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Studies on chimeric plants of the grapevine (Vitis vinifera L., cultivar Bolgar)

by

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Étude sur les plantes chimériques de la vigne (Vitis vinifera L., variété Bolgar)

Résumé. — Chez la variété Bolgar on a découvert des vignes chimériques — résultat de mutations naturelles. Une partie de ces vignes est diploïde, une autre représente une chimère périclinale di-tétraploïde du type 2—4. Quand les sections fruitières sont formées sur la partie chimérique, les caractéristiques du rendement et de la qualité du raisin sont les plus basses.

Introduction

Spontaneous mutant forms have been described in a series of cultivars of *Vitis vinifera* L. Some of them are the result of gene mutations which cause changes in one or several features (Durquety *et al.* 1974, Durquety and Dommerc 1976, Boubals 1976), while others are due to genome mutations; however, in all cases so far described they are tetraploids (Wagner 1958, Rives and Pouget 1959, Marton 1968). Alongside with the tetraploids, chimeric grapevines have also been found in some cultivars (Thompson and Olmo 1963, Staudt 1973). In Bulgaria, Genchev and Zankov (1964) and Todorov (1972) were the first to find tetraploid forms in the cultivar Bolgar.

During our studies of the cultivar Bolgar we also found chimeric grapevines (Todorov 1972). We undertook this study in order to clarify the character of their dual nature and its effect upon grape yield.

Material und methods

The studies were made during the period 1977—1978 in the Experimental Station of Viticulture in Rousse with 14-year-old grapevines of the cultivar Bolgar which were trained by the double Guyot pruning method. These vines partly show the morphological features of the type, while — in the same plants — the other parts are distinguished by their broader and coarsely lacerated leaves and their larger clusters with much bigger berries.

The following cytological indices were investigated: size of stomata from leaf epidermis and number of chloroplasts in the guard cells, length of pollen grains and number of their pores, and number of chromosomes in cells of root tips.

10 leaves each were sampled from typical and mutated parts and 400 stomata from corresponding leave sections were measured. 100 pollen grains each were studied. Chromosome counting was done on roots of cuttings from normal and chimeric shoots evaluating 30 root cells each.

The stomata cells were studied after treating the epidermis with Lugol solution, and the pollen cells after staining with 4% acetocarmine. Chromosome number was determined by the method of DIMITROV and GADEVA (1974).

Besides the above mentioned indices a number of agrobiological and technological indices of the test vine were also studied.

Results and discussion

The results of the cytological investigation are given in Table 1. They reveal statistically significant differences in length and width of stomata between the changed and the unchanged parts of the grapevine. There is a greater difference in length ($t = 6.45$, $P < 0.001$) than in width ($t = 3.07$, $P < 0.001$). The differences in the number of chloroplasts in the cells of the stomata are small and statistically insignificant. Significant deviations have been observed in the size of the pollen grains. Their average length in the changed part is by 4.3 μm greater. Here, the difference has been proven very well ($t = 6.17$, $P < 0.001$). As seen from data in Table 1 the number of pores of pollen grains in the unchanged part is 3, while in the changed part it is 4.

Chromosome number in the cells of root tips from both parts of the grapevine is also different: $2n = 38$ in the unchanged and $2n = 76$ in the changed part. This is an indication of the tetraploid character of the endogenic tissues of the changed part.

Previous investigations of grapevine (RIVES and POUGET 1959, LELAKIS 1962, TODOROV and DIMITROV 1974) have shown that the tetraploid forms are characterized by larger stomata and an increased number of chloroplasts in the guard cells. An in-

Table 1

Cytological characteristics of the grapevine, cv. Bolgar

Caractéristique cytologique de la vigne, cv. Bolgar

Parts of the grapevine	Stomata			Pollen grains		Root tips
	Avg. length (μm)	Avg. width (μm)	Number of chloroplasts/ guard cell	Avg. length (μm)	Number of pores	N° of chromosomes (2n)
Unchanged (diploid)	31.4 ± 0.24	19.4 ± 0.20	19.3 ± 0.61	24.9 ± 0.24	3	38
Changed (chimera)	27.7 ± 0.20***	17.7 ± 0.17**	20.7 ± 0.36 NS	29.2 ± 0.24***	4	76

** = Significant at $P < 0.01$.
*** = Significant at $P < 0.001$.
NS = Not significant.

crease of the size of pollen grains and the number of their pores in the tetraploid grapevines has also been proven (WAGNER 1959, RIVES and POUGET 1959, GENCHEV and ZANKOV 1964).

On the basis of these investigations and the data from our studies, the conclusion can be made that the epidermis of the leaves of the changed part of the grapevine has not a polyploid character because the size of the stomata cells has not been increased and the number of their chloroplasts does not differ from that of the diploids. In this case, a decrease of the size of stomata of these leaves has been observed; this has been found in other chimeric grapevines as well (TODOROV 1972). In all probability, this is due to the suppressive action of the tetraploid tissues upon the diploid ones.

