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CHARACTERISTICS AND BASIC TRAITS CONNECTED WITH THE SEED-PRODUCTIVITY IN THE FRUIT OF F1 TOMATO HYBRIDS

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Abstract

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Variability has been studied and a comparative evaluation has been made of the basic traits connected with the seed-productivity in the fruit of intravarietal hybrids of tomatoes and their parental lines. The research was conducted at the Maritsa VCRI, Plovdiv during the period of 2005-2008. The variance of the indicators average weight, average number of seeds in one fruit and the absolute weight of seeds of the large-fruit parental varieties is higher than the small-fruit ones. The hybrid combinations of tomatoes hardly vary from their parental forms as referring to the variance of average number of seeds in the fruit, number of seeds in 1g of fruit and absolute weight of seeds. The average number of seeds in 75% of hybrid combinations is bigger than those of the parental line, and in 25% it is smaller than the parental forms with greater number of seeds but it is not smaller than the female one. The number of seeds in 1g of fruit in F1 hybrid combinations of tomatoes is significantly larger than those of the parental forms. Only in two of the hybrid combinations Bela x Roma and Venera x Roma the absolute weight of the seeds is smaller both compared to the female and the male lines. The achieved results give us a reason to conduct a successful breeding in accordance with these traits in order to create hybrids with lower seed-productivity by a precise choice of parental couples.

*Key words***:** tomatoes, seeds, variance, level of dominance

Introduction

In Bulgaria the tomato hybrids for industrial processing gradually spread more widely in production (Danailov, 2008; 2009a; Masheva and Mihov, 2009). Many researches show data of complex combinations and relations between genes and genotype-environment as well as their influence on physiological, morphological and bio-chemical traits (Daskalov et al., 1974; Georgiev, 1984; 1988; Danailov, 2001; Danailov, 2002; Jinks, 1983; Suresh et al., 1995). Depending on the varieties, differences have been found in the average number, size and absolute weight of the seeds in the fruit (Pet and Gurretsen, 1983). There is a correlation between fruit and seeds size, between the average weight of the fruit and the absolute weight of the seeds. The number of the seeds depends both on the variety and the environment conditions at the time of the blossoming and fertilization (Popova and Mihailov, 1973).

One of the specific problems of F1 hybrid

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tomatoes, compared to their parental lines, is the bigger insemination of the fruit (Mihailov, 1974). Although the bigger quantity of seeds in the fruit of F1 hybrid tomatoes is not considered to be an advantage, in a theoretical aspect, the issue of insemination productivity of the fruit of F1 hybrid plants is of interest as far as the clarification of its relation to the heterosis of productivity of the fruit is concerned (Danailov, 2009b). The data concerning the variability and the characteristics of the basic indicators connected to the seed-productivity in the F1 hybrid tomato fruit that result from the hybridization between various variety-types is rather scarce.

The present research has been conducted to examine the variability, characteristics and the basic traits connected to seed-productivity in the fruit of intravarietal tomato hybrids as well as to make a comparative evaluation in accordance with these traits of the seeds in the fruit of F1 hybrid combinations and their parental lines.

Material and Method

The hybridization between the two basic variety-types (large-fruit and small-fruit – peeled type) determinant tomatoes, was conducted on the 8x2 scheme in 2005. For female parents the varieties Stela, Topaz, Trapeziitsa, Yana were used – from the large-fruit group; UC-82A, Kapri, Bela and Venera were used as well - from the small-fruit, peeled type. For the mail components, the varieties Miliyana were used –from the large-fruit group, and Roma – from the small-fruit, peeled type tomatoes.

The plants of F1 hybrid combinations and the tomato varieties used for parental lines were grown on the test field of Maritsa VCRI, the City of Plovdiv in the period of 2006 – 2008, in accordance with the common technology for mid-early tomato field production. The experiment was conducted in accordance with the block method in four replications by the summarized schemes of Barov and Mincheva (1973), on 4.8 m² test lot with 20 plants. Every year, from 5 plants in every replication of the F1 hybrid combinations and the parental varieties, 5 fruit are selected in technological ripeness. The average weight of the fruit and the average number of seeds in the fruit are measured, the average of seeds per unit of weight is calculated from the average weight of the fruit, and the absolute weight of the seeds (weight of 1000 seeds) is defined.

The achieved results are statistically processed by the means of variational, correlation analysis (Lakin, 1990) and analysis of variance by Duncan (1955).

