Dihaploid Female Lines, Mother Component of F_1 Pickling Cucumber Hybrids

Vesselina Nokolova, M. Alexandrova, and V. Stoeva
Institute of Horticulture and Canned Foods, 4003 Plovdiv, Bulgaria

Introduction: Haploid cucumber plants (*Cucumis sativus* L.) (n=x=7) have reduced fertility or often exhibit full sterility (Nikolova and Niemirowicz-Szczytt, 1995) The use of different techniques such as colchicine treatment (Nikolova and Niemirowicz-Szczytt, 1996), (Chen and Staub, 1997) and regeneration from callus (Faris et al., 1996) gives the possibility of creating fertile dihaploid (DH) genotypes. This is a prerequisite for stabilization of homozygous DH lines (Nikolova and Alexandrova, 2001), which are valuable starting materials for a heterosis breeding in cucumber.

For our cucumber genetic and breeding programs, it was necessary to evaluate the morphological traits of homozygous DH lines and to study the possibilities of including them in heterosis breeding; to evaluate the qualities of new F_1 hybrids; and to estimate the size and structure of their fruit yield, compared to the yield of the standard Bulgarian variety Toni F_1.

Materials and Methods: Some morphological peculiarities and sex expression of five dihaploid lines of pickling cucumbers, Nos. 43, 44, 45, 50 and 51 were studied during 1999. Their F_1 hybids were obtained by crossing with lines highly-resistant to powdery mildew and tolerant to CMV, i.e., monoecious lines 8/9, 8/19, T/19 and K-2 cultivated under the greenhouse conditions during April-August 2000-2001. The development of the hybrids, sex expression and fruit morphology were evaluated during the growth of 50 F_1 plants. The marketable and total fruit yields were assessed by performing comparative variety experiments, using a block method in four replications. Toni F_1, the standard pickling cucumber variety in Bulgaria, was used as a control. Harvesting was done every second day. The total yield was determined from the mass of the standard (length 3-12 cm) and non-standard fruits, and the marketable yield from extra, first and second quality fractions with fruit sizes of 3-6 cm, 6-9 cm and 9-12 cm, respectively.

Results and discussion: The DH pickling cucumber lines Nos. 43, 44, 45, 50 and 51 had well developed, vigorous plants of gynoecious type and their flowers and leaves exhibited a morphology typical for diploid *C. sativus* genome. The fruits had light green color with light strips, warts and white spines.

The F_1 hybrids between DH lines and lines 8/9, 8/19, T/19 and K-2 were vigorous, and of gynoecious type. At the start of growth, single male flowers at the bottom of the stem were observed. In some plants, the extremely high temperature during the summer, also provoked formation of male flowers on one or (rarely) more nodes of the central stem and the branches. This was probably due to the heterozygosity in the F_1 and to the incomplete expression of the dominant genes determining female sex expression. In homozygous DH lines only female flowers were observed irrespectively, due to the unfavourable summer temperature. The fruit morphology typical for DH lines dominated in the F_1.

The results from the comparative study of seven F_1 hybrids and the standard Toni F_1 are given in Table 1. The data in Table 1 shows that the F_1 hybrids slightly exceed the standard in total yield (by 0.6-8.9%). This yield was lower (91.7%) only in the hybrid combination DH 51 x 8/9. Similar trends were observed when analyzing marketable yield. Data in the table demonstrates that in five hybrid combinations (DH 44 x T/19, DH 45 x T/19, DH 43 x 8/9, DH 51 x 8/19 and DH 50 x K-2), the yields from the fractions 3-6 cm (extra quality) and from 6-9 cm (first quality) had higher values compared to those in the standard. Two F_1 hybrids, DH 44 x T/19 and DH 45 x T/19, had the highest yield of extra and first quality fruits. They exceeded Toni F_1 by 33.4 and 20.5%, respectively, for fraction 3-6 cm, while for fraction 6-9 cm, it was 10.9 and 13.0%. In these two hybrids the total marketable produce (3-12 cm) was higher by 10.5 and 8.0%, respectively.

