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Some Agronomical Characteristics of Doubled Haploid Lines Produced by Irradiated Pollen Technique and Parental Diploid Genotypes in Melons*

Nebahat SARI
Department of Horticulture, Faculty of Agriculture, Çukurova University, 01330 Balcalı, Adana - TURKEY
nesari@mail.cu.edu.tr
Halit YETİŞİR
Department of Horticulture, Faculty of Agriculture, Mustafa Kemal University,
Tayfur Sokmen Campus, Hatay - TURKEY
yetisir1@yahoo.com

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Abstract: This study was carried out at the Department of Horticulture, Faculty of Agriculture, Çukurova University in spring 1999 and 2000. In the study, 46 doubled haploid lines produced by irradiated pollen technique and 10 original diploid genotypes were used as plant materials. To investigate inbreeding depression in melons, doubled haploid lines and original diploid parental lines were compared with regard to plant vigor, yield and quality. Various plant growth and fruit characteristics were determined over two years. These were plant main stem height, node number, main stem diameter, earliness and total yield, fruit weight, fruit diameter, fruit length, rind thickness, flesh thickness, diameter and length of seed cavity and total soluble solid contents. Double haploid lines showed similar results to the original diploid lines. Inbreeding depression was not observed in these materials. Great variations were noted in respect of fruit weight and fruit length. It can be concluded that homozygosity did not cause any significant adverse effects on plant vigor, yield or quality in melons.

Key Words: Dihaploidization, inbreeding depression, melon, fruit characteristics

Işınlanmış Polen Tekniğiyle Üretilen Dihaploid Kavun Hatlarının ve Orijinal Diploid Hatların Bazı Tarımsal Özellikleri

Özet: Bu çalışma 1999 ve 2000 yılları ilkbahar yetiştirme dönemlerinde Çukurova Üniversitesi, Ziraat Fakültesi, Bahçe Bitkileri Bölümünde yürütülmüştür. Çalışmada 10 orijinal diploid ve ışınlanmış polen tekniği ile üretilen 46 dihaploid genotip bitkisel materyal olarak kullanılmıştır. Kavunda kendileme depresyonunu araştırmak için dihaploid saf hatlar ile onların üretildiği orijinal diploid hatlar bitki büyümesi, verim ve kalite açısından karşılaştırılmıştır. Geliştirilmiş olan dihaploid hatların bazı meyve ve bitkisel özellikleri belirlenmiştir. Bu özellikler; bitki ana gövde uzunluğu, boğum sayısı, ana gövde çapı, toplam verim, erkenci verim, meyve ağırlığı, meyve çapı, meyve yüksekliği, kabuk kalınlığı, meyve eti kalınlığı, çekirdek evi çapı ve çekirdek evi yüksekliği ile toplam suda çözünebilir kuru madde miktarıdır. Çalışmanın sonuçlarına göre, dihaploid hatlar, orijinal diploid genotiplere yakın değerler vermişlerdir. Kendileme depresyonu tespit edilmemiştir. Meyve şekli, büyüklüğü ve kabuk rengi açısından genotipler arasında çok büyük bir varyasyon tespit edilmiştir. Kavunda dihaploidizasyon tekniği ile homozigotlaştırmanın bitki büyümesi, verim ve kalite üzerine önemli olumsuz bir etkiye sebep olmadığı sonucuna varılmıştır.

Anahtar Sözcükler: Dihaploidizasyon, kendileme depresyonu, kavun, meyve özellikleri

Introduction

The haploidization technique is of great importance by saving time and increasing efficiency in plant breeding programs. In addition, the haploidization technique possesses certain advantages in physiological and genetic studies. Ovule-ovarium culture, anther culture,

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interspecific hybridization or induction by deficient pollen are used to produce haploid plants (Allard, 1960). In *Cucurbitaceae* plants the most successful technique is pollination by the irradiated pollen technique to produce haploid progenies. This technique was first tried in 1987 and haploid plants were produced successfully in melons (Sauton and Dumas de Vaulx, 1987; Sauton, 1988); The technique was improved and became an applicable method in plant breeding with some modifications. The same method was applied to the watermelon (Gürsöz et al., 1991; Sarı et al., 1994), cucumber (Niemirowicz-Szcytt and Dumas de Vaulx, 1989; Sauton, 1989; Caglar and Abak, 1997) and squash (Kurtar et al., 2002) and successful results were obtained.