The values of the indicators connected to the seed-productivity of the fruit of F1 hybrids are calculated according to the first (P1) and the second (P2) parent, according to the average parental value (MP) and according to the parent with greater strength of the trait (HP) (D.Omarov, 1975). The level of dominance of the indicators of the seed-productivity of the fruit of F1 hybrid tomatoes is determined (d/a) (Genchev et al., 1975).

Results and Discussion

In the conducted research, the average weight of the fruit of the large-fruit determinant tomatoe varietys that were used as parental components varies from 104.5g for Stela to 168.2g for Trapeziitsa (Table 1). The largest fruit of this group are the varieties Trapeziitsa and Miliyana and the smallest ones are the varieties Stela and Topaz. The average weight of the fruit in the small-fruit group is from 48.2g (variety Roma) to 63.1g (variety Kapri). The varieties of the two groups – large-fruit and small-fruit, used as female parental components as well as the varieties Miliyana and Roma used as mail parental components, statistically vary in average weight of the fruit (Table 1).

The variance of the average weight of the fruit is much stronger in the large-fruit tomatoe varieties compared to those of the small-fruit ones both in the hybrid combinations and in the parental forms (Tables 1 and 2). The analysis of

Table 1
Average number of seeds per unit of weight from the average weight of the fruit in the parental lines of tomatoes

Variety	Average weight of the fruit, g			Average number of seeds in one fruit			Average number of seeds in 1g of the fruit		
	$\bar{x}$ ± sd		CV%	$\bar{x}$ ± sd		CV%	$\bar{x}$ ± sd		CV%
Miliyana	166.9 a	±45.6	27.3	179.9 a	±37.2	20.7	1.08 de	±0.06	6.5
Stela	104.5 d	±19.9	19.0	135.2 c	±27.2	20.2	1.29 c	±0.06	7.8
Topaz	115.9 c	±17.6	15.2	127.6 c	±28.2	22.1	1.10 d	±0.09	10.2
Trapeziitsa	168.2 a	±47.9	28.5	162.9 b	±38.7	23.9	0.97 f	±0.05	4.4
Yana	155.8 ab	±33.6	21.6	156.9 b	±32.3	20.6	1.01 e	±0.08	8.3
Roma	48.2 g	±3.5	7.2	65.6 f	±5.2	7.9	1.36 b	±0.07	9.8
UC-82A	60.4 e	±5.7	9.2	75.9 e	±12.1	16.0	1.26 c	±0.09	11
Kapri	64.1 e	±7.4	12.8	86.5 d	±11.5	13.3	1.35 b	±0.07	9.1
Bela	52.8 f	±4.8	9.2	70.9 e	±11.9	16.9	1.34 b	±0.06	7.7
Venera	58.1 ef	±5.4	8.4	82.9 d	±12.2	14.7	1.43 a	±0.07	9.7

Table 2
Average number of seeds per unit of weight from the average weight of the fruit in the hybrid tomato combinations

Hybrid combinations	Average fruit weight, g			Average number of seeds in one fruit			Average number of seeds in 1g of fruit		
	$\bar{x}$ ± sd		CV%	$\bar{x}$ ± sd		CV%	$\bar{x}$ ± sd		CV%
Stela x Miliyana	140.6 c	±18.6	11.8	188.1 b	±25.5	13.5	1.34 e	±0.06	8.4
Topaz x Miliyana	153.1 b	±19.6	12	183.5 b	±17.9	10.9	1.20 f	±0.05	5.7
Trapeziitsa x Miliyana	170.1 a	±31.6	18.6	205.4 a	±33.1	16.1	1.21 f	±0.08	9.4
Yana x Miliyana	157.9 b	±21.0	15	189.8 b	±20.0	11.8	1.20 f	±0.07	7.9
UC-82A x Miliyana	76.0 f	±10.2	13.4	145.0 de	±15.8	10.9	1.91 ab	±0.05	8.7
Kapri x Miliyana	86.1 de	±12.7	14.7	155.4 d	±17.3	11.2	1.80 b	±0.05	9.7
Bela x Miliyana	71.4 g	±9.7	13.6	137.4 e	±17.0	12.4	1.92 ab	±0.04	7.7
Venera x Miliyana	80.3 ef	±7.5	9.3	148.2 de	±19.0	12.8	1.85 b	±0.04	8.9
Stela x Roma	82.3 e	±8.3	10.1	162.9 c	±21.1	13	1.98 ab	±0.03	6.8
Topaz x Roma	84.4 e	±8.9	10.6	167.3 c	±16.5	8.8	2.22 a	±0.04	8.2
Trapeziitsa x Roma	91.6 d	±7.3	8	170.8 c	±16.8	8.7	2.12 a	±0.05	9.1
Yana x Roma	86.9 de	±8.7	10.1	166.4 c	±19.4	11.6	1.91 ab	±0.04	8.5
UC-82A x Roma	59.2 h	±3.8	6.4	90.5 g	±12.4	13.7	1.53 d	±0.05	7.1
Kapri x Roma	60.4 h	±3.2	5.3	102.6 fg	±13.3	13	1.70 c	±0.05	7.8
Bela x Roma	58.4 h	±4.0	6.8	97.3 g	±9.9	10.3	1.67 cd	±0.04	6
Venera x Roma	62.8 h	±3.9	6.2	111.9 f	±15.1	14.1	1.78 c	±0.06	10.3