Data of pollen grains (presence of 4 pores) and, particularly, of the number of chromosomes in the cells of root tips (2n = 76) are a conclusive proof of the tetraploid nature of the subepidermal cell layers of the changed part.

On the basis of the present results, the conclusion can be made that the grapevine under discussion is a chimera consisting of two parts, viz. with changes and without changes (diploid). The changed part is essentially a di-tetraploid periclinal chimera whose epidermis is diploid, while the subepidermal cell layers are tetraploid. This chimera is of the 2—4 type already described in other grapevine types by THOMPSON and OLMO (1963) and STAUDT (1973).

It can also be assumed that the chimeric grapevine under study has appeared as the result of tetraploid mutation in an initial cell of the subepidermal layer of the growth cone in only one of the buds of the winter eye.

Table 2 contains data of the agrobiological and technological characteristics of both parts of the grapevine. It is shown that the fruiting coefficient (average number of bunches/shoot) as well as the grape yield of the chimeric part are 7 and 5 times smaller, respectively, than those of the diploid part. However, the reverse is true in the case of average weight of cluster and average weight of 100 berries. In the changed part, these figures are 1.5 times higher than in the unchanged one. The number of seeds per 100 berries is considerably smaller in the chimeric part, while the percentage of parthenocarpic grains is almost equal in both parts.

No differences have been observed with respect to sugar and acid contents in the grapes. However, it is noteworthy that grape ripening in the changed part has

Table 2

Agrobiological and technological characteristics of the grapevine, cv. Bolgar

Caractéristique agrobiologique et technologique de la vigne, cv. Bolgar

Indices	Unchanged part (control	Changed part (chimera)
Coefficient of fruiting	1.02	0.15
Mean yield of grapes per vine (kg)	5.63	1.21
Mean weight of bunches (g)	227	372
Mean weight of 100 berries (g)	543	785
Seed number in 100 berries	168	123
Parthenocarpic berries (%)	11	12
Sugar content (%)	15.26	15.30
Total acid content (‰)	7.10	7.05

begun 9 d earlier, which is probably due to the lower yield. Besides, grapes from the chimeric part contain more tannin (felt by tasting) which, as established earlier (Todorov 1972), is a characteristic feature of the tetraploid grapevines of the cultivar Bolgar.

Summary

Chimeric grapevines have been established in the cultivar Bolgar as a result of the natural mutation process. Part of these grapevines is diploid, while the other part of the same plants is a di-tetraploid periclinal chimera of the 2—4 type. Yield and quality of grapes are the lowest in the cases when the fruit-bearing shoots are formed on the chimeric part.

References

Boubals, D., 1976: Une mutation génétique de l'Alicante Bouschet. Progr. Agric. Vitic. 93 (3), 79.

Dimitrov, B. and Gadeva, P., 1974: An improved squash method for investigating the chromosomes of *Vitis vinifera* L. (Bulg.). Genet Plant Breed. 7, 175—177.

Durquety, P. M., Destandeau, G. et Naude, E., 1974: Une mutation chez *Vitis vinifera:* Tannat à feuille brillante. Progr. Agric. Vitic. 91 (18), 577—579.

— — et Dommerc, J. C., 1976: Une mutation utile: Le Cabernet „Handia" à grandes grappes, dans le Cabernet Franc. Progr. Agric. Vitic. 93 (23), 716—720.

Genchev, G. and Zankov, Z., 1964: Studies on some natural polyploids of grapes (Bulg.). Nauchn. Tr. Vissh Selskotop. Inst. "G. Dimitrov", Agron. Fak., Ser. Gradinar. Lozar. Rast. Zasht. 14, 65—77.

Lelakis, P., 1962: Induction de la polyploïdie chez *Vitis vinifera* L. par application de la colchicine. Ann. Ecole Natl. Agric. (Montpellier), 48—78.

Marton, N., 1968: Tétraploïdes entre les sous-cultivars du cépage Riesling Italien. Rev. Hort. Viticult. (7—8), 55—71.

Rives, M. et Pouget, R., 1959: Le Chasselas Gros Coulard-mutant tétraploïde. Vitis 2, 1—7.

Staudt, G., 1973: Ploidiechimären bei europäischen *Vitis-vinifera*-Sorten. Vitis 12, 89—92.

Thompson, M. M. and Olmo, H. P., 1963: Cytohistological studies of cytochimeric and tetraploid grapes. Amer. J. Bot. 50, 901—906.

Todorov, I., 1972: Etudes sur le polymorphisme chez le cépage Bolgar et les possibilités de la sélection clonale (bulg.). Diss. Pleven.

— — and Dimitrov, B., 1974: A study on some indirect methods for determining the ploidy level in the grape variety Bolgar *(Vitis vinifera* L.) (Bulg.). Genet. Plant Breed. 7, 218—225.

Wagner, E., 1958: Über spontane tetraploide Mutanten von *Vitis vinifera* L. Vitis 1, 197—217.

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