Turkey is the second biggest melon producer after China (FAO, 2001) and has great genetic diversity in melon sources. Therefore, Turkey is regarded as the second source of the genetic origin of melons. Although Turkey has great genetic diversity in melons (Barut et al., 1992), this rich diversity has not been evaluated to characterize the genotype and produce new hybrid genotypes.

Inbreeding depression is usually defined as a reduction in the fitness or vigor of offspring derived from mating between relatives (inbreeding) compared to offspring resulting from mating among unrelated individuals (outcrossing) (Stebbins, 1958; Wright, 1977; Stubber, 1994). Inbreeding depression and heterosis are considered to be two aspects of the same phenomenon (Falconer, 1981; Mather and Jinks, 1982). Heterosis is clearly related to heterozygosity. On the other hand, inbreeding depression is due to the segregation and expression of deleterious recessive mutations in inbred progenies (Allard, 1960; Simmonds, 1979). The most likely cause of the reduction of fitness upon inbreeding involves the expression of deleterious recessive alleles. Recessive alleles are expressed in homozygotes but remain unexpressed when they occur with dominant alleles in heterozygotes. Deleterious alleles originate when the underlying DNA sequence of the functional allele is altered by a mutation of the code for a gene product that is either harmful or simply does not work (Lande and Schemske, 1985; Schemske and Lande, 1985). Plant and animal breeders have known for centuries of the superior vigor and yield associated with outbreeding compared to inbreeding. The importance of inbreeding in evolutionary biology was established in 1876 with the publication of "The Effects of Cross and Self Fertilisation in the Vegetable Kingdom" by Charles Darwin. These extensive studies involving 57 species of plants indicated that inbreeding depression is a widespread and significant evolutionary force (Lande and Schemske, 1985; Schemske and Lande, 1985).

Inbreeding effect or inbreeding depression appears in some species when plants are continuously selfed or dihaploidized. For example, in *Helianthus annuus*, decreases in vegetative growth, seed yield (42%) and oil content (44%) have been determined (Tuberosa, 1983). In maize a reduction in vigor accompanying inbreeding was reported as early as 1908 by Shull. In rice, significant reductions in vigor (35.9%) and yield (40%) have been reported (Zhi Kang et al., 2001). On the other hand, in watermelon, no significant difference was found between original diploids and dihaploid lines (Sarı et al., 1998).

A breeding program was started to produce melon lines resistant to races 0-1 by the Department of Horticulture, Faculty of Agriculture, Çukurova University, the Antalya Citrus and Greenhouse Research Institute and the Adana Plant Protection and Research Institute of the Ministry of Agriculture and Rural Affairs in 1995. In the project, completed in 1999, 47 double haploid lines were produced, 25 of which were resistant to *Fusarium oxysporum* f sp. *melonis* races 0 and 1 (Sarı et al., 1999).

The aim of this study was to characterize and to compare the 46 double haploid lines with 10 original diploid materials in respect of plant vigor, yield and quality, and to determine inbreeding depression in the melon. This study is the first known research investigating inbreeding depression in the melon.