the average weight of fruit of the varieties used as parental components and the F1 hybrids shows that the research includes genotypes with varying fruit weights, which is a basis for difference in the average number of seeds in one fruit and in the absolute weight of the seeds.

The large-fruit tomato varieties have significantly larger number of average seeds in one fruit, which varies from 127.6 to 179.9, while the small-fruit ones vary from 65.6 to 86.5 (Table 1). The variance of average number of seeds in one fruit is stronger in large-fruit varieties and weaker in small-fruit ones. The differences in the variance according to this trait are insignificant in the hybrid combinations. Significant differences in the variance of the average number of seeds in one fruit are observed only in large-fruit varieties and hybrid combinations in which they are used (Tables 1 and 2). A strong correlation between average weight of fruit and the average number of seeds is observed. The correlation quotient for the parental lines of tomatoes is r=0.98 and for the hybrids r=0.86.

The fruit of the hybrid combinations of tomatoes produced after using parental forms with approximately equal number of seeds in one fruit have larger number of seeds from the parental lines i.e. they are significantly superior in this indicator. In the hybrids that result from using parental forms of fruit with varying number of seeds significant superiority according to this trait can only be observed in the cases when the female parent is from the large-fruit variety type (Table 3).

Only four tomato hybrid combinations vary with a significantly smaller number of seeds in a fruit compared to the parental lines, which is in fact positive trait. They result from hybridization of small-fruit female and large-fruit male parent. The average number of seeds in one fruit in these hybrid combinations is smaller than that of the parental form with the larger number of seeds and

Table 3

Heterosis effect and level of dominance in accordance with the average number of seeds in one fruit in the fruit of hybrid tomato combinations

Hybrid combinations	Heterosis effect, %				Level of dominance
	According to P1	According to P2	MP	HP	
Stela x Miliyana	39.1	4.6	19.4	4.6	1.37
Topaz x Miliyana	43.8	2.0	19.3	2.0	1.14
Trapeziitsa x Miliyana	26.1	14.2	19.8	14.2	4.00
Yana x Miliyana	21.0	5.5	12.7	5.5	1.86
UC-82A x Miliyana	91.0	-19.4	13.4	-19.4	0.33
Kapri x Miliyana	79.7	-13.6	16.7	-13.6	0.48
Bela x Miliyana	93.8	-23.6	9.6	-23.6	0.22
Venera x Miliyana	78.8	-17.6	12.8	-17.6	0.35
Stela x Roma	20.5	148.3	62.3	20.5	1.79
Topaz x Roma	31.1	155.0	73.2	31.1	2.28
Trapeziitsa x Roma	4.8	160.4	49.5	4.8	1.16
Yana x Roma	6.1	153.7	49.6	6.1	1.21
UC-82A x Roma	19.2	38.0	27.9	19.2	3.83
Kapri x Roma	18.6	56.4	34.9	18.6	2.54
Bela x Roma	37.2	48.3	42.6	37.2	10.96
Venera x Roma	35.0	70.6	50.7	35.0	4.35

Table 4

Heterosis effect and level of dominance according to the number of seeds in 1g of fruit

