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Genetics and Selections

Starting Material for Selection of Mulberry Varieties Tolerant to Leaf Dwarf in Natural Populations of Kartli

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ABSTRACT. Among the integrated methods of struggle against mulberry leaf disease – leaf dwarf – the most efficient and economically justified one is diversity of varieties – obtaining and identification of new starting selection material, which, , according to their preliminary diagnostic and correlation indices, would be characterized by high potential for resistance. The present paper offers structural-anatomical characteristics of the mulberry hybrid forms revealed in the zone free from infection, in Kartli region, on the basis of morphological description, which to a certain extent, condition their resistance to extreme environment conditions and are in positive correlation with leaf nutritive values. *© 2011 Bull. Georg. Natl. Acad. Sci.*

Key words: *correlation, tolerant, gene pool, identify.*

Introduction: The spread of mulberry plant in Georgia has a fairly long history. This plant is considered aboriginal to the Caucasus and has been spread in Georgia since the beginning of the 4th century B.C. The natural conditions of the Caucasus are so favorable for the mulberry plant that its wild forms occur to the present day in the coastal zone of the Black Sea, in Kakheti, Kartli. In various parts of Georgia we find mulberry forests, thus for example the Sagarejo mulberry forest massifs, big massif of Lezhbadini in Marneuli region, mulberry forests in the vicinity of Tsnori, Khobi, Chaladidi and other settlements. The plant is encountered abundantly on the banks of the Mtkvari and Alazani and other rivers of Georgia [3].

Industrial mulberry varieties occur in almost all regions of Georgia, up to 1000-1200 meters above the sea level. From times immemorial abundance of nutritive base here created favorable conditions for the development of sericulture. In addition, mulberry has diverse applications, therefore the prospects of its development are considerable.

The question of strengthening the nutritive basis of sericulture in Georgia was paid special attention from the 1930s, attended by significant success. Whereas in 1932 there were 4,500000 mulberry plants in Georgia [4], in 1964 its number exceeded 15 million plants. It was the culmination in the history of sericulture. Later the number of mulberry plants sharply decreased due to the spread of mulberry leaf disease – curl (dwarf) in West Georgia. In the first decade of the century, due to the spread of the disease the fodder base for sericulture decreased by 11 million plants. At the efforts of researchers this deficit was filled in by the 80-90s, mostly at the expense of underbred hybrid forms and, quite naturally, it was not accompanied by the growth of leaf productivity. From the beginning of the 90s in the leading sericulture regions of Georgia mulberry leaf epiphyte was observed in East Georgia too and it encompassed Akhmeta, Telavi, Gurjaani, Lagodekhi, Qvareli and Sighnaghi districts. The only region by that period where the symptoms of the above said leaf disease were not observed was Kartli. Therefore study of the va-

riety composition of mulberry plantations will enable us to avoid a new epiphyte and on the basis of healthy material to carry out the so-called genetic prophylaxis.

Currently the nutritive base for sericulture in the republic covers 5 million mulberry plants, including 2 million trees in the form of plantations and the remaining part represented in the form of individual plants, mostly in homestead plots [2]. To restore the nutritive base of sericulture, alongside with other measures, it is necessary to identify tolerant to disease varieties in the zone free from infection and to realize their intense application in industry.

Material and methods: To identify old varieties in mulberry plantations existing in Kartli region and to identify new interesting forms, expeditionary studies were performed in 2009-2011. Plantations were studied and registered according to morphological characteristics, biographic particulars were filled in, interesting specimens were recorded, which were studied according to diagnostic correlation signs: anatomical structure of sprout and leaf mesophile and by leaf chemical composition. From the scions taken from the mulberry forms in the stage of physiological rest the material was propagated by means of clone selection and currently it is being tested against the background of natural infections – at the Base of Sericulture of the Kutaisi Experimental Zonal Station of Sericulture

Results and Discussion. On the basis of two-year route studies in the leading sericulture districts of Georgia, such as Kareli, Khashuri, Kaspi, Mtskheta, Dighomi and Bolnisi, Marneuli, the number of mulberry plants was registered. It should be stated that the level of sparseness is too high in the plantations (4.0-4.5%). Due to incorrect exploitation and absence of an adequate agrotechnical background, the plants are on the decline and their productivity indices are low. Revelation of tolerant varieties of mulberry in the indicated region and planting of new plantations is very urgent.