Materials and Methods

The study was carried out in the Department of Horticulture, Faculty of Agriculture, Çukurova University in spring 1999 and 2000. Forty-six double haploid (DH) lines, (A4, B5, B7, B9, C1, C3, C5, C7, C8, C9, C10, C13, C17, C18, C19, D5, D10, D11, D13, D20, D25, D34, E8, E13, E14, E19, E21, E25, G2, G7, G8, G20, G22, G25, G28, G34, G35, H1, H2, H5, H14, H27, I5, I7, K2, K4), and 10 starting materials, (original diploid parental genotypes) (T1, 5/11, 8/12, 9/25, 13/13, 14/1, 14/2, 48/131, 61/13 as female parents, 58/2 as male parent), were used as plant materials. This material was selected from different regions of Anatolia where early

melon cultivation has been carried out and then improved by selfing. At least nine lines were produced by selfing, then the seeds were harvested and pooled together to maintain genetic make-up. Female parents (nine lines) were crossed with 58/2 (resistant to *Fusarium oxysporum* f. sp. *melonis* races 0 and 1) line, and then BC1 populations for each genotype were produced. Haploid lines were produced from BC1 populations by irradiated pollen techniques. Doubled haploid lines were produced in the framework of a study carried out between 1995 and 1999 called "Development of doubled haploid melon lines resistance to *Fusarium oxysporum* f. sp. *melonis* races 0 and 1" (Supported by TÜBİTAK).

In the study, seeds were sown into 1:1 peat and perlite medium in plastic pots with dimensions of 8 x 8 x 8 cm on 04.01.1999 and 13.01.2000. Seedlings with three true leaves were planted in two 360 m^2 plastichouses on 02.03.1999 and 07.03.2000. Seedlings were transplanted according to double line methods with (1 x 0.5) x 0.5 m spacing. Each genotype was replicated three times with five plants. After planting, the soil surface was covered with 0.05 mm transparent plastic mulch and low tunnels were established to increase the temperature around the plant at night time until the temperature was optimum (20-25 °C) for melon plants (Abak et al., 1991). Plants were grown with a single stem by pruning and hanging. Additional macro elements (N: P_2O_5:K_2O) were supplied with doses of 250:80:300 kg ha^{-1} (Zuang, 1982). Total P_2O_5 was applied before planting. N and K_2O_5 were divided into three equal amounts. The first part was applied before planting, and the rest during the vegetation period.

Main stem height, main stem diameters and node numbers were determined for each genotype on 20.04.1999 and 10.05.2000 (about the first setting period). In the first year, the harvest started on 24.05.1999 and ended on 25.06.1999. In the second year experiment, the harvest started on 05.06.2000 and continued for about one month. The first 15-day yields were taken as early yields for both years of the study. Total and early yields were presented as kg m^{-2}. Fruit weight, diameter, length, diameter and length of seed cavity, total soluble solids (TSS), and thickness of rind and flesh were determined in three randomly sampled fruits for each replicate for all genotypes. The melon fruit was sliced longitudinally into two equal parts. Fruit diameter was measured at the equatorial region. Distance between peduncle and blossom end was measured as fruit length. Diameter and length of seed cavity were measured in the same manner. Total soluble solid was determined with a hand refractometer at room temperature. Thickness of the rind and flesh were measured with a digital compass. The results presented in tables are means of the two years.

Data were subjected to an analysis of variance by Costat statistical program and means were compared by Tukey test at 1% significance levels.

Results and Discussion

The two-year results for certain plant growth characteristics and total and early yields are given in Table 1. Means of all DH lines and starting material were calculated and compared. No significant difference was determined between DH lines and starting materials with regard to total and early yields. The highest total yield (over 8 kg m^{-2}) was obtained from C13, I5, E21, E14, D11, E8, G22, C9 and D5 among the DH lines; on the other hand, genotypes 8/12, 9/25 and 58/2 produced the highest yield among starting materials. The lowest yield was obtained from B7, C19, H5, G28 and C10.

In early spring, the early yield that is an indication of high income is important for farmers. In this respect, 32 of the DH lines produced 50% of their yield in the first 15 days of harvest, and E14, E13, E21, D11 and D13 were the early yielding genotypes. In contrast, I7, K4, E8, E25, C9, B7, C19 and D34 were late yielding genotypes among DH lines. In starting materials, 61/13, 48/131 and T1 were late yielding genotypes.