Hybrid combinations	Heterosis effect, %				Level of dominance
	According to P1	According to P2	MP	HP	
Stela x Miliyana	3.9	24.1	13.1	3.9	1.48
Topaz x Miliyana	9.1	11.1	10.1	9.1	11.00
Trapeziitsa x Miliyana	24.7	12.0	18.0	12.0	3.36
Yana x Миляна	18.8	11.1	14.8	11.1	4.43
UC-82A x Miliyana	51.6	76.9	63.2	51.6	6.90
Kapri x Miliyana	33.3	66.7	48.1	33.3	71.00
Bela x Miliyana	43.3	77.8	58.7	43.3	16.27
Venera x Miliyana	29.4	71.3	47.4	29.4	23.00
Stela x Roma	53.5	45.6	49.4	53.5	13.40
Topaz x Roma	101.8	63.2	80.5	101.8	173.00
Trapeziitsa x Roma	118.6	55.9	82.0	118.6	77.00
Yana x Roma	89.1	40.4	61.2	89.1	14.71
UC-82A x Roma	21.4	12.5	16.8	12.5	4.40
Kapri x Roma	25.9	25.0	25.5	25.0	69.00
Bela x Roma	24.6	22.8	23.7	22.8	32.00
Venera x Roma	24.5	30.9	27.6	24.5	11.00

Table 5

Absolute weight of the seeds

Variety	Absolute weight of the seeds of the parental lines			Absolute weight of the seeds of the hybrid combinations					
				x Miliyana			x Roma		
	$\bar{x}$ ± sd		CV%	$\bar{x}$ ± sd		CV%	$\bar{x}$ ± sd		CV%
Miliyana	3.768	±0.15	4.01	-	-	-	-	-	-
Stela	3.382	±0.12	3.66	3.404	±0.13	3.69	3.113	±0.09	2.3
Topaz	3.265	±0.07	2.34	3.346	±0.12	3.54	3.063	±0.12	4.02
Trapeziitsa	3.207	±0.09	2.95	3.344	±0.14	4.42	3.101	±0.11	3.65
Yana	3.279	±0.07	2.05	3.287	±0.18	5.34	3.017	±0.13	4.19
Roma	2.675	±0.15	5.54	-	-	-	-	-	-
UC-82A	2.700	±0.16	5.96	2.825	±0.17	6.17	2.680	±0.18	6.56
Kapri	3.101	±0.15	4.81	3.161	±0.17	5.47	2.730	±0.15	5.59
Bela	2.456	±0.16	6.40	2.625	±0.19	7.19	2.365	±0.13	5.36
Venera	2.745	±0.20	3.33	2.915	±0.18	6.02	2.570	±0.11	4.57

it is not smaller than the number of the female parental form. In this case the direction of crossing has a significant influence on the number of formed seeds in the fruit of the F1 tomato hybrids, female effect is observed. The larger insemination of the fruit in the hybrid combinations compared to

Table 6
Absolute weight of the F1 hybrid combination seeds in percentage according to the female and male parents

Hybrid combination	According to the female, %	According to the male, %
Stela x Miliyana	100.7	90.3
Topaz x Miliyana	102.5	88.8
Trapeziitsa x Miliyana	104.3	88.7
Yana x Miliyana	100.2	87.2
UC-82A x Miliyana	104.6	75.0
Kapri x Miliyana	101.9	83.9
Bela x Miliyana	106.9	69.7
Venera x Miliyana	106.2	77.4
Stela x Roma	92.0	116.4
Topaz x Roma	93.8	114.5
Trapeziitsa x Roma	96.7	115.9
Yana x Roma	91.8	112.8
UC-82A x Roma	99.3	100.2
Kapri x Roma	88.0	102.1
Bela x Roma	96.3	88.4
Venera x Roma	93.6	96.1

the parental forms is probably determined by the bigger vitality of the hybrid plants, which ensures better conditions for the processes of pollination and fertilization. According to the average number of seeds in one fruit, most of the tomato hybrid combinations are superior to their parental forms; they seldom take intermediate position or are insignificantly inferior to the parental form with larger number of seeds (Table 3).

As a rule seeds are not produced from the fruit of tomato hybrid varieties and this makes their higher number undesired. The trait is undesired also with the large-fruit variety - type used for fresh consummation and especially with the tomatoes for industrial processing since this leads to an increase of the waste and a decrease in the tomato product. This is why the tomato hybrid varieties of with lower number and lower absolute weight of the seeds in the fruit are preferable in comparison with the hybrids with higher values of these indicators.