As is seen from the analysis of numerical material the aggregate index of mulberry plants in Kartli region in the period up to 1990 formed 10.8% of the total plants grown in the republic, that is, in the period that followed the existing plantations were mainly preserved and the quantity of plants was somewhat increased at the expense of planting new plantations on the individual homestead land plots (by 2.095%), although we should state that new mulberry plantings are mostly fruit varieties or hybrid forms.

Forms interesting for the selection process, revealed on the ground of morphological description, were studied by us in terms of the anatomical structure of leaf and sprout (node), since their fine cellular system and xeromorphous construction (ratio of palisade and spongy cells, excess of soft bast in modular part of petiole etc.) are in positive correlation with their relative resistance to leaf disease – curl [5].

Anatomical structure of sprouts of the mulberry variety Mukhrani-21 (Fig. 1)**.** The sprout is weakly fluffed, covered with average thickness cuticle. Epidermal cells are one-layer, in clorenchyma tissue of three-row bark parenchyma druses are abundant, conducting system is of ring type, with spiral vessels.

Petiole in basal section is slightly deepened, it is characterized by average density fluffing, conducting beams are open-form, roundish, in wood tissue spiral vessels are observed. Central vein, which forms immediate continuation of petiole, is oval, slightly fluffed. Epidermis is of one-row, colenchyma is whole, druses are few in colenchyma, they are fixed in the main tissue too. Additional conducting beams are observed in parenchyma.

Leaf is characterized by glazy surface, it is of average thickness, cuticle is thin, one-layer, big size cells are presented in epidermis. Cystolith is of pear-form, spongy parenchyma prevails over palisade forms, druses are spread in spongy parenchyma. Conducting beam is more concentrated, is encircled with bast and colenchyma cells. Number of druses is increased in conducting beam.

Analysis of anatomical structure enables us to suppose that the edibility index and resistance to diseases of Tamarisi-14 leaf is high in the hybrid form. This form is distinguished for the physical properties of leaf, by good consistency.

Kaspi 4(1). Anatomical structure of sprout (Fig. 2)**.** The sprout is weakly fluffed, with one-cell trichomes, cuticle is of average thickness. Epidermis is of one-layer, colenchyma tissue is three-layered. There are mechanical cells spread group-wise in bark parenchyma. Conducting

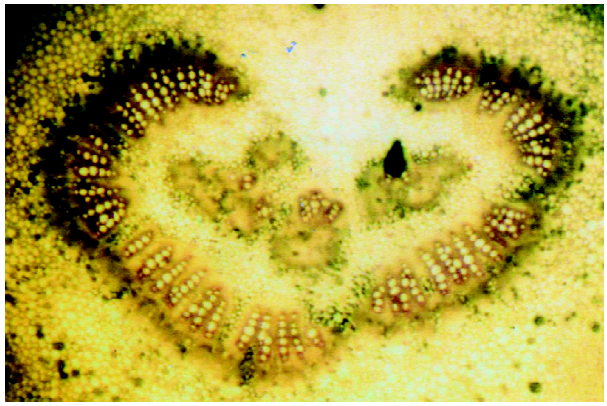

Fig. 1. Mukhrani-21.

system is active, cambium is four-layer; radial beams are of di- or mono arc type. Wood tissue is characterized by thickened membrane, cells - libriforms. Central cylinder is encompassed by perimedullar tissue.

Leaf petiole is roundish, slightly deepened along its length, non-fluffed colenchyma is of plate form. Trichomes are of simple type, one- or two-cell. Druses are frequent in mesoderm. Conducting beam is of arc form, wood is helical, radial beams are poly-, di- and mono arc type.

In medullar section of leaf petiole there are additional conducting beams (up to 19-20) which is in positive correlation with its high resistance to environmental extreme conditions. Walls of the central vein, below, are slightly fluffed, trichomes are simple, one-cell, conic; plate colenchyma is complete and massive. Main tissue is of solid structure, which is characteristic mostly of nutritive mulberry forms. Oxalic acid calcium crystals are present in small quantity.

