INFLUENCE OF THE MATERNAL FACTOR IN THE CONTROL OF SOME BIOLOGICAL CHARACTERS AND PRODUCTIVITY OF TOMATOES

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Abstract. The phenotype character is determined not only by genotype, but also by maternal effects, namely by the direct contribution of the maternal phenotype on the phenotype of the descendants. By researching the influence of maternal factor in the control of some biological characters and productivity in tomato, there were registered 64 % cases of maternal effects. It was found that one and the same maternal form, in different combinations may manifest different influence on the phenotypic spectrum in segregating populations, what reveals the importance of the interactions of the two genomes - maternal and paternal in the formation of the character.

Keywords: maternal effect, tomato, reciprocal hybrids.

Rezumat. Influenţa factorului maternal în controlul unor caractere biologice şi de productivitate la tomate. Fenotipul caracterului este determinat nu doar de genotip, ci şi de efectele materne (maternale), adică de contribuţia directă a fenotipului matern asupra fenotipului urmaşilor. Prin cercetarea influenţei factorului matern în controlul unor caractere biologice şi de productivitate la tomate, au fost înregistrate 64 % cazuri de efecte materne. S-a constatat că una şi aceeaşi formă maternă, în diferite combinaţii poate manifesta influenţă diferită asupra spectrului fenotipic în populaţiile segregante, ceea ce relevă importanţa interacţiunilor celor 2 genomuri - matern şi patern în formarea caracterului.

Cuvinte cheie: efect matern, tomate, hibrizi reciproci.

INTRODUCTION

Optimization and efficiency programmes of amelioration of tomato is inconceivable in the absence of knowledge of the genetic basis of characters for which it is performed research and technology development genotypes with the desired qualities (AGONG et al., 2000). The extension of the tomato cultures into new geographic areas, developing technologies, diversification of production destination, all these make necessary the creation of varieties with special adaptations (BOTNARI & CEBOTARI, 2003). In recent years, the research focused on the adaption of the vegetable material to the environmental conditions, in particular at the stressful factors that play a limitative role. On the other hand, the consumers' requirements regarding the quality of the fruit are increasingly diversified, with regard to both appearance and consistency of the fruit, organoleptic and nutritional attributes, but also to the opportunities of industrial capitalization of tomatoes. The productivity of tomatoes, as as well as of other vegetable species, is a very complex trait that depends on the productivity elements – features set up on the basis of hereditary varieties and their interaction with environmental conditions (http://ru.scribd.com).

In relatively recent studies, it is mentioned about the involvement of maternal factor in the heritance of quantitative and qualitative characters (BALASHOVA et al., 2012). Even the response to selection can be affected by this effect (ETTERSON & GALLOWAY, 2002). Maternal and paternal effects can lead to different evolutions of the one for which selection is oriented. Parents influence children indirectly (genetically) and directly (through the resources they supply the seed) (HOLESKI, 2007). However, selection based on direct genetic effect, without taking into consideration the cytoplasm maternal form may not be adequate, and lead to the exclusion of an important source of genetic variance (WOLF et al., 2002). The **goal of the research** was to determine the influence of maternal factor in control of some biological characters and productivity of tomatoes.

MATERIAL AND METHODS

Three combinations of reciprocal hybrids belonging to to F_1, F_2 and F_3 generations, derivatives from 4 varieties of tomatoes - Gloria, Jubiliar, Atlasnâi, Zastava were used as research material as they present many characters. There were analysed the following biological indices: the number of seeds per fruit, fruit mass (g), fruit length and diameter (mm), pericarp and mesocarp thickness (mm), number of seminal lodges, plant height (cm); the productivity: mass (g) and number of fruit per plant.

The influence of the maternal factor was determined by reciprocity effect (r_e) according to the formula proposed by the author (REINHOLD, 2002).

The statistical processing of the data was performed in STATISTICA 7 software package.