The average number of seeds per 1g of average weight of the fruit in the tomato parental forms varies from 0.97 to 1.43g, while in the hybrid combinations it is from 1.20 to 2.22g (Tables 1 and 2). The ratio between the average weight of the fruit and the stage of insemination shows that from the hybrid combination tomato fruit, compared to their parental forms, is larger in quantity of seeds per 1 g of the weight of the fruit. A negative correlation between the stage of insemination and the average weight of fruit is observed both in hybrid combinations (r= -0.72) and in the direct varieties (r= -0.93) used as parental components.

The research shows that the number of seeds in 1g of fruit in F1 tomato hybrid combinations is significantly larger compared to the parental forms; the superiority is significant (Table 4). The hybrids with parents having approximately equal number of seeds are with the lowest superiority. The highest superiority according to average number of seeds per 1 g of fruit has the hybrid combinations Trapeziitsa and Roma.

The research includes varieties of tomatoes completely different in absolute weight for parental components (Table 5). Large-fruit type-varieties have higher absolute weight of seeds (from 3.207 to 3.378g) compared to the small-fruit ones (from 2.457 to 3.101g). A strong correlation between the average weight of fruit and the absolute weight of seeds is observed both in the parental lines (r=0.83) and in the hybrids (r=0.84).

The percentage increase or decrease of the absolute weight of the seeds in the hybrid tomato combinations is different according to the female and male forms (Table 6). The seeds in the fruit of hybrid combinations obtained after using the Miliyana variety as a male parent have higher absolute weight than those of the female parent. Hybrid combinations in which the male parent is the small-fruit variety Roma, the absolute weight

Table 7
Heterosis effect and level of dominance according to the absolute weight of the seeds in the fruit of the hybrid tomato combinations

Hybrid combinations	Heterosis effect, %				Level of dominance
	According to P1	According to P2	MP	HP	
Stela x Miliyana	0.7	-9.7	-4.8	-9.7	-0.89
Topaz x Miliyana	2.5	-11.2	-4.8	-11.2	-0.68
Trapeziitsa x Miliyana	4.3	-11.3	-4.1	-11.3	-0.51
Yana x Miliyana	0.2	-12.8	-6.7	-12.8	-0.97
UC-82A x Miliyana	4.6	-25.0	-12.6	-25.0	-0.77
Kapri x Miliyana	1.9	-16.1	-8.0	-16.1	-0.82
Bela x Miliyana	6.9	-30.3	-15.6	-30.3	-0.74
Venera x Miliyana	6.2	-22.6	-10.5	-22.6	-0.67
Stela x Roma	-8.0	16.4	2.8	-8.0	0.24
Topaz x Roma	-6.2	14.5	3.1	-6.2	0.32
Trapeziitsa x Roma	-3.3	15.9	5.4	-3.3	0.60
Yana x Roma	-8.0	12.8	1.3	-8.0	0.13
UC-82A x Roma	-0.7	0.2	-0.3	-0.7	-0.60
Kapri x Roma	-12.0	2.1	-5.5	-12.0	-0.74
Bela x Roma	-3.7	-11.6	-7.8	-11.6	-1.83
Venera x Roma	-6.4	-3.9	-5.2	-6.4	-4.00

of seeds is smaller compared to that of the female parent. The results show that there is a significant influence of the male parent of the absolute weight of seeds in the hybrid tomato combinations. When crossing different female with the same male form the percentage increase in the absolute weight of seeds is different depending on the variety used as a female component. In two of the hybrid combinations Bela x Roma and Venera x Roma the absolute weight of seeds is smaller than both of the female and the male parent. Consequently, the absolute weight of seeds in the hybrid tomato combinations is formed by the interaction of the genetic factors between the parental couples, by the influence of the cytoplasm of the female parent, and by the environmental factors.

The absolute weight of the seeds in the fruit of F1 tomato hybrid compared to the average one of the two parents is with positive values only in hybrid combinations acquired as a result of hybridization between a female and a male variety with bigger absolute weight of seeds (Table 7). The absolute weight of seeds in the fruit of all the hybrids is with lower values than those of the parental form with bigger absolute weight. Three of the tomato hybrid combinations according to this trait take an intermediate position. In 75 % of hybrid combinations superiority of the parental form with smaller absolute weight of seeds is observed.

