

ABSTRACT

The doctoral thesis entitled „**The Behaviour of Some Vine Varieties for Quality Red Wines Grafted on Various Rootstocks in the Viticultural Center Cozmești – Bohotin from the Huși Vineyard**” has as its main objective to promote the production of quality red wines in the viticultural area Cozmești – Bohotin. Research took eight years, of which three for the setting up of the plantation or experimental area and the orientation of the vines, and five more following fruit – bearing necessary for research.

The thesis has seven chapters, of which three are theoretical and four experimental. The first chapter includes a presentation of stock vines; the second presents the current state of research concerning the interaction between the stocks and the fruit - bearing varieties, while the third includes a characterization of the viticultural ecosystem Cozmești – Bohotin. The experimental part is made up of four chapters, of which the first introduces the organization of the experimental area; the second presents the research objectives; the third contains the experimental results, and the fourth presents the statistical processing and interpretation of experimental results.

Ecosystem Characterization. The Cozmești – Bohotin viticultural centre represents the interface between the Iași and the Huși vineyards by means of the slope known as „Fața Prutului”. The slope vine plantation lies on the left slope of the Moșna brook, along its mid sector.

The relief consists of slightly bulging sculptured configurations surrounded by rivers, with a gentle south - western slope. The slopes are long and relatively even, with an average inclination of 10 – 15%. The first relief zone, with altitudes of up to 30 m, lies to the west of the Moșna brook; the second relief zone with altitudes of 50 to 100 m is made up of a slope with a length of 7 – 8 kms and a width of 1.5 – 2 kms, and the third zone, with altitudes of up to 200 m occupies the eastern half of the Moșna brook basin.

The geological factors pertain to the *Bessarabian* (clay, chalky sandstone and sand), topped by 3 – 4 m loess deposits; the *Kerssonian* (sandy clay and sand with sandstone concretions, which make up the higher part of the relief at altitudes above 200 m); the *Meotian*

(10 – 20 m thick sandy cinerites which form isles in the highest altitudes) and the *Lower Quaternary* (river-drawn deposits to the east of Cozmești, on the terraces of the Prut river).

The hydrographic network is scarce, comprising the brook Moșnișoara in the east of the territory and its adjacent lesser brooks, which drain the area.

The climate is of the markedly continental type, with harsh winters and droughty summers, influenced by the air circulation in the open valley of the Prut river. The climate characteristics are: annual average temperature 9.6°C, average vegetation duration 183 days; global thermal balance 3693 – 4309°C; active thermal balance 3223 – 3879°C and practical thermal balance for vine 1330 – 1739°C. The coldest month is January (- 3.6°C), with absolute lows of -26.8°C, which endanger the unprotected vines, while the hottest month is July (+21.3°C), with absolute highs of up to +41.6°C, which often coincide with drought periods. The global annual insolation is 2137 hrs of which 1348 represent the vine vegetation period. Annual rainfall amounts to 517.8 mms, of which 320.5 mms during the vegetation period. Maximum rainfall occurs in the summer (June – July) while minimum rainfall is in the winter (January – February).

Soils. The majority are cambic vegetable earth/chernozems (30 – 35%), followed by clays at higher altitudes (250 – 300 m). In the plateau area, the soils are loess-like deposits, and in the north – central area, chalky sandstone.

Research Objectives. To study of the agrobiological behaviour of quality red wine varieties/clones grafted on various rootstocks in the ecological conditions in the viticultural centre Cozmești – Bohotin, as well as to determine the technological value of vine varieties, with a view to promoting the production of quality red wines in the respective viticultural area. The research was centered on the following varieties:

- the native Fetească neagră, grafted on 4 rootstocks (Oppenheim 4 selection; Crăciunel 71 selection and Ruggeri 140);
- Cabernet Sauvignon, represented by 3 clones (USA 7 – Dg and 4 – Iș), grafted on 5 rootstocks (Paulsen 1103, Crăciunel 71 selection, Oppenheim 4 selection, Oppenheim 4 selection – clone 4 and Ruggeri 140).
- Merlot, represented by the clone 8 – VL, grafted on 2 rootstocks (Kober 5 BB and Ruggeri 140). The planting material/the grafted vines were furnished by the Viticultural Research Institutes.