RESULTS AND DISCUSSION

The study of the influence of parental factor, in control of some biological characters and productivity in tomato, during two years has demonstrated the differentiated contribution of maternal factor depending on the character and combination. Thus, the overall maternal effects were confirmed in 64 % of cases. The most affected indices by the

maternal influence characters were: plant height, fruit length, pericarp thickness and number of fruit per plant, while less influenced were mass, fruit diameter, number of seeds per fruit, number of seminal lodges (Table 1).

Table 1. Maternal and paternal effects in the reciprocal hybrids F_1 of tomato for some quantitative characters.

Combination	**Gloria x Jubiliar/ Jubiliar x Gloria**		**Gloria x Atlasnâi/ Atlasnîi x Gloria**		**Gloria x Zastava/ Zastava x Gloria**		**Total maternal effects:**	
Character	2012	2013	2012	2013	2012	2013	2012	2013
Plant height (mass flowering)	-0.01	-1.73	+0.09	-1.03	-0.71	+2.45	*2*	*2*
Plant height (mass fructification)	+0.21	-2.29	-0.47	-71.00	-0.08	-452.00	*2*	*3*
Plant height (mass ripening)	+0.14	-1.31	-0.48	-1.00	-0.24	-1.21	*2*	*3*
Fruit mass	+0.02	-0.11	+0.12	+0.58	-0.65	+1.64	*1*	*1*
Fruit length	-0.25	-0.46	-1.77	-7.75	-0.46	-0.24	*3*	*3*
Fruit diameter	-0.83	+0.69	+0.49	-0.41	+1.08	+4.79	*1*	*1*
Pericarp thickness	-0.31	-0.72	+0.27	+2.48	-0.10	-1.24	*2*	*2*
Mesocarp thickness	-0.07	-1.14	-0.07	+0.26	-0.14	+2.11	*3*	*1*
Number of seminal lodges	-0.43	-0.43	+0.11	+0.25	-2.40	+0.83	*2*	*1*
Number of seeds per fruit	+0.08	-0.42	+1.11	+0.70	-0.20	+0.42	*1*	*1*
Number of fruit per plant	-0.13	-0.63	+1.06	-0.15	-0.80	-0.49	*2*	*3*
Total maternal effects:	*7*	*10*	*4*	*6*	*10*	*5*	*21*	*21*

Although in all the 3 reciprocal combinations Gloria variety was involved, the biggest impact as maternal form it had in combination with Jubiliar and less with Atlasnâi, which reveals the important role of intra-allelic interactions in the manifestation of the maternal effect. As it is known, the weight (mass) of fruit and number of fruits per plant are the basic elements of plant productivity – mass of fruit per plant. By analysis the elements of the productivity of tomatoes, there were registered quite different values in case of both parental forms and the reciprocal hybrids.

Mass of fruit per plant. The value of this index varied between 1.6 and 2.9 kg at parents and between 1.8 and 2.7 kg – at hybrids. The true differences between reciprocal hybrids were found to the combinations: F_3 Gloria x Atlasnâi (II)/F_3 Atlasnâi x Gloria (II), F_3 Gloria x Zastava (II)/F_3 Zastava x Gloria (II).

Number of fruit per plant. It varied in interval 19.1 … 46.0 at parents and 18.7 … 41.2 – at hybrids. Significant differences between reciprocal combinations were found to the hybrids: F_3 Gloria x Jubiliar (II)/F_3 Jubiliar x Gloria (II), F_3 Gloria x Atlasnâi (I)/F_3 Atlasnâi x Gloria (I), F_3 Gloria x Atlasnâi (II)/F_3 Atlasnâi x Gloria (II), F_3 Gloria x Zastava (I)/F_3 Zastava x Gloria (I) şi F_3 Gloria x Zastava (I)/ F_3 Zastava x Gloria (I) (Fig. 1).