The differences between the new hybrids and variety Toni F_1 were more clearly expressed in analyzing the structure of the marketable yield. It was established that in the F_1 combinations DH 44 x T/19 and DH 45 x T/19. the extra and first quality fruits had a greater

Table 1. Results from comparative study of new F_1 hybrids of pickling cucumbers (average for the period 2000-2001)

Hybrid	Marketable yield from fruits with length						Total marketable yield		Yield from fruits longer then 12 cm		Total yield	
	3 – 6 cm		6 – 9 cm		9 – 12 cm							
	kg/ha	relative yield %	kg/ha	relative yield %	kg/ha	relative yield %	kg/ha	relative yield %	kg/ha	relative yield %	kg/ha	relative yield %
1. Toni F1 (st)	14649.7	100.0	29888.3	100.0	19472.2	100.0	64010.2	100.0	11160.3	100.0	91937.5	100.0
2. DH 43 x 8/9	16430.2	112.2	33769.4	113.0	20040.7	102.9	70240.3	109.7	10443.1	93.6	98766.6	107.4
3. DH 43 x 8/19	14593.5	99.6	32084.9	107.3	22532.2	115.7	69210.6	108.1	10548.5	94.5	94780.8	103.1
4. DH 44 x T19	19547.1	133.4	33136.3	110.9	18074.8	92.8	70758.2	110.5	11503.8	103.1	100123.5	108.9
5. DH 45 x T19	17652.3	120.5	33784.7	113.0	17679.9	90.8	69116.9	108.0	9010.3	80.7	96811.5	105.3
6. DH 51 x 8/9	14145.7	96.6	27419.7	91.7	16195.0	83.2	57760.4	90.2	9649.7	86.5	84327.2	91.7
7. DH 51 x 8/19	17063.0	116,5	31458.2	105.3	17534.1	90.0	66055.3	103.2	7968.6	71.4	92557.5	100.6
8. DH 50 x K2	15505.0	105.8	30743.5	102.9	19948.8	102.4	66197.3	103.4	13078.9	117.2	97726.6	106.3

proportion (74.4%) of marketable yield, and in compliance with this the hybrids exceed the variety Toni F_1 (69.6%) by about 5%. The proportion of the second quality fruits (9-12 cm) in the formation of this yield was 25.6%.

The marketable yield structure was similar in other F_1 hybrids, DH 51 x 8/19, DH 51 x 8/9, and DH 43 x 8/9, in which the yields from the 3-6 cm and 6-9 cm fractions were 73.5, 72.0 and 71.5% higher, respectively, from the standard produce. The better structure of marketable yield in the new F_1 hybrids probably was due to the dihapliod mother components.

On the basis of the obtained results we consider that the use of homozygous DH lines in the heterosis breeding of pickling cucumbers raises the possibility of obtaining of higher fruit yields from extra and first quality fractions (3-6 and 6-9 cm). These fractions are the most desired ones for processing industry.

Conclusions: The dihaploid lines Nos 43, 44, 45, 50 and 51 are of gynoecious type, with good morphological characters of the fruits and could be used as mother components in the heterosis breeding of pickling cucumbers. The F_1 hybrids of the dihaploid lines with monoecious lines – 8/9, 8/19, T/19 and K-2 – give higher total and marketable yield compared to the control Toni F_1. The marketable yield structure of the new hybrids is better. The hybrid combinations DH 44 x T/19 and DH 45 x T/19 are the most promising ones. Their yield from the extra fruit quality fraction (3-6 cm) exceeds the standard variety Toni F_1 by 33.4 and 20.5%, respectively and from 6-9 cm fraction (first quality) - by 10.9 and 13.0%.

Literature cited:

1. Chen, J. and J. Staub, 1977. Attempts at colchicine doubling of interspecific hybrid of *Cucumis sativus* L x *C.hystrix* Chakr. Cucurbit Genetics Cooperative Report 20 : 24-26
2. Faris, N, M. Racoczy-Trajanowska, S. Malepszy, K. Niemirowicz-Szczytt, 1996. Induction and regeneration of cucumber (*Cucumis sativus* L.) doubled haploids. Journal of Applied Genetics, Poland, 37 A: 181-186
3. Nikolova, V. and K. Niemirowicz-Szczytt, 1995. Evaluation of meiosis in cucumber (*Cucumis sativus* L.) monohaploids. Caryologia 48: 3-4
4. Nikolova, V. and K. Niemirowicz-Szczytt, 1996. Dihaploidization of cucumber (*Cucumis sativus* L.) haploids by colchicine treatment. Acta societatis botanicorum Poloniae, 65, No 3-4: 311-317
5. Nikolova,V. and M. Alexandrova, 2001. Gynogenesis in a dihaploid line of cucumber (Cucumis sativus L.). Cucurbit Genetics Cooperative Report 24: 20-21