Results of plant growth characteristics from the two years are presented in Table 1. The longest plants were in the E14, E13, K4, E8, C13 and A4 DH lines. In starting material, the longest plants were found in 61/13, 13/13 and 9/25. The highest node numbers were in the A4, G7, G22, K2 and I7 lines, and the lowest node number were in the B7, C19 and D34 lines. With regard to stem diameter, the highest was in E14, and the lowest in C10. Other genotypes presented intermediate values between these two genotypes.

The results of the fruit characteristics are presented in Table 2. Although some quite different characteristics were determined, such as fruit shape and color, fruit quality parameters were similar in both DH lines and

Table 1. Some plant growth characteristics and yields of double haploid (DH) lines and starting materials (SM).

Starting Materials	Double Haploid Lines	Early Yield kg m^{-2}	Total Yield kg m^{-2}	Plant Height (cm)	Node Number (nodes $plant^{-1}$)	Main Stem Diameter (mm)
T1		0.1 p	6.7 b-h	206 a-e	29 abc	10.2 a-f
	A4	3.0 g-p	6.4 b-h	211 a-d	34 a	11.7 abc
5/11		4.6 c-l	6.6 b-h	195 a-g	27 b-h	10.6 a-e
	B5	4.8 c-k	6.5 b-h	162 d-j	24 b-k	11.3 a-d
	B7	0.3 op	3.4 h	120 j	21 ijk	10.6 a-e
	B9	2.7 h-p	6.8 b-h	152 e-j	23 e-k	10.1 a-f
8/12		4.5 c-m	8.5 a-f	174 d-j	27 b-h	10.6 a-e
	C1	3.5 f-p	5.6 d-h	139 g-j	25 b-j	10.6 a-e
	C3	2.2 i-p	7.0 b-g	171 d-j	27 b-g	10.1 a-f
	C5	3.0 g-p	5.4 d-h	135 hij	22 g-k	9.8 a-f
	C7	4.2 d-n	7.3 b-g	160 d-j	23 f-k	9.0 def
	C8	3.6 f-o	6.1 c-h	161 d-j	23 d-k	9.1 c-f
	C9	1.1 m-p	8.3 a-f	159 d-j	23 e-k	10.7 a-e
	C10	2.1 j-p	5.1 e-h	138 hij	22 g-k	7.8 f
	C13	9.0 a	11.3 a	207 a-e	24 b-k	9.0 c-f
	C17	2.5 h-p	6.0 c-h	150 e-j	24 b-k	10.3 a-f
	C18	4.2 d-n	7.4 b-g	160 d-j	26 b-j	10.9 a-e
	C19	0.8 nop	5.9 c-h	138 hij	22 h-k	9.0 def