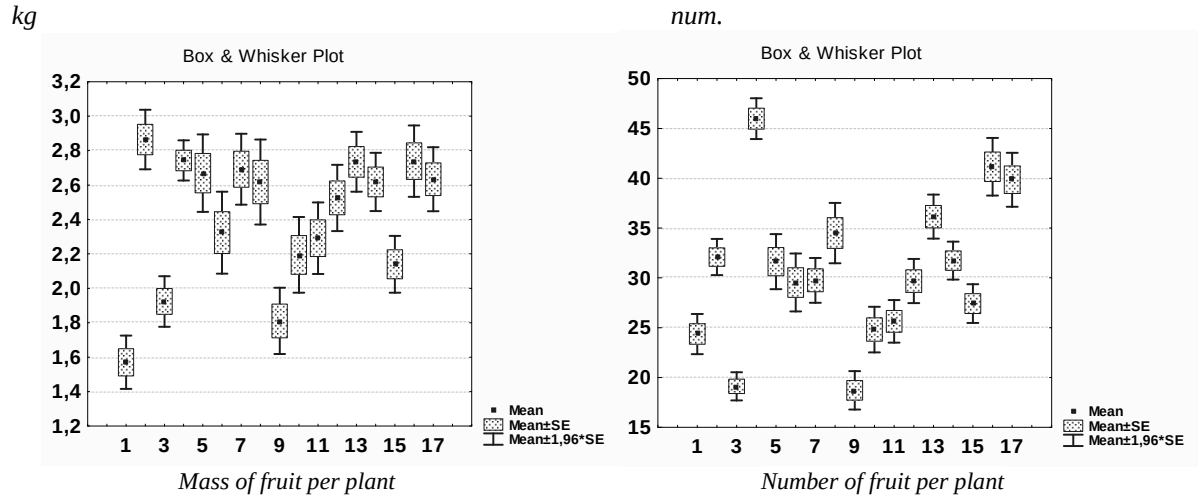
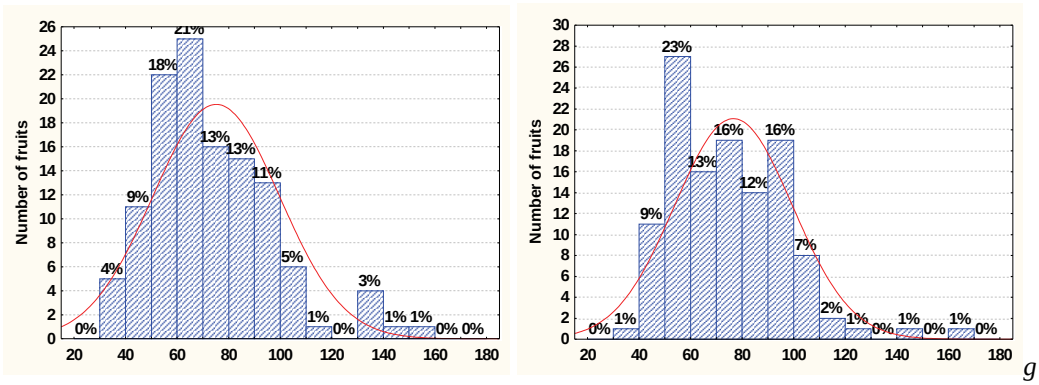


Figure 1. Comparative notes of the productivity elements of tomatoes.

Legend: 1. Gloria; 2. Jubiliar; 3. Atlasnâi; 4. Zastava; 5. F_3 Gloria x Jubiliar (I); 6. F_3 Gloria x Jubiliar (II); 7. F_3 Jubiliar x Gloria (I); 8. F_3 Jubiliar x Gloria (II); 9. F_3 Jubiliar x Gloria (I); 10. F_3 Gloria x Atlasnâi (I); 11. F_3 Gloria x Atlasnâi (II); 12. F_3 Atlasnâi x Gloria (I); 13. F_3 Atlasnâi x Gloria (II); 14. F_3 Gloria x Zastava (I); 15. F_3 Gloria x Zastava (II); 16. F_3 Zastava x Gloria (I); 17. F_3 Zastava x Gloria (II).