Druses are abundantly present in bast tissue, they sit mostly in groups. Vessels are helical type. They form islands in the central section of the central vein. This fact is in direct correlation with high resistance to leaf dwarf.

Leaf plate cuticle is thin, epidermis is of single-row type, palisade- parenchyma prevails over spongy one, it is thicker, homogeneous, thin and of oblong form; roundish cystoliths are fixed in it; conducting beam is concentrated, lips are simple type, it belongs to heterocyclic series.

Okami 5 (1). Anatomical structure of the sprout (Fig. 3). Mulberry hybrid form Okami 5(1) is characterized by powerful sprouts, petiole and central vein and conducting system, abundance of active cells, powerful cystoliths and abundance of additional conducting beams in petiole mesipeciole.

Leaf mesophyle is somewhat fluffed, cuticle – thin, upper epidermis – double-layer, lower – single layer, that is palisade parenchyma is thick, there are two type cystoliths in it; spongy parenchyma is of solid structure and there are rather many druses in spongy parenchyma. Lips belong to simple type.

There are structures in sprout joints which are used for systematic purposes. Its nature is rather specific. It is in the joints that a leaf, flower and other formations are developed by direct participation of conducting apparatus. Therefore, it is the joint in which structural diversities inherent to varieties are expressed.

To add more validity to the data we carried out volumetric and quantitative measurements of structural elements of sprout joints of the above described mulberry forms. We made measurements (microscope MBÈ-3) of bark, wood, bast thickness, vital and perimedullar zone thickness. We counted radial beam vessels and fibers in the whole zone of the preparation. Their length and width were measured.

Numerical data are given in Table.

As is seen from the numerical data of Table (graph 7) the mulberry forms Tsereteli 407, Okami 4(1), Tamarisi-14 and Mukhrani 21 are distinguished for a powerful conducting system (vessel-fiber beams), which conditions the activity of physiological processes and guarantees unhindered connection between surface bodies and root system and vice versa. The mulberry forms: Tsereteli 407 and Tamarisi 14, are distinguished for the abundance of live cells of bark and wood (which is in direct connection with resistance to extreme environmental conditions). Both forms grow in Kvemo Kartli region, while among the forms grown in Kaspi and Mtskheta districts the best indices in resistance to extreme environmental conditions are inherent to – Kaspi 4(1), Mukhrani 21. The best forms according to sprout medullar zone thickness are Marneuli 44 and Mukhrani 21; according to wood thickness – Tamarisi 14; according to virtual zone thickness – Mukhrani 21, while the form Tsereteli 407 is the best according to the constituent elements of anatomical structure. Mulberry forms Kaspi 4(1) and Mukhrani 21 are characterized by

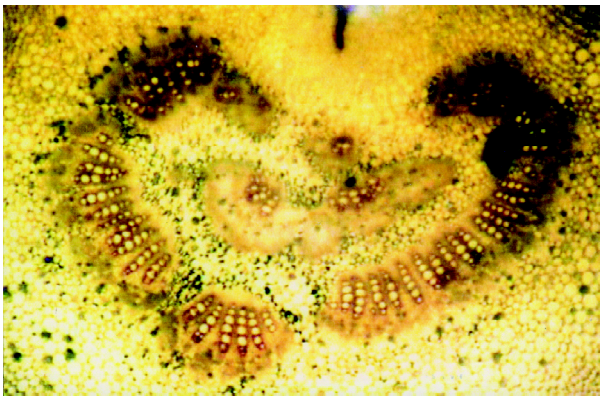

Fig. 2. Kaspi 4(1)

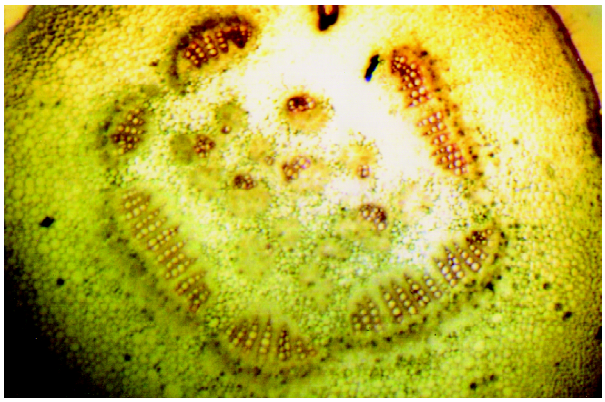

Fig. 3. Okami 5 (1).

