Ripening fruit						
	Density of patches	Size of patches	Warts	Strength of attachment of peduncle at maturity	Shape of base	Shape of apex	Size of pistil scar
180	Absent	00	Absent	Medium	Rounded	Rounded	Medium
175	Absent	00	Absent	Weak	Pointed	Rounded	Small
174	Absent	00	Absent	Medium	Pointed	Rounded	Medium
173	Absent	00	Absent	Medium	Truncate	Truncate	Large
176	Absent	00	Present	Very strong	Pointed	Rounded	Small
181	Absent	00	Absent	Medium	Rounded	Truncate	Large
182	Absent	00	Absent	Weak	Pointed	Pointed	Large
183F	Absent	00	Absent	Very strong	Rounded	Truncate	Large
184F	Absent	00	Absent	Very strong	Rounded	Truncate	Medium
185F	Absent	00	Absent	Very weak	Truncate	Truncate	Large
186F	Absent	00	Absent	Very strong	Pointed	Pointed	Medium
187F	Absent	00	Absent	Very strong	Rounded	Rounded	Medium
90T	Absent	00	Absent	Medium	Rounded	Rounded	Small
91T	Absent	00	Absent	Very strong	Rounded	Rounded	Medium
92T	Absent	00	Absent	Very strong	Truncate	Truncate	Large
93T	Absent	00	Absent	Very strong	Truncate	Truncate	Medium
94T	Absent	00	Absent	Very strong	Rounded	Rounded	Medium
95T	Absent	00	Absent	Very strong	Rounded	Rounded	Small
188	Absent	00	Absent	Very weak	Truncate	Truncate	Medium
189	Absent	00	Absent	Very strong	Rounded	Rounded	Small
KZ1	Sparse	Small	Absent	Strong	Truncate	Truncate	Large
KZ2	Absent	00	Absent	Weak	Truncate	Truncate	Large
KZ3	Absent	00	Absent	Weak	Truncate	Truncate	Large
PF1	Absent	00	Absent	Strong	Truncate	Truncate	Small
PF4	Absent	00	Absent	Medium	Rounded	Rounded	Medium

00 = This trait was absent.

Between the selected RILs, the fruit grooves varied greatly from absent, weakly to strongly expressed. Also, the width of grooves varied greatly from narrow, medium to broad. The depth of grooves was different from very shallow, shallow, medium, deep to very deep. The color of grooves varied from white, yellow to green. Creasing of surface was absent in all of the selected RILs except both 91T and 189. The creasing of surface was weak in the previous two RILs. These results were coincided with Hussein and Selim (2015), who reported that the fruit grooves varied from absent, weakly to strongly in the sweet melon.

Table 7. Continued.

Selected RILs	Ripening fruit				
	Grooves	Width of grooves	Depth of grooves	Color of grooves	Creasing of surface
180	Strongly expressed	Medium	Deep	Green	Absent
175	Absent	00	00	00	Absent
174	Weakly expressed	Narrow	Shallow	Yellow	Absent
173	Absent	00	00	00	Absent
176	Absent	00	00	00	Absent
181	Absent	00	00	00	Absent
182	Weakly expressed	Narrow	Very shallow	Green	Absent
183F	Weakly expressed	Medium	Shallow	Green	Absent
184F	Weakly expressed	Medium	Shallow	Green	Absent
185F	Strongly expressed	Broad	Very deep	Green	Absent
186F	Absent	00	00	00	Absent
187	Absent	00	00	00	Absent
90T	Weakly expressed	Medium	Medium	green	Absent
91T	Strongly expressed	Medium	Medium	White	Weak
92T	Strongly expressed	Broad	Medium	Green	Absent
93T	Weakly expressed	Narrow	Very shallow	Green	Absent
94T	Strongly expressed	Medium	Very deep	Green	Absent
95T	Strongly expressed	Medium	Very deep	Green	Absent
188	Absent	00	00	00	Absent
189	Absent	00	00	00	Weak
KZ1	Strongly expressed	Broad	Deep	Green	Absent
KZ2	Absent	00	00	00	Absent
KZ3	Absent	00	00	00	Absent
PF1	Strongly expressed	Broad	Deep	Green	Absent
PF4	Weakly expressed	Narrow	00	00	Absent

00 = This trait was absent.