The research histograms demonstrated that, in case of the reciprocal hybrids F_2 and F_3, the plant distribution in phenotypic classes was different for all the analysed characters.

For example, for the *weight (mass) of the fruit*, the analysis of the histograms of the distribution of fruits in reciprocal populations, demonstrated that in F_2 Gloria x Zastava, the maximum frequency of distribution was registered for the phenotypic class 60-70 g (21 %), while the maximum weight class, 150-160 g, registered the lowest percentage, namely 1%. In case of F_2 Zastava x Gloria, the maximum frequency was certified for the class 50-60 g (23 %) and the class with maximum weight – 160-170 g registered the lowest frequency (1 %) (Fig. 2).

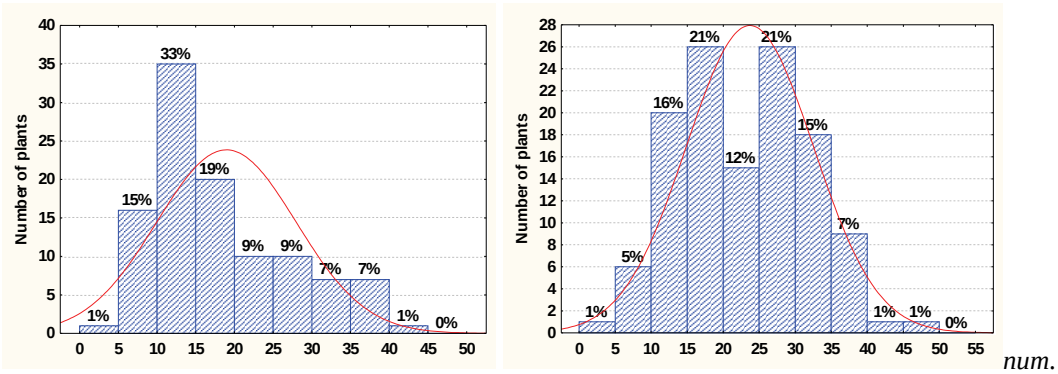


g

F_2 Gloria x Zastava *F_2 Zastava x Gloria*

Figure 2. The histograms of distribution of the tomato plants on the basis of *fruit size* in F_2 reciprocal segregating populations.

There were found important differences for the *number of fruits per plant*. In case of F_2 Gloria x Jubiliar the maximum frequency of distribution was for the class 10-15 (33 %), and maximum class: 40-45 (15 %), while for F_2 Jubiliar x Gloria, it was observed the tendency of dividing the population in two subpopulations with their own maximum of distribution; the maximum class was 45-50 (1 %) (Fig. 3).

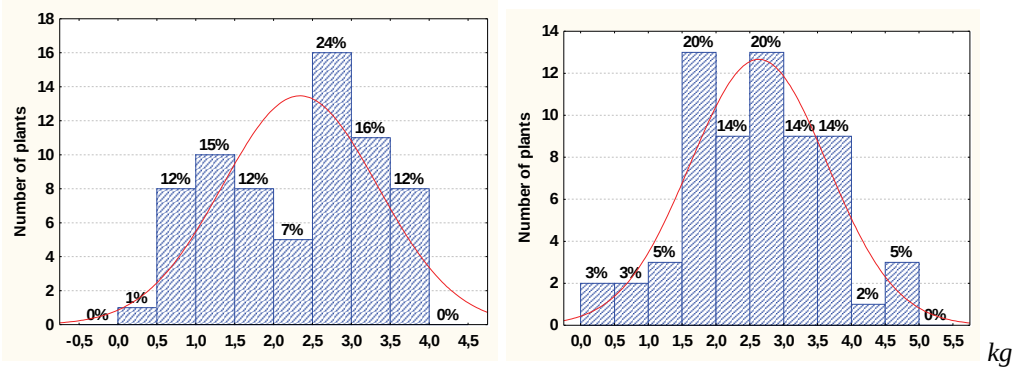


num.

