

Monohybrid Dominant Inheritance of TMV Resistance in Some Oriental Varieties of Yaka Tobacco

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Abstract – Investigations were made on the inheritance of resistance to tobacco mosaic virus (TMV) in some oriental tobacco varieties by the method of interspecies hybridization.

The selection process started with crossing of TMV resistant varieties (AA) with non-resistant aromatic varieties of the type Yaka. In F₁, TMV resistance was inherited dominantly, or the obtained plants were heterozygous (Aa). From self-pollinated hybrids of F₁ generation, the plants obtained in F₂ were varying in their genotypes in 3 : 1 ratio (3 resistant : 1 non-resistant plants). Genetic formula of the resistant plants is (AA), (Aa) and (Aa). When inoculated with infective sap, plants show necrotic reactions, which indicates that the investigated trait was dominant. In F₂ generation a number of resistant plants were selected to create separate progenies in F₃. Inoculation was carried out with infective sap from diseased plants, using the method of Ternovsky (1965, cit. by Trančeva, 1995).

The aim of the paper was to study the mode of inheritance of TMV resistance in creation of new varieties of Yaka tobacco.

Keywords – Resistant Genotypes, Tobacco, TMV.

I. INTRODUCTION

In hybridization process, monohybrid inheritance denotes hybridization between individuals of two varieties, when inheritance of only one character is observed, i.e. its two alternatives (pair of alleles) by which the parents are differed. A number of authors (S.Borojević, K.Borojević, 1976, Genčev 1980, Marinković 1981, Gershenzon 1983, Avala F.J. Kiger J.A. 1984, etc), emphasize the importance of Mendel's laws, according to which in the inheritance of two pure lines differing by a pair of alternative genes, one of them is represented in F₁ hybrids (in full dominance) and all hybrid individuals are uniform in relation to the observed character.

The fact that the character resistance to TMV is inherited in monohybrid dominant way (according to many authors), offers a possibility for deliberately intended and fully controlled selection in breeding new TMV resistant oriental lines and varieties of the type Yaka.

II. METHODOLOGY

Investigations began at the experimental field and glasshouse of Tobacco Institute-Prilep in 1997, as a part of the project "Breeding of new oriental varieties resistant to TMV," with financial support of Macedonian Ministry of education and science (Dimitrieski M., Miceska G., et.al.2000).

Bulgarian TMV resistant varieties Rila 89 and Nevrokop 1146 were used as initial material for hybridization and crossed with local varieties of the type Yaka (Yaka 23,

Yk. 1. 65 and Yk. 1. 123). Selection of parental varieties was based upon previous investigations. The method of intraspecies hybridization was used in the process of breeding, in accordance with Mendel's laws for character inheritance, applying the scheme of monohybrid dominant inheritance (Scheme 1). Hybrid progenies from F₁, F₂ and F₃ were tested on adequate surface and with sufficient number of individuals for each generation. Thus, 1-2 plants were taken from F₁ generation, 8-10 resistant individuals were selected and isolated from F₂ (special progenies of which were created in F₃), whereas in F₃ generation resistant homozygous progenies were determined.

Juice from mosaic-infected tobacco plants was used for inoculation, according to the method of Ternovsky (1965, cit. by Trančeva, 1995). The juice from infected leaves was heated for 12 minutes in water bath at 80°C, in order to inactivate all other viruses, e.g. cucumber mosaic virus (CMV) and Potato Virus Y (PVY). Observations were made between the 7th and 10th day of inoculation, after the appearance of local necrotic spots on resistant plants and mosaic patterns on the leaves of susceptible plants.

III. RESULTS AND DISCUSSION

The selection process started with crossing among resistant varieties of foreign origin (AA), used as maternal component, and domestic non-resistant varieties and lines (aa) of Yaka tobacco used as paternal component. In F₁ generation, heterozygous plants were obtained (Aa), i.e. all hybrids showed necrotic reaction after infestation, which indicates that resistant alleles are dominant and non-resistant alleles are recessive.