9/25		7.0 a-f	8.4 a-f	212 a-d	27 b-h	11.4 a-d
	D5	7.1 a-e	8.2 a-f	177 c-i	28 b-g	11.5 a-d
	D10	6.5 a-f	7.8 a-g	174 d-j	26 b-j	11.0 a-e
	D11	7.2 a-e	8.8 a-d	185 b-h	28 b-g	10.6 a-e
	D13	8.6 ab	9.2 abc	166 d-j	26 b-j	9.9 a-f
	D20	4.3 c-m	5.9 c-h	159 d-j	24 c-k	11.6 a-d
	D25	5.2 b-j	6.7 b-h	167 d-j	27 b-i	9.8 a-f
	D34	1.3 l-p	5.6 d-h	157 d-j	19 k	10.0 a-f
13/13		4.0 d-n	6.3 c-h	212 a-d	29 a-d	10.1 a-f
	E8	0.1 p	8.2 a-f	232 abc	26 b-j	10.7 a-e
	E13	5.3 b-j	6.6 b-h	241 ab	25 b-j	11.2 a-d
	E14	7.3 a-d	8.6 a-e	245 a	25 b-j	12.4 ab
	E19	2.1 j-p	5.6 d-h	200 a-f	26 b-j	10.6 a-e
	E21	7.7 abc	9.9 ab	203 a-f	25 b-j	11.0 a-e
	E25	0.5 op	6.4 b-h	190 a-h	27 b-h	11.2 a-d
14/1		1.7 k-p	6.2 c-h	178 c-i	24 c-k	10.5 a-e
	G2	5.8 a-h	8.0 a-f	174 d-j	27 b-g	11.0 a-e
	G7	6.4 a-g	6.5 b-h	182 c-h	29 ab	11.7 abc
	G8	4.2 d-n	5.4 d-h	147 f-j	26 b-j	10.5 a-e
	G20	5.6 a-i	8.1 a-f	188 b-h	28 b-g	12.4 a
	G22	5.0 c-k	8.4 a-f	187 b-h	28 a-e	11.4 a-d
	G25	5.3 b-j	6.0 c-h	177 d-j	26 b-j	10.6 a-e
	G28	3.8 e-o	4.4 gh	146 f-j	25 b-j	10.0 a-f
	G34	4.2 d-n	5.3 e-h	147 f-j	26 b-j	10.2 a-f
	G35	4.3 c-m	6.8 b-h	162 d-j	25 b-k	11.2 a-d
14/2		5.5 b-j	7.2 b-g	178 c-i	27 b-h	9.9 a-f
	H1	5.0 c-k	7.9 b-g	147 f-j	25 b-k	11.5 a-d
	H2	5.1 c-k	7.3 b-g	161 d-j	27 b-h	10.1 a-f
	H5	3.0 g-p	4.9 fgh	124 ij	25 b-k	9.7 b-f
	H14	5.2 b-j	7.0 b-g	173 d-j	26 b-i	11.0 a-e
	H27	5.3 b-j	6.7 b-h	190 a-h	25 b-j	9.6 c-f
58/2		6.4 a-g	8.3 a-f	158 d-j	27 b-h	11.2 a-d
48/131		1.2 l-p	6.8 b-h	160 d-j	21 jk	9.4 c-f
	I5	5.1 c-j	9.2 abc	168 d-j	24 d-k	9.6 c-f
	I7	1.1 m-p	7.6 b-g	188 a-h	28 b-f	10.7 a-e
61/13		0.4 op	8.1 a-f	232 abc	28 a-e	10.0 a-f
	K2	5.1 c-k	6.1 c-h	170 d-j	28 a-f	9.7 a-f
	K4	1.3 l-p	7.3 b-g	233 abc	26 b-j	8.4 ef
Means of SM		**3.5**	**7.3**	**190**	**27**	**10.4**
Means of DH		**4.2**	**6.9**	**172**	**25**	**10.5**
MSD (1%)		3.5	3.6	57	6	2.7