Conclusions

The variance of average weight of fruit, average number of seeds in one fruit and absolute weight of seeds in large-fruit parental tomato varieties is higher than that of the small-fruit ones. Hybrid tomato combinations do not significantly differ from the parental forms according to the variance of the average number of seeds in a single fruit, average number of seeds in 1g of fruit, and absolute

weight of seeds. According to the average number of seeds in a single fruit in 75% of hybrid tomato combinations, superiority of the parental forms with larger number of seeds is observed, while in 25% the number of seeds in a single fruit is smaller than that of the parental form with larger number of seeds, but it is not smaller than that of the female. The average number of the seeds in 1g of fruit in F1 tomato hybrid combinations is significantly bigger in comparison to the parental forms. Only in two of the hybrid combinations Bela x Roma and Venera x Roma the absolute weight of seeds is smaller both than that of the female and the male line. The seed-productivity of fruit in hybrid tomatoes is probably determined by the interaction of the genetic factors, by the specific traits of the parental couples, by the influence of the cytoplasm of the female parent, as well as by the environmental factors. The achieved results connected to the seed-productivity in the tested genotype tomatoes give us a reason to conduct a successful breeding in accordance with these traits in order to create hybrids with lower seed-productivity by a precise choice of parental couples.

References

Barov, V. and T. Mincheva, 1973. Summarized schemes of the methods of the latin square and the latin rectangular. *CNIRD at "Bulgarplod"*, Plovdiv, 391 pp. (Bg).

Danailov, Zh., 2001. Heterosis – Highly efficient method for tomato breeding. *Scientific Works of the Agricultural University – Plovdiv*, vol. XLVI, (3): 187-192 (Bg).

Danailov, Zh., 2002. New achievement in tomato breeding in Bulgaria. First Symposium on Horticulture, Ohrid, Republic of Macedonia, 16-20 October, pp. 338-341.

Danailov, Zh., 2008. Tomato hybrids for different production trends 1. Elena prima F1 – Determinate hybrid for middle-early and late field production. *Genetics and Breeding*, **37** (3-4): 59-64.

Danailov, Zh., 2009a. New bulgarian tomato hybrids with height productivity and good flavor. *Acta Hort., (ISHS)* **830**: 313-316.

Danailov, Zh., 2009b. Investigations on the heterosis and its application in tomato (*Solanum lycopersicum* L.) breeding. *Doctors thesis* (DSc), 313 pp. (Bg).

Daskalov, Hr., etc., 1974. Heterosis and its use in vegetable production. *Hristo G. Danov Publ. House*, Plovdiv, 39 pp.(Bg).

Duncan, D., 1955. Multiple range and multiple F-tests. *Biometrics,* **11**: 1-42.

Genchev, G., E. Marinkov, B. Yovcheva and A. Ognyanova, 1975. Biometrical methods in plant growing. *Genetics and Breeding*, *Zemizdat*, Sofia, pp. 240-242 (Bg)

Georgiev, Hr., 1984. Genetic bases of heterosis. *Anthology "Heterosis of Crops"* – National Conference, 19-20.I., Sofia, pp. 3-16 (Bg).

Georgiev, Hr., 1988. Opportunities of perfection of the heterosis methods of breeding of the crops. (Ru) "*Heterosis of Crops"* – II National conference, 22-23.XI., Sofia, pp. 3-8 (Bg).

Jinks, J. L., 1983. Biometrical genetics of heterosis. *In: Heterosis*. R. Frankel (ed), *Springer - Verlag*. Berlin, Heidelberg, N.Y., Tokyo, pp. 17-70.

Lakin, G., 1990. Biometrics. Higher School, Moscow, 352 pp. (Ru).

Masheva, St. and M. Mihov. 2009. Trends of the research work in vegetable crops and potatoes in Bulgaria, IVth Balkan Symposium on Vegetables and Potatoes, 9-12 September 2008, Plovdiv-Bulgaria, *Acta Hort., (ISHS)* **830**: 45-52.

Mihaylov, L., 1974. Study of the demonstration of heterosis in blossoming, Pollination and Seed-productivity of Tomatoes. Sofia, Dissertation (Bg).

Omarov, D., 1975. About the methods of reporting and evaluation of the heterosis in plants. *Agricultural Biology,* **1**: 123-127 (Ru).

Popova, D. and L. Mihaylov, 1973. Studies on the heterosis effect of the seed-productivity in tomatoes. *Genetics and Breeding*, **6:** 411-418 (Bg).

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