The dominant inheritance of this trait was also confirmed by other authors. Holmes, Kostov and Ternovskiy obtained homozygous forms of tobacco (*N. tabacum*) which succeeded to localize TMV. Holmes was the first to report from genetic aspect that one gene is responsible for localization of the virus, which usually appears as dominant (cited by Kostov, 1941-1943). According to S. Stoyanov Gelemerov (2005), Kostov crossed the resistant form *N. tabacum* var. *viridula* (*N. tabacum* x *N. glutinosa*) with Basma 36 and noted dominant inheritance of this trait (existence of local necrotic reaction). Ternovskiy used TMV resistant gene from *N. glutinosa* to create the varieties Đubek 7, Đubek 566, Trapezond 161 etc. He reported that Shabanov, Lulov and Manolov also worked on TMV resistant varieties. Petkova (2008) investigated three TMV resistant tobacco varieties which transmitted this trait in F₁ with dominant inheritance. She reported that the same statement was confirmed by Manun (1981).

From self-pollinated hybrid individuals in F₁, genotypically diverse plants were obtained in F₂ generation, with ratio 3:1, i.e. 3 resistant plants : 1 non-resistant, or 75% of the individuals were resistant to TMV and 25% were non-resistant. Thus, it could be stated that segregation of the character resistance to TMV appeared in F₂ generation, according to the following pattern : 1AA : 2Aa : 1aa (AA, Aa, aA, aa), i.e. 25% of the hybrids were homozygous TMV resistant individuals, 50% resistant heterozygous individuals and 25% homozygous non-resistant individuals. However, in hybrids showing necrotic reaction, it is not clear whether resistant varieties are of AA genotype (homozygous) or Aa (heterozygous). In order to determine the genotype of resistant plants from F₂ generation, 7-10 plants were isolated for F₃ generation. The higher number of randomly selected plants from F₂ progeny increased the possibility for determination of homozygous progenies (AA) totally resistant to TMV. For realization of our goals, infestation was made of all individuals from each F₃ progeny.

In hybrids where all hybrids showed necrotic reaction, complete resistance to TMV was achieved. It indicates that in relation to this character they are homozygous (AA), i.e. the character is permanently in their genome, which can be confirmed in F₄.

The resistant progenies should be further consolidated in relation to other morphological -productional and qualitative characters desired in the process of breeding. In other progenies, which showed to be heterozygous (Aa) in F₂, as well as accidentally missed breeding materials up to F₃, F₄ or other generations, the monohybrid scheme of inheritance can be applied as soon as TMV resistant plants are determined.

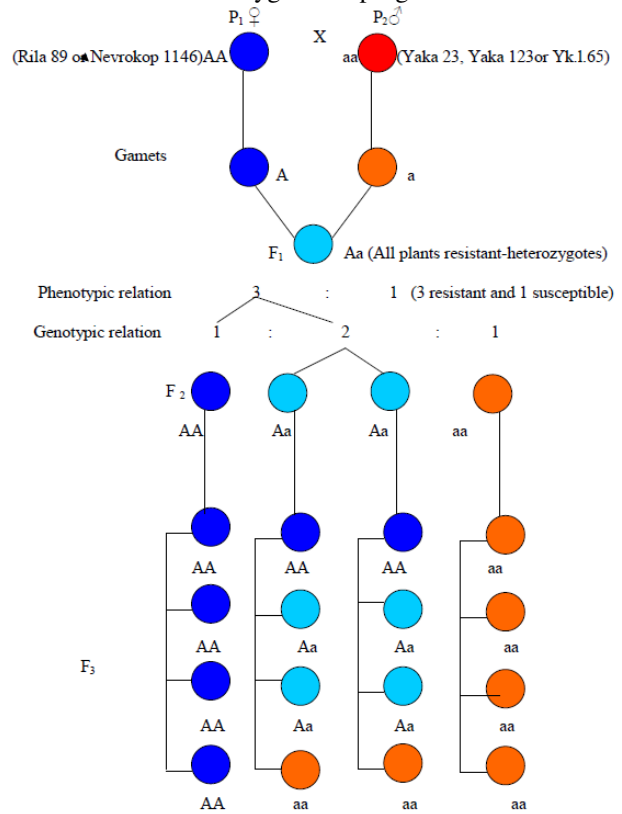
Based on the monohybrid scheme of hybridization among above mentioned varieties, three homozygous lines with resistance to TMV were created: Yk 1.301/23, Yk 1.65-82/1 and Yk 1. 123/7. They are distinguished by their good productional and qualitative properties and present a good potential for the new tobacco varieties that should be included in tobacco production in the future(Dimitrieski M., Miceska G., et all.2005), as and three new homozygous lines with resistance to TMV were created of pilep tobacco (Miceska G., Dimitrieski M. at all. 2005).