* First column shows starting materials (diploid lines).
** Second column shows dihaploid lines produced by irradiated pollen techniques.
*** Same letter indicates the absence of significant difference at p = 0.01 Tukey tests.

Table 2. Fruit characteristics of double haploid (DH) lines and starting materials (SM).

Starting Materials*	Double Haploid Lines**	Fruit Weight (g)	Fruit Diameter (cm)	Fruit Length (cm)	Seed Cavity Diameter (cm)	Seed Cavity Length (cm)	Rind Thickness (mm)	Flesh Thickness (mm)	TSS (%)
T1		1196 d-o***	12.4 a-j	14.8 g-n	6.1 a-g	9.1 h-p	4.2 a-d	17.9 a-i	8.0 a-l
	A4	1218d-o	11.8 b-n	14.4 h-p	5.9 b-g	9.4 h-o	5.2 a-d	13.6 e-l	6.3 h-l
5/11		767 o-u	10.9 h-p	12.5 k-t	4.8 g	7.2 n-q	4.3 a-d	15.7 b-l	9.5 a-g
	B5	743 o-u	10.5 k-q	12.7 j-t	4.7 g	8.0 j-q	6.4 a-d	17.1 a-k	9.2 a-h
	B7	468 tu	9.3 pq	9.7 t	4.9 g	5.9 q	3.1 d	11.7 jkl	8.5 a-k
	B9	824 m-u	10.8 i-q	13.1 i-t	5.0 g	7.8 l-q	6.1 a-d	16.4 a-l	9.3 a-h
8/12		1135 f-o	12.6 a-h	14.1 h-r	6.0 b-g	9.2 h-p	6.4 a-d	18.4 a-h	8.7 a-j
	C1	798 n-u	11.0 h-p	15.0 f-n	5.4 b-g	8.7 i-q	4.1 bcd	13.8 d-l	9.0 a-i
	C3	896 k-u	11.0 h-p	10.9 p-t	5.7 b-g	7.2 n-q	5.2 a-d	15.0 d-l	8.2 a-l
	C5	558 stu	10.3 m-q	10.5 rst	5.1 fg	6.4 pq	3.8 d	12.7 g-l	8.3 a-k
	C7	909 k-u	12.2 b-k	13.0 j-t	5.8 b-g	8.2 i-q	5.3 a-d	18.1 a-i	7.4 c-l
	C8	1001 i-s	11.8 b-m	12.6 k-t	5.3 b-g	7.8 l-q	5.2 a-d	18.1 a-i	6.6 f-l
	C9	1210 d-o	12.6 a-h	16.3 e-j	5.8 b-g	11.7 c-h	6.4 a-d	12.1 i-l	8.4 a-k
	C10	461 u	9.0 q	16.3 e-j	5.2 c-g	6.7 n-q	5.9 a-d	12.4 i-l	10.5 abc
	C13	1403 c-j	12.6 a-h	14.2 h-q	5.9 b-g	11.1 c-i	4.8 a-d	18.6 a-g	7.2 e-l
	C17	836 l-u	11.3 h-o	11.4 n-t	6.9 ab	7.8 l-q	4.6 a-d	11.1 kl	6.2 h-l
	C18	900 k-u	11.3 h-o	13.5 h-s	5.8 b-g	8.7 i-q	4.9 a-d	15.1 d-l	10.4 a-d
	C19	605 r-u	10.0 n-q	10.6 q-t	6.2 a-g	7.7 m-q	4.7 a-d	11.5 jkl	7.3 d-l
9/25		1071 h-r	11.5 e-n	15.4 f-m	6.0 b-g	10.8 d-k	3.5 d	15.9 b-l	5.4 kl
	D5	1556 a-g	13.4 a-d	16.8 d-i	7.1 a	11.9 c-h	5.8 a-d	18.5 a-h	7.0 e-l
	D10	1203 d-o	12.6 a-h	15.0 f-n	6.9 abc	9.4 h-o	6.4 a-d	15.4 c-l	6.6 f-l
	D11	939 j-t	11.5 f-n	14.1 h-r	5.6 b-g	9.4 h-o	4.7 a-d	15.3 c-l	5.2 l
	D13	1369 c-k	13.2 a-f	15.3 f-k	5.8 b-g	10.4 e-m	3.5 d	16.3 b-l	6.0 i-l
	D20	860 l-u	10.9 h-p	12.6 k-t	5.2 d-g	7.9 k-q	4.4 a-d	15.1 d-l	7.5 c-l
	D25	1072 h-r	10.8 i-q	13.3 h-t	6.3 a-g	9.3 h-p	4.0 bcd	15.7 b-l	6.1 i-l
	D34	576 stu	9.6 opq	10.0 st	5.3 b-g	8.1 j-q	5.8 a-d	10.9 l	5.9 jkl