The experimental plantations. Were set up in the year 2000 at the Cozmești Viticultural Farm of the Vinia Trading Company. The total area of the plantations is 37.1910 hectares, of

which Fetească neagră 10.4680 hectares, Cabernet Sauvignon 20.4610 hectares and Merlot 5.7620 hectares.

The plantations have the following characteristics: rectangular plots of 120 / 170 m, with areas between 0.556 – 2.260 hectares. The planting distances 2.20/1.20 m; planting density 3787 per hectare. The leading method of vines in plantation is the bilateral cord, on medium height stems (70 – 80 cm). The support system – vertical monoplane espaliers with 5 wires (one support wire and two levels of double wires).

The experimental pattern adopted was randomized blocks. The experiments were of the bifactorial type on the vinifera variety – rootstock – a total of 12 variants, in 5 randomized blocks.

Observations and data. Were collected following the first fruit bearing, during the first five years (2003 – 2007): the biological observations and technological data confirm the influence of rootstocks on the Vinifera varieties under research.

The observations and data are: the evolution of the vegetation phenophases; the growth strength of shoots; the fertility and productivity of varieties/clones; the technological and phenolic maturation of grapes; the quantity and quality of grape production; the extent of maturation of the wooden shoots in the autumn at the end of vegetation; bud loss during wintertime; the wood quantity per plant eliminated by cutting and the configuration of the root system of plantation vines.

Experimental results. The analysis of the climate factors during the experimental period, as well as the computation of the values of the synthetic/ecological indicators $I_{Hr} = 0,02$ and $I_{AOe} = 4749 - 5025$, confirm the ecological vocation of the Cozmesti – Bohotin viticultural centre for the production of quality red wines. For enhanced certainty, climatograms were also employed.

The development of the vegetation phenophases. It was found that these show the biological characteristics of varieties/clones, being influenced only by the climate factors. The evolution of the vegetation phenophases was remarkably uniform timewise, with the exception of the maturation of grapes, which was the least predictable phenophase. The first varieties to begin vegetation in the spring (sap leaking) are the Cabernet Sauvignon and Merlot, followed closely by the Fetească neagră. Bud bursting occurs after April 20, while flowering begins after May 24 at the earliest and ends before June 13. Shoot growth is the longest vegetation phenophase, which lasts from 120 to 150 days. The Fetească neagră and Cabernet Sauvignon varieties showed the most marked vegetative growths of 10 – 15 m/plant, while the Merlot

variety's growth was of less than 8.98 – 9.5 m/plant. The formation of grapes lasts 34 to 40 days in the case of the Fetească neagră and 40 to 50 days for the Cabernet Sauvignon and Merlot varieties. Grape maturation lasts 30 to 45 days and begin earliest for the Fetească neagră (from September 20 to October 1) followed by the Merlot and Cabernet Sauvignon varieties (from October 1 to October 10).

Fertility and Productivity. Show the agrobiological worth of varieties/clones and determine grape production. Fertility expressed as the percentage of fertile/fruit - bearing shoots depends on the biological nature of varieties: the most fertile proved to be Cabernet Sauvignon – the USA clone, with 83 – 93% fertile shoots and the clone 4 – Iş, with 69 – 79% fertile shoots, followed by Merlot – clone 8 VL, with 76 – 83% fertile shoots; the least fertile was the Feteasca neagră variety, with 55 – 76% fertile shoots (average fertility).