Between the selected RILs, the cork was formed in all of the selected RILs except for 174, 184F, 186F, 187F, 189, KZ_1 and PF_1. Meanwhile, the thickness of cork layer varied greatly from very thin, thin, medium, thick to very thick, but the pattern of cork formation was netted only in all of selected RILs except for 90T, 91T which were linear and netted, as well as, PF_1 which was linear only. Also, the density of pattern of cork formation varied greatly from very sparse, sparse, medium, dense to very dense only in the netting RILs. These results agreed with Hussein and Selim (2015) who found that the fruit cork formation varied from absent, semi to present in the sweet melon.

Table 7. Continued.

Selected RILs	Ripening fruit			
	Cork formation	Thickness of cork layer	Pattern of cork formation	Density of pattern of cork formation
180	+	Medium	Netted only	Dense
175	+	Thick	Netted only	Dense
174	-	00	00	00
173	+	Medium	Netted only	Medium
176	+	Medium	Netted only	Medium
181	+	Medium	Netted only	Dense
182	+	Medium	Netted only	Dense
183F	+	Thick	Netted only	Dense
184F	-	00	00	00
185F	+	Very thick	Netted only	Very dense
186F	-	00	00	00
187F	-	00	00	00
90T	+	Very thin	Linear and netted	Very sparse
91T	+	Thin	Linear and netted	Sparse
92T	+	Thick	Netted only	Dense
93T	+	Very thick	Netted only	Very dense
94T	+	Thick	Netted only	Dense
95T	+	Thick	Netted only	Dense
188	+	Thin	Netted only	Medium
189	-	00	00	00
KZ1	-	00	00	00
KZ2	+	Medium	Netted only	Dense
KZ3	+	Medium	Netted only	Medium
PF1	-	00	Linear only	Sparse
PF4	+	Thick	Netted only	Dense

00 = This trait was absent.
+, - = Present and absent, respectively.

Between the selected RILs, the width of flesh in longitudinal section (at position of maximum fruit diameter) varied greatly from thin, medium to thick. Also, the main color of flesh varied greatly from greenish white, green, yellowish white, orange to reddish orange. The intensity of orange color of flesh varied from light, medium to dark only for orange flesh RILs. The firmness of flesh varied from soft, medium to firm. These results agreed with Hussein and Selim (2015), who found that the flesh color varied from greenish white, whitish green, pale orange and orange in original population of sweet melon, while, in selected inbred lines it was varied greatly from white, greenish white, whitish green, light green, cream, pale orange and orange. Also, they recorded that the fruit flesh firmness varied from medium, soft and hard in original populations and selected inbred lines of sweet melon.

Table 7. Continued.

Selected RILs	Ripening fruit			
	Width of flesh in longitudinal section (at position of maximum fruit diameter)	Main color of flesh	*Intensity of orange color of flesh	Firmness of flesh
180	Medium	Green	00	Medium
175	Thick	Orange	Medium	Medium
174	Medium	Reddish orange	Dark	Medium
173	Medium	Green	00	Firm
176	Medium	Yellowish white	00	Firm
181	Thick	Orange	Medium	Soft
182	Medium	Orange	Medium	Soft
183F	Thin	Orange	Medium	Medium
184F	Medium	Orange	Medium	Firm
185F	Medium	Orange	Medium	Firm
186F	Medium	Orange	Medium	Firm
187F	Thick	Orange	Medium	Firm
90T	Medium	Greenish white	00	Soft
91T	Thick	Reddish orange	Dark	Firm
92T	Thin	Orange	Dark	Firm
93T	Medium	Orange	Medium	Firm
94T	Thick	Reddish orange	Medium	Firm
95T	Thick	Reddish orange	Medium	Firm
188	Medium	Orange	Light	Soft
189	Medium	Orange	Light	Medium
KZ1	Thick	Orange	Light	Firm
KZ2	Thick	Yellowish white	00	Medium
KZ3	Thick	Yellowish white	00	Medium
PF1	Medium	Orange	Medium	Medium
PF4	Thick	Orange	Medium	Medium

*Only for orange flesh.
00 = This trait was absent.