IV. CONCLUSION

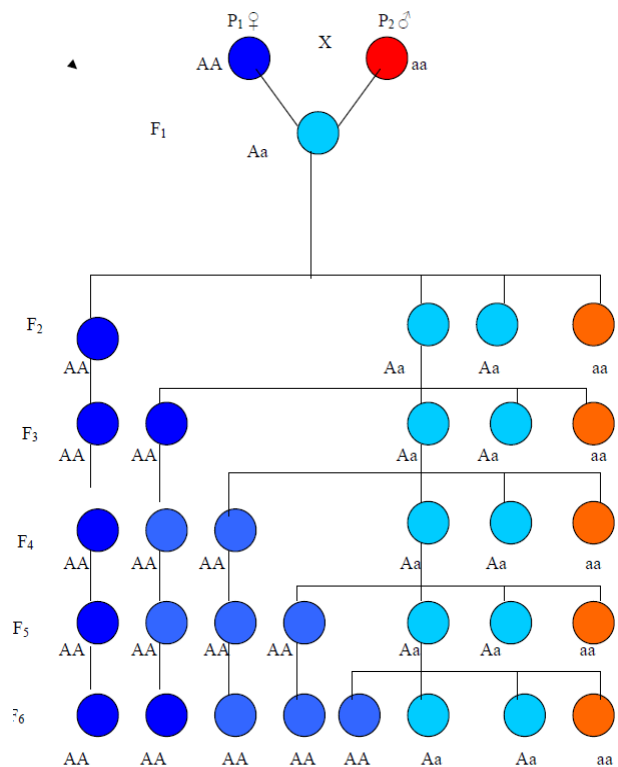
Investigations on monohybrid dominant inheritance of TMV resistance, in hybridization between introduced resistant oriental tobacco varieties and the susceptible varieties of the type Yaka, led to the following conclusions:

- A simple breeding scheme can be applied in creation of new tobacco varieties resistant to TMV, because the character inherited in a monohybrid dominant way is easy to control and also the method of inoculation is easily applicable.
- Monohybrid dominant inheritance of the character offers a possibility to isolate only one or two self-fertilized plants in F₁ and 8-10 plants in F₂, which show resistance to

TMV. From these plants, special progenies will be created in F₃, and testing of all plants (60-80) will enable determination of homozygous F₃ progenies.



Scheme br.1. Monohybrid dominant inheritance in F₁, F₂ and F₃ generation for the character resistance to TMV



Scheme 2. Monohybrid inheritance of tobacco mosaic virus (TMV) with possibility for selection up to the F₆ generation

- The presented monohybrid scheme appeared to be highly rational and practical. As a result, three homozygous lines resistant to TMV have been obtained.(Yk.l.301/23, Yk.l.65-89/1 and Yk.l.123/7), which present the future potential and perspective of tobacco production.

- Beside selection of the character resistance to TMV, the monohybrid scheme allows simultaneous selection of hybrid individuals in relation to other quantitative and qualitative characters as well.

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