Productivity is given by the size of grapes and is in direct correlation with the fertility of soils. The Cabernet sauvignon variety, although with small grapes (98.6 gs on average), has high productivity, due to its percentage of fertile shoots. The Merlot and Feteasca neagră varieties, with large grapes (110 – 113 gs on average) also has high productivity, although its fertility is lower.

Tehnological and phenolic maturation of grapes. Is simultaneous for the red wine varieties, and the accumulation of polyphenoles (antocyanins and tannin) in the grapes being as important as the accumulation of sugars. The phenolic maturation takes longer than technological maturation (accumulation of sugars) and consequently grapes are harvested following a brief period of overmaturation at the end of the harvesting campaign.

- The Feteasca neagra variety begins grape maturation the earliest, at the end of August, and this lasts until the end of September, which gives a total of 30 to 35 days. Upon harvesting, its grapes accumulate 218 – 223 grs/litre sugars and 376 – 600 mgs antocyanins/kg of grapes. The levels of the glucoacidimetric index, which show the level of tehnological maturation of grapes, range between 21.5 and 26.7. To accumulate higher quantities of sugars and antocyanins overmaturation of grapes is necessary.

- The Cabernet sauvignon variety begins grape maturation later, after September 1, and this lasts 35 to 40 days. Phenolic maturation of grapes coincides completely with the phechnological one, so overmaturation is unnecessary. The grapes accumulate in excess of 200 gs sugar/litre and 932 to 1262 mg of antocyanins/kg of grapes. The levels of the glucoacidimetric index range between 20.4 and 24. The clones 4 – Iş and 7 – Dg grafted on the Oppenheim 4 Selection accumulate the optimal quantities of sugars and antocyanins.

- The Merlot variety begins maturation early, like the Feteasca neagra, and this lasts 30 to 35 days. Its grapes accumulate 215 – 226 gs sugars/litre and 618 – 727 mg of antocyanins/kg of

grapes. The levels of the glucoacidimetric index range between 23.7 and 23.9. Overmaturation in the case of Merlot is not beneficial, because grape skin is thin and water is easily lost through evaporation, which causes the grapes to wither. The Kober 5 BB rootstock proved to be best.

Quantity and quality of grape production reflects the technological value of vine varieties/clones. The quantity and quality of grape production correlates in a positive manner, in accordance with each variety, with the level of grape production and the technological operations performed during vegetation. Rootstocks have an indirect influence on the quantity and quality of grape production through the development of the root system, which ensures the nutrition of vine (absorbtion of water mineral substances from the soil).

- The Cabernet Sauvignon – USA clone yields the highest grape productions of 11,5 – 13,6 tons/hectare, but grapes have a smaller quantity of sugar (185 – 189 gs/litre of must). The clone 4 – Iş on rootstocks SO4 and Ru – 140 uields both better quality and high quantities of grapes (an average of 11 tons/hectare, with 190 – 198 gs sugars/litre).
- The Merlot variety clone 8 VL comes next, with an average grape production of 10,4 tons/hectare and high quantities of sugar (206 – 216 gs/litre of must).
- The Feteasca neagra variety on rootstocks SO4 and SC – 26 yields low quantities of grapes (8 – 10 tons/hectare), but high quality (207 – 216 gs sugar/litre).

Other experimental data relevant to the agrobiological behaviour of quality red wine varieties in the ecological conditions of the Cozmesti – Bohotin viticultural centre.

The starch supply in cords, at the end of the vegetation period indicative of the degree of maturation of wood. The Cabernet Sauvignon, Merlot and Feteasca neagră varieties accumulate 7.50 to 10.10 % starch in their cords, which indicates an average degree of wood maturation.

The varieties resistance to frost, as indicated by the viability of buds on cords in the spring, upon cutting for fruit – bearing. In the years with normal winters (such as 2004), when absolute lows did not affect vine, bud viability was 84 – 85% for Cabernet Sauvignon and 79 – 80% for Merlot and Fetească neagră. There is no correlation between the starch supply