Between the selected RILs, the rate of change of fruit skin color from maturity to over maturity varied greatly from absent, very slow, slow, medium to fast. The secondary salmon coloring of flesh was absent only for RILs which have white, greenish white, green and yellowish white flesh color. The hue of color of skin at over maturity varied from creamish, yellow to orangish yellow only for RILs which change fruit skin color from maturity to over maturity. Intensity of skin yellow color at over maturity varied from light, medium to dark only for RILs which change skin color at over maturity. The time of ripening varied greatly from very early, early, medium, late to very late. Also, the fruit shelf life varied greatly from very short, short, medium, long to very long. While within the selected RILs, all ripening fruit traits of each RIL were uniformity and homogeneous.

Table 7. Continued.

Selected RILs	Ripening fruit					
	Rate of change of skin color from maturity to over maturity	*Secondary salmon coloring of flesh	**At over maturity : hue of color of skin	***At over maturity : intensity of yellow color of skin	Time of ripening	Shelf life
180	Slow	Absent	Yellow	Light	Early	Medium
175	Medium	00	Orangish yellow	Medium	Medium	Medium
174	Medium	00	Orangish yellow	Medium	Medium	Medium
173	Slow	Absent	Yellow	Dark	Late	Long
176	Very slow	Absent	Orangish yellow	Medium	Late	Very long
181	Medium	00	Orangish yellow	Dark	Medium	Short
182	Medium	00	Orangish yellow	Dark	Medium	Short
183F	Medium	00	Orangish yellow	Dark	Medium	Short
184F	Very slow	00	Yellow	Light	Late	Very long
185F	Medium	00	Yellow	Light	Medium	Short
186F	Very slow	00	Creamish	Medium	Late	Long
187F	Very slow	00	Orangish yellow	Medium	Late	Long
90T	Fast	Absent	Orangish yellow	Medium	Early	Short
91T	Slow	00	Yellow	Medium	Medium	Long
92T	Absent	00	00	00	Late	Long
93T	Absent	00	00	00	Late	Very long
94T	Absent	00	00	00	Medium	Very long
95T	Absent	00	00	00	Medium	Very long
188	Fast	00	Orangish yellow	Dark	Very early	Very short
189	Slow	00	Orangish yellow	Medium	Medium	Medium
KZ1	Very slow	00	Yellow	Light	Late	Long
KZ2	Fast	Absent	Orangish yellow	Medium	Early	Short
KZ3	Medium	Absent	Orangish yellow	Medium	Early	Short
PF1	Very slow	00	Yellow	Light	Late	Medium
PF4	Absent	00	00	00	Very late	Medium

***Only for white, greenish white, green and yellowish white flesh.**
****Only for fruit change skin color from maturity to over maturity.**
*****Only change skin color at over maturity.**
00 = This trait was absent.

Seed

Data obtained on seed traits are presented in Table 8. Between the selected RILs, the seed length varied greatly from very short, short, medium to long. Most of the selected RILs had medium seed width, but each of RILs 176, 91T, 188,PF_1 and PF_2 had narrow seed width and each of RILs 174, 183F and KZ_1 had very narrow seed width. All the selected RILs had pine-nut seed shape except for 91T. Also, all the selected RILs had cream yellow seed color except for KZ_1 which was whitish. Meanwhile, the intensity of seed color was medium for all of the selected RILs except both 173 and KZ_1 which were light. Each of 176, 181, 182, 183F and 93T were dark. Regarding within the selected RILs, all seed traits of each RIL were uniformity and homogeneous.