F_2 Gloria x Jubiliar *F_2 Jubiliar x Gloria*

Figure 3. The histograms of distribution of the tomato plants on the basis of *number of fruit per plant* in F_2 reciprocal segregating populations.

The differences in the distribution histograms were also certified in reciprocal populations F_3. For *mass of fruit per plant*, the combination F_3 Gloria x Jubiliar, the phenotypic class 2.5-3.0 kg registered the maximum frequency of distribution (24 %) and the class with maximum values – 3.5-4.0 kg (12.0 %); in case of F_3 Jubiliar x Gloria, the maximum frequency was certified for the class 1.5-2.0 kg and 2.5-3.0 kg (20 %) and the class with maximum values – 4.5-5.0 kg (5 %) (Fig. 4).

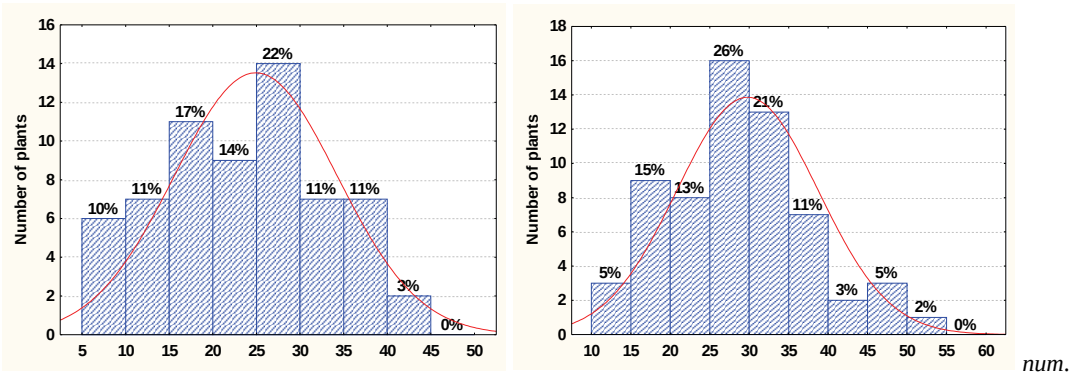


kg

F_3 Gloria x Jubiliar *F_3 Jubiliar x Gloria*

Figure 4. The histograms of distribution of the tomato plants on the basis of *mass of fruit per plant* in reciprocal populations F_3.

There were found important differences and for the *number of fruits per plant*. For F_3 Gloria x Atlasnâi, the maximum frequency of distribution was for the class 25-30 (22 %) and maximum class: 40-45 (1 %), while for F_3 Atlasnâi x Gloria the maximum frequency of distribution was for the class 25-30 (29 %) and maximum class – 50-55 (2 %) (Fig. 5).



F_3 Gloria x Atlasnâi *F_3 Atlasnâi x Gloria*

Figure 5. The histograms of distribution of the tomato plants on the basis of *number of fruit per plant* in reciprocal populations F_3.

We underline that the same maternal form – genotype Gloria, in combination with Jubiliar, Atlasnâi and Zastava, manifested different influence on the phenotypic spectrum in segregating populations, what reveals the importance of the interactions of the two genomes - maternal and paternal in the formation of the character and the degree of efficiency of the maternal factor.

CONCLUSIONS

1. By researching the influence of parental factor in the control of some biological characters and productivity in tomato, there were found 64 % cases of maternal effects.
2. There were registered quite different values of the productivity elements, both for the parental forms as well as the reciprocal hybrids of F_3 generation; these differences denote–the importance of the maternal form in the formation of the quantitative characters.
3. It was found that the same maternal form in combination with different conditions manifested different influence on the phenotypic spectrum in segregating populations of tomato; this reveals the importance of the interactions of the two genomes - maternal and paternal in the formation of the character and factor interaction *maternal form x abiotic conditions.*

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