Table

Indices of anatomical structure of sprouts of new mulberry forms

Description of mulberry forms	Bark thickness	Wood thickness, μ	Bast thickness, μ	Vital zone, μ	Medullar zone, μ	Number of radial beams	Number of vessels	Number of fibers
1	2	3	4	5	6	7	8	9
Okami 5(1)	24.00	105.0	16.7	11.6	10.00	205.0	679.0	65.0
Kaspi 4 (1)	51.7	165.3	15.9	14.0	11.5	239.7	819.7	65.3
Tamarisi 14	56.8	190.2	10.0	11.1	8.7	242.0	759.0	75.0
Dighomi 8	29.0	123.0	12.0	8.0	10.00	164.1	535.0	57.2
Marneuli 44	58.1	92.2	14.7	11.5	12.0	227.7	635.5	46.0
Tsereteli 407	61.4	169.1	19.9	12.8	12.6	201.0	920.3	55.7
Mukhrani 21	62.0	107.7	14.0	18.8	12.1	217.0	831.3	55.6

big size druses. New mulberry forms studied by us, due to their anatomical structure, are valuable starting material for use in the selection process to obtain forms characterized by high productivity and immunity.

Conclusion. New mulberry forms growing in Kartli region which are distinguished for their morphological indices are the best starting material for selection. According to leaf mesophile, petiole and sprout joint anatomical structure the mulberry forms Okami 5(1) and Tamarisi 14 should be used in selection for immunity purposes to create highly productive varieties resistant to leaf dwarf.

New mulberry forms revealed in the zone free from infection, in Shida and Kvemo Kartli, are significant prerequisites for the success of mulberry selection process and enrichment of the gene pool in Georgia.

გენეტიკა-სელექცია

ფოთლის სიხუჭუჭისადმი ტოლერანტული თუთის ჯიშებისათვის სასელექციო საწყისი მასალის შერჩევა ქართლის ბუნებრივ პოპულაციებში

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თუთის ფოთლის სიხუჭუჭის წინააღმდეგ ბრძოლის ინტეგრირებული მეთოდებიდან ყველაზე ეფექტური და ეკონომიკურად გამართლებულია ჯიშთა მრავალფეროვნება, მაღალი პოტენციური გამძლეობის ახალი

სასელექციო საწყისი მასალის მიღება-გამოვლინება, მათი წინასწარი სადიაგნოსტიკო და კორელაციური ნიშნებით. წინამდებარე ნაშრომში მოცემულია ინფექციისაგან თავისუფალ ზონაში, ქართლის რეგიონში, მორფოლოგიური აღწერის საფუძველზე გამოვლენილი თუთის ჰიბრიდული ფორმების სტრუქტურულ-ანატომიური საფუძვლები, რომლებიც გარკვეულწილად განაპირობებენ მათ მდგრადობას გარემოს ექსტრემალური პირობებისადმი და დადებით კორელაციაშია ფოთლის კვებით ღირებულებასთან.

REFERENCES

1. *G. Aleksidze* (1975), Proceedings of the Georgian Agrarian Institute, vol. **11**:.285, Tbilisi (in Georgian).
2. *Z. Asatiani* (2002), Proceedings of the Georgian Agrarian Institute, **18**: 20-26, Tbilisi (in Georgian).
3. *G. Zviadadze* (1989), Tutis khis zogierti khe-mtsenaris, abreshumis parkisa da khami abreshumis nedleulis resursebi [Material resources of some plants of mulberry tree, silk cocoon and raw silk]. Tbilisi, p.10-17 (in Georgian).
4. *G.Nikoleishvili* (2005), Meabreshumeobis ekonomikuri epektianoba da misi potentsialis gamoqenebis srulqopis gzebi [Ways of perfection of application of the potential of economic efficacy of sericulture in market economy conditions]. Tbilisi, p.93-104 (in Georgian).
5. *D. Shalamberidze* (1997), In: Collected papers of the Scientific Research Institute of Sericulture of Georgia, Tbilisi, p.45 (in Georgian).

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