Table 8. Seed traits of newly RILs evaluated in the open field during early summer season.

Selected RILs	Seed				
	Length	Width	Shape	Color	Intensity of color
180	Medium	Medium	Pine-nut	Cream yellow	Medium
175	Long	Medium	Pine-nut	Cream yellow	Medium
174	Medium	Very narrow	Pine-nut	Cream yellow	Medium
173	Medium	Medium	Pine-nut	Cream yellow	Light
176	Long	Narrow	Pine-nut	Cream yellow	Dark
181	Long	Medium	Pine-nut	Cream yellow	Dark
182	Long	Medium	Pine-nut	Cream yellow	Dark
183F	Short	Very narrow	Pine-nut	Cream yellow	Dark
184F	Long	Medium	Pine-nut	Cream yellow	Medium
185F	Medium	Medium	Pine-nut	Cream yellow	Medium
186F	Long	Medium	Pine-nut	Cream yellow	Medium
187F	Medium	Medium	Pine-nut	Cream yellow	Medium
90T	Medium	Medium	Pine-nut	Cream yellow	Medium
91T	Long	Narrow	Not pine-nut	Cream yellow	Medium
92T	Medium	Medium	Pine-nut	Cream yellow	Medium
93T	Medium	Medium	Pine-nut	Cream yellow	Dark
94T	Medium	Medium	Pine-nut	Cream yellow	Medium
95T	Medium	Medium	Pine-nut	Cream yellow	Medium
188	Short	Narrow	Pine-nut	Cream yellow	Medium
189	Medium	Medium	Pine-nut	Cream yellow	Medium
KZ1	Very short	Very narrow	Pine-nut	Whitish	Light
KZ2	Medium	Medium	Pine-nut	Cream yellow	Medium
KZ3	Short	Medium	Pine-nut	Cream yellow	Medium
PF1	Short	Narrow	Pine-nut	Cream yellow	Medium
PF4	Short	Narrow	Pine-nut	Cream yellow	Medium

These findings illustrated that there is a big variation between RILs in the most descriptive traits and it indicates that these RILs had large genetic distance. So, these RILs are best materials to produce local hybrids because large genetic distance resulted in high heterosis. While all descriptive traits are complete homogeneous within these RILs. It indicates that these RILs are distinctness, uniformity and stability. So, these RILs can be used as a local hybrid parents.

Also, this confirms that SSD selection method is very effective method to produce RILs from cross pollinated varieties with high homogeneity in short time. These results are coincided with those of Haddad and Muehlbauer (1981), Fehr (1987), Sarutayophat and Nualsri (2010), and Miladinovic *et al* (2011), who reported that the SSD was an efficient breeding method and speeds up the generation time in cross pollinated varieties. So, it was cost and time saving. Although SSD was an effective method, it could be discarded many important genes because the selection begins later in the sixth generation.

Fruit quality

Data obtained on fruit quality are presented in Table 9. RIL KZ_2 gave the heaviest AFW and was significantly different from all other selected RILs. RIL 175 ranked second in AFW, but it wasn't significantly different from RILs

KZ_3, KZ_1, 176, 90T and 181. While, RIL 183F had the least AFW, but it wasn't significantly different from RIL 92T. Regarding FSI, RIL 181 gave cylindrical fruits, but it wasn't significantly differed from RILs 186F, 91T, 187F, 176 and 175. Most of RILs gave round fruits while RILs 173 and 93T had oblate fruits.

Table 9. Fruit quality traits of newly RILs evaluated in the open field during early summer season.