13/13		1074 h-r	12.3 b-k	13.1 i-t	6.2 a-g	8.0 j-q	4.9 a-d	15.7 b-l	7.4 c-l
	E8	886 l-u	10.3 m-q	14.8 g-n	4.9 g	10.9 d-j	7.7 abc	16.8 a-l	7.7 b-l
	E13	1458 b-i	11.4 g-n	23.2 a	6.8 a-e	16.1 ab	5.1 a-d	13.5 f-l	6.4 g-l
	E14	1782 abc	12.2 b-k	23.2 a	6.1 a-g	18.1 a	4.9 a-d	15.8 b-l	6.4 g-l
	E19	960 j-s	12.5 a-i	11.4 n-t	6.2 a-g	6.6 opq	3.9 cd	15.5 c-l	7.1 c-l
	E21	1618 a-e	12.3 a-k	20.5 abc	5.1 efg	14.1 bc	3.9 cd	18.9 a-f	6.5 g-l
	E25	634 q-u	10.4 l-q	10.6 q-t	6.9 ab	7.5 m-q	3.7 d	12.6 h-l	10.8 ab
14/1		1083 g-q	11.7 c-n	14.2 h-q	4.9 g	9.6 g-m	6.1 a-d	19.0 a-f	10.4 a-d
	G2	1144 e-p	12.4 a-j	15.7 f-l	5.9 b-g	10.7 e-l	6.3 a-d	18.5 a-h	10.9 a
	G7	1147 e-p	11.0 h-p	17.0 c-h	5.5 b-g	12.5 c-g	5.2 a-d	15.9 b-l	8.6 a-j
	G8	1637 a-d	10.9 h-p	12.0 l-t	5.2 c-g	7.7 m-q	3.5 d	16.2 b-l	8.9 a-j
	G20	1288 d-m	13.4 a-d	14.1 h-r	6.8 abc	9.3 h-p	6.7 a-d	18.5 a-h	8.6 a-j
	G22	1268 d-n	12.2 b-k	16.1 e-k	5.8 b-g	10.3 f-m	6.1 a-d	17.9 a-i	8.2 a-l
	G25	1471 b-i	12.2 b-l	20.1 a-d	5.5 b-g	13.8 bcd	4.6 a-d	18.7 a-f	7.6 c-l
	G28	1305 c-l	13.2 a-g	14.6 h-o	6.1 a-g	9.2 h-p	4.6 a-d	19.8 a-d	9.1 a-i
	G34	636 q-u	10.7 i-q	10.9 o-t	5.9 b-g	7.0 n-q	6.6 a-d	14.4 d-l	7.1 e-l
	G35	801 n-u	11.3 h-o	11.7 n-t	5.5 b-g	6.9 n-q	5.6 a-d	16.5 a-l	9.9 a-e
14/2		892 k-u	11.6 d-n	11.9 m-t	6.1 b-g	8.3 i-q	5.8 a-d	15.9 b-l	9.5 a-g
	H1	770 o-u	11.7 c-n	13.5 h-s	5.8 b-g	8.0 j-q	5.4 a-d	16.6 a-l	9.5 a-g
	H2	836 l-u	11.8 c-n	12.0 m-t	5.6 b-g	7.6 m-q	5.5 a-d	15.2 c-l	9.2 a-h
	H5	585 stu	10.3 m-q	10.5 rst	5.3 b-g	6.7 n-q	4.3 a-d	13.1 f-l	9.1 a-i
	H14	713 p-u	11.2 h-o	10.4 rst	5.9 b-g	7.5 m-q	7.0 a-d	16.4 a-l	10.1 a-e
	H27	651 q-u	10.6 j-q	10.8 p-t	5.6 b-g	6.9 n-q	6.3 a-d	14.7 d-l	8.9 a-i
58/2		879 l-u	11.8 b-n	12.4 k-t	5.5 b-g	7.9 k-q	5.7 a-d	17.4 a-j	8.8 a-j
48/131		1983 a	13.3 a-e	20.7 ab	5.8 b-g	13.3 bcde	8.2 a	21.2 abc	8.1 a-l
	I5	1563 a-f	14.1 a	18.6 b-f	6.6 a-f	11.8 c-h	5.7 a-d	22.4 a	7.1 e-l
	I7	795 n-u	10.3 m-q	13.5 h-s	4.7 g	8.3 i-q	5.1 a-d	16.9 a-k	9.7 a-f
61/13		1536 a-h	13.5 ab	14.9 g-n	6.8 a-d	10.7 e-l	5.8 a-d	19.5 a-e	8.1 a-l
	K2	1403 c-j	11.8 b-m	19.6 a-e	5.7 b-g	13.2 b-f	5.3 a-d	17.5 a-j	8.5 a-j
	K4	1899 ab	13.4 abc	18.3 b-g	5.2 d-g	12.0 c-h	8.0 ab	21.6 ab	7.4 d-l
Means of SM		**1162**	**12.2**	**14.4**	**5.8**	**9.4**	**5.5**	**17.7**	**8.4**
Means of DH		**1036**	**11.5**	**14.1**	**5.8**	**9.4**	**5.2**	**15.8**	**7.9**
MSD (1%)		478	1.8	3.7	1.6	3.0	4.0	6.0	3.1

* First column shows starting materials (diploid lines).
** Second column shows dihaploid lines produced by irradiated pollen techniques.
*** Same letter indicates the absence of significant difference at p = 0.01 Tukey tests.

starting materials. Some DH lines with long fruit shapes were found, although there was no long-shaped genotype among the starting materials. Some other different genotypes with netted and ribbed fruit were also determined.

Fruit weight varied between 461 g and 1983 g and the heaviest fruits were harvested from 48/131, K4, E14 and E21 while the smallest fruits were obtained from C10, D34, B7, E25, C5 and C19. More variation was found in fruit length than in fruit diameter.

The smallest seed cavities characterizing high fruit flesh productivity were in genotypes B5, B7, B9, E8, G8, I7, 5/11 and 14/1. The largest seed cavities were in genotypes D5, E13 and E14. Rind thickness, important for storing and transportation, was between 3.51 mm and 8.17 mm. The thickest rind was in 48/131, K4 and H14, and the thinnest in 9/25, B7, C5, D13 and G8. The thickest fruit flesh was in I5, K4 and 48/131, and the thinnest fruit flesh in C10, C19, C5, C9, D25, D34 and E25. Another important quality parameter is total soluble solids (TSS). TSS was at a sufficient level in all genotypes. However, TSS varied according to genotype. Genotypes with over 10% TSS were C10, C18, G2, E25, H14 and 14/1, while the lowest TSS values were in D11, 9/25, D25, D11 and D13.

In this study, inbreeding depression was not determined in all genotypes. Double haploid lines and original diploid genotypes presented similar values with regard to the investigated parameters. In the watermelon, a member of the *Cucurbitaceae* family, the inbreeding effect was not (Sarı et al., 1998) as strong as in the sunflower (Tuberosa, 1983), maize (Shull, 1908; Wimon, 1977), rice (Zhi-Kang et al., 2001), the strawberry (Rosati et al., 1975) and tobacco (Deaton et al., 1986; Nielsen and Collins, 1989). Double haploid lines and original diploid materials presented similar agronomical characteristics to the watermelon (Sarı et al., 1998). Rubino and Wehner reported that species of the *Cucurbitaceae* family exhibit little inbreeding depression, and no significant inbreeding depression was found in watermelon (Sarı et al., 1998). Homozygosity was reported not to have a negative effect on plant vigor, yield or quality in the watermelon (Sarı et al., 1998) or cucumber (Rubino and Wehner, 1984). Results from this study supported by previous studies indicate that inbreeding depression is not significant in the fruit yield, quality or plant vigor of doubled haploid melon lines.

In a future study, the general and specific combination abilities of double haploid lines with high total and early yield and good fruit characteristics will be determined, and the first Turkish hybrid melon cultivars will be developed via irradiated pollen technique.

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