Selected RILs	Average fruit weight (gm)	Fruit shape index	Flesh thickness (cm)	Cavity diameter (cm)	TSS (%)
180	758.5	1.07	3.40	4.83	12.60
175	1187.5	1.26	3.10	5.37	9.23
174	748.3	0.99	3.00	6.33	12.60
173	895.0	0.82	2.33	4.53	11.20
176	1031.3	1.27	2.93	6.73	10.33
181	983.1	1.37	2.47	7.43	9.47
182	904.6	1.19	2.17	6.23	8.83
183F	106.5	0.88	1.37	4.00	8.47
184F	725.9	1.12	3.20	4.17	10.20
185F	527.6	0.93	2.50	6.27	10.93
186F	602.7	1.34	3.30	4.77	13.87
187F	799.4	1.30	3.03	5.00	12.90
90T	1012.5	1.04	3.07	6.53	9.60
91T	717.4	1.30	3.83	4.10	12.20
92T	287.9	0.88	2.33	4.07	14.60
93T	741.7	0.86	3.17	4.10	13.20
94T	655.6	1.22	3.40	4.13	14.33
95T	554.2	1.20	3.00	4.33	14.87
188	663.7	0.95	2.17	5.07	12.33
189	551.3	1.04	2.27	4.80	8.60
KZ1	1133.3	0.91	3.57	6.80	10.20
KZ2	1618.5	0.96	4.50	5.63	12.53
KZ3	1155.2	1.13	4.77	4.33	12.40
PF1	776.4	1.00	3.07	5.17	11.53
PF4	633.3	1.09	3.10	3.67	13.93
$LSD_{0.05}$	250.76	0.15	0.50	0.77	1.33

Concerning flesh thickness, RIL KZ_3 had the greatest flesh thickness, but it wasn't significantly different from RIL KZ_2. Meanwhile, RIL 91T ranked second in flesh thickness, but it wasn't significantly different from RILs KZ_1, 94T and 180. While RIL 183F had the smallest flesh thickness and was significantly different from all other selected RILs. Also, the least cavity diameter was determined in RIL PF_4, but it wasn't significantly different from RILs 183F, 92T, 91T, 93T, 94T, 184F, KZ_3 and 95T. On the contrary, the largest cavity diameter was estimated in RIL 181, but it wasn't significantly different from RILs KZ_1 and 176. Similarly, RIL 95T had the highest TSS, but it wasn't significantly different from RILs 92T, 94T, PF_4 and 186F. Also, RIL 93T ranked second in TSS. While RIL 183F had the lowest TSS, but it wasn't significantly different from RILs 189, 182, 175, 181 and 90T.

Yield and its components

Data obtained on yield and its components are presented in Table 10. RIL KZ_3 produced the highest EY, but it wasn't significantly different from RILs PF_1 and 175. Also, RIL 189 ranked second in the EY, but it wasn't significantly different from RILs 188, 184F and 180. On the contrary, RIL 176 gave the lowest EY, but it wasn't significantly different from RILs 93T, 185F, 92T and 173. Similarly, RIL KZ_2 produced the highest TY, but it wasn't significantly different from RIL 93T. Meanwhile, RIL 175 ranked second in the TY without significant differences from RILs KZ_1 and KZ_3. On the other hand, RIL 183F had the lowest TY without significant differences from RIL 186F.

Table 10. Early, total, marketable yield and its ratio of newly RILs evaluated in the open field during early summer season.

Selected RILs	Early yield (ton/feddan)	Total yield (ton/feddan)	Marketable yield (ton/feddan)	Percentage of MY (%)
180	2.15	8.70	7.90	90.7
175	3.15	11.76	10.18	86.4
174	0.77	7.25	6.29	86.8
173	0.38	10.37	9.75	94.0
176	0.01	7.05	6.53	92.6
181	2.12	6.58	5.75	87.4
182	1.80	7.42	6.62	89.0
183F	0.53	3.28	2.86	87.2
184F	2.38	6.07	5.47	90.2
185F	0.25	6.60	6.03	91.1
186F	0.89	3.58	3.20	89.3
187F	0.59	9.44	8.95	94.8
90T	0.88	8.30	7.48	90.1
91T	0.82	6.89	6.31	91.5
92T	0.27	6.03	5.58	92.6
93T	0.01	13.28	12.98	97.7
94T	1.31	8.18	6.98	85.2
95T	1.34	8.25	7.30	88.5
188	2.53	6.07	4.96	81.8
189	2.60	5.32	3.93	73.9
KZ1	0.61	11.05	9.62	87.0
KZ2	1.48	13.70	11.93	87.2
KZ3	3.31	10.77	9.05	84.1
PF1	3.31	8.81	7.58	85.9
PF4	0.74	9.07	7.68	84.7
$LSD_{0.05}$	0.47	1.12	1.17	4.8

Likewise, RIL 93T gave the highest MY, but it wasn't significantly different from RIL KZ_2. The RIL 175 ranked second in the MY, but it wasn't significantly different from RILs 173, KZ_1 and KZ_3. While RIL 183F produced the lowest MY, but it wasn't significantly different from RILs 186F and 189. Concerning the percentage of MY, RIL 93T had the highest percentage of MY without significant differences from RILs 187F and 173. On the contrary, RIL 189 gave the lowest percentage of MY and was significantly different from all other selected RILs.

These findings illustrated that these RILs are best resources for high cantaloupe fruit quality and yield. So, the breeders can be used these RILs to cantaloupe improvement. These results are in agreement with Reddy *et al* (2013), who reported that germplasm is an indispensable material to plant breeders and germplasm collection is essential to crop improvement.

Degree of homogeneity for selected RILs

Coefficient of variance (CV %) of AFW, FSI, flesh thickness, cavity diameter and TSS within the selected RILs are presented in Table 11. The coefficient of variance for AFW ranged from 2.12 % in RIL 183F to 9.76 % in RIL 176. Similarly, the CV % for FSI ranged from 1.15 % in RIL KZ_3 to 8.65 % in RIL 189. Regarding flesh thickness, the CV % ranged from 1.09 % in RIL 93T to 8.95 % in RIL 176. For cavity diameter, the CV % ranged from 1.88 % in RIL 183F to 10.08 % in RIL 176. Finally in the TSS, the CV % ranged from 1.65 % in RIL KZ_2 to 12.35 % in RIL 176. These results revealed that RIL 176 had the highest CV % in the AFW, flesh thickness, cavity diameter and TSS. So, this RIL could be needed to more homogeneity and it can carry out by more self pollination and selection.

Table 11. Coefficient of variance (CV %) estimated for some traits of fruit quality within newly RILs evaluated in the open field during early summer season.

Selected RILs	Average fruit weight	Fruit shape index	Flesh thickness	Cavity diameter	TSS
180	2.55	1.25	2.43	2.49	6.45
175	3.12	2.54	2.25	9.65	4.73
174	2.68	3.25	4.52	4.95	3.85
173	2.20	1.65	1.40	3.45	5.94
176	9.76	4.44	8.95	10.08	12.35
181	4.56	3.15	3.35	2.57	8.47
182	3.25	2.27	3.48	3.66	4.25
183F	2.12	1.35	1.30	1.88	2.62
184F	4.85	4.80	3.85	4.61	6.78
185F	3.65	3.92	1.58	2.85	2.60
186F	4.25	2.85	4.26	6.34	9.87
187F	2.32	1.45	1.75	2.75	7.15
90T	5.40	2.75	1.20	4.95	3.60
91T	3.44	1.95	2.65	3.15	6.98
92T	4.15	2.86	1.15	2.02	5.30
93T	2.65	3.40	1.09	6.59	4.05
94T	3.20	1.29	2.50	8.87	8.02
95T	3.58	7.85	6.85	4.82	2.67
188	6.75	6.85	1.98	3.87	2.55
189	8.55	8.65	7.05	7.35	10.95
KZ1	3.15	1.45	2.56	2.92	3.85
KZ2	2.95	2.56	1.25	4.06	1.65
KZ3	2.18	1.15	3.96	2.04	4.30
PF1	4.05	3.46	1.95	3.66	2.64
PF4	3.15	2.38	4.55	2.88	8.68

These findings illustrated that the coefficient of variance within RILs was very low in all previous traits which was ranged from 1.09 to 12.35. This indicated that these RILs had highly homogeneity in all previous traits except for RIL 176. These results coincided with Abdel-Ghani and Atif (2014), who reported that the low coefficient of variance in snake melon indicated to high homogeneity within inbred lines. Also, Solieman *et al* (2012) found that the coefficient of variation in three eggplant cultivars studied before selection by mass selection and selfing with selection was very high, but after selection variability levels within the studied traits turned down as a result of practicing the two breeding methods.

The results of variance coefficient within selected RILs confirmed the DUS test where the selected RILs in the two determinations had highly homogeneity and stability. So, after seven generations using SSD selection method can be produced newly inbred lines from cantaloupe with highly homogeneity and stability. These results agreed with those of Haddad and Muehlbauer (1981), Ntare *et al* (1984), Fehr (1987), Miladinovic *et al* (2011), who found that the SSD method of selection has been used successfully to produce pure lines and varieties from self and cross pollinated crops.

Genetic Parameters

Data obtained on coefficient of variance (CV %) between RILs, gain of selection and broad sense heritability for some traits of fruit quality and yield are presented in Table 12. The coefficient of variance between RILs was high in the all traits, ranged from 33.31 to 51.06 %. It indicates that there is large genetic distance between RILs and this result confirmed the result of DUS test. So, these RILs had large distinctness between each other in all studied traits and this distinctness was sufficient for SSD selection method. These results are in harmony with those obtained by Vadivel and Bapu (1990), Rai *et al.* (1998) and Rodriguez- Burruezo *et al.* (2008), who found that the evaluation of many local genotypes of eggplant showed high values of variation coefficient. This suggested sufficient genetic variability for a simple breeding method such as pure line selection.

Table 12. Coefficient of variance (CV %) between RILs, gain of selection and broad sense heritability for some fruit quality traits and yield of newly RILs evaluated in the open field during early summer season.

Traits	CV between RILs (%)	Gain of selection	Broad sense heritability (%)
Average fruit weight (gm)	49.31	26.19	78.85
Fruit shape index	38.18	0.01	76.23
Flesh thickness (cm)	40.05	0.07	84.80
Cavity diameter (cm)	39.08	0.09	83.13
TSS (%)	36.99	0.15	80.59
Early yield (ton/feddan)	51.06	0.10	92.83
Total yield (ton/feddan)	38.37	0.25	93.64
Marketable yield (ton/feddan)	39.82	0.23	92.16
Percentage of MY (%)	33.31	0.37	69.52

After seven generations from self pollination and selection only in the sixth and seventh generations, the gain of selection was high in AFW, percentage of MY, TY, MY, TSS and EY, but it was low in FSI, flesh thickness and cavity diameter. Also, broad sense heritability was high in all studied traits which was ranged from 69.52 to 93.64 %. So, high values of heritability and gain of selection for these traits indicates the presence of large number of fixable additive genes regulating the inheritance of traits and the environmental effects had a minor role. Hence, selection for these traits could be effective for cantaloupe improvement. These results are in agreement with Khatab *et al* (2013), who stated that the predicted gain of selection (GS) were generally lower value resulted in a slow progress in improvement of some traits in eggplant. At the same time, Singh and Kumar (2005) reported that heritability is an index for calculating the relative selected on the basis of the general performance of their influence of environment on expression of genotypes. According to Sarutayophat and Nualsri (2010) the efficiency of selection depends not only on the selection method, but also on the heritability of different traits in different species. Also, Tazeen *et al* (2009) suggested that heritability provides an idea to the extent of genetic control for expression of a particular trait and the reliability of phenotype in predicting its breeding value. Songsri *et al* (2008) reported that high heritability indicates less environmental influence in the observed variation.

In conclusion, SSD was an effective selection method in cantaloupe. Twenty five newly developed RILs were produced by this selection method. These RILs were not only distinctness, uniformity and stability, but also they had high fruit quality and yield. The coefficient of variance within selected RILs was very low in traits of fruit quality and this confirmed that these selected RILs had high homogeneity in these traits. On the contrary, the coefficient of variance between selected RILs was high in all studied traits and this indicates that the genetic distance between these selected RILs was large. Also, all of studied traits had high heritability and most of these traits gave high gain of selection. Finally, the selected RILs considered as best resources to be used for cantaloupe improvement.

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إستنباط وتوصيف سلالات جديدة مرباة داخلياً من الكنتالوب بإستخدام التحدر من بذرة واحدة

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أُجريت هذة الدراسة خلال الفترة من ٢٠١١ إلى ٢٠١٤ بمزرعة بحوث الخضر بقها – محافظة القليوبية. الهدف من هذة الدراسة هو إنتاج إتحادات وراثية جديدة مرباة داخليا من الكنتالوب بإستخدام طريقة تربية التحدر من بذرة واحدة لمدة سبعة أجيال متتالية تحت ظروف الصوبة. إستُخدم فى هذا البحث أربعة هجن تجارية من الكنتالوب متفوقة تحت الظروف المصرية وهى Primo،و Mirella (يتبعا طراز الجاليا)،و Magenta،و Kousto (يتبعا طراز الشارانتيه) كمصادر وراثية لإنتاج سلالات مرباه داخلياً جديدة من الكنتالوب. إنتُخبت خمسة وعشرون سلالة مرباة داخلياً وزُرعت بذور جيلها الثامن فى الحقل المكشوف أثناء العروة الصيفية المبكرة ٢٠١٤ بمزرعة بحوث الخضر بقها، لتوصيف هذه السلالات طبقاً لوصف UPOV, (2006) لإختبار درجة الإختلاف، التجانس، الثبات لهذه السلالات بالإضافة إلى تحديد قيمتها التطبيقية فى الزراعة وتحديد قيمتها كمصادر وراثية من الكنتالوب. كما تم تقدير معامل الإختلاف داخل وبين هذه السلالات،و العائد من الإنتخاب،و درجة التوريث على النطاق الواسع.

أثبتت النتائج المتحصل عليها أن التحدر من بذرة واحدة طريقة تربية فعالة وموفرة للوقت فى الكنتالوب وأُنتج بواسطها خمسة وعشرون سلالة مرباه داخلياً. كانت هذة السلالات على قدر كبير من الإختلاف فيما بينها، التجانس داخلها، الثبات الوراثى، كما ملكت قدر مرتفع من صفات الجودة والمحصول. بالإضافة إلى أن معامل الإختلاف داخل هذة السلالات المنتخبة كان منخفضا فيما عدا السلالة ١٧٦ ولكن كان هذا المعامل مرتفعاً جداً فيما بينها ،وبالتالى أكدت نتائج معامل الإختلاف داخل وبين السلالات ما تحصل عليه من إختبار DUS.

أشار ذلك إلى إمتلاك السلالات المنتخبة على درجة عالية من التجانس،و كانت بينها مسافة وراثية واسعة، كما ان درجة التوريث على النطاق الواسع كانت مرتفعة فى كل الصفات المدروسة حيث تراوحت من ٦٩.٥٢ إلى ٩٣.٦٤ ٪، كذلك كان العائد من الإنتخاب مرتفعاً فى كثير من الصفات المدروسة.

من كل هذة النتائج نستنتج أن تأثير البيئة على التباين الملاحظ فى هذة السلالات منخفض ويرجع ذلك إلى إرتفاع درجة التوريث على النطاق الواسع. ايضا تلازم درجة التوريث المرتفعة على النطاق الواسع مع العائد المرتفع من الإنتخاب لأى صفة تدل على أنه يتحكم فى وراثة هذه الصفة جينات ذات تأثير إضافى،و نجد أن تحت هذة الظروف يكون الإنتخاب مُجدى. إتضح من كل ذلك أن السلالات المنتخبة تحت الدراسة كانت تعتبر مصادر جيدة لإستخدامها فى تحسين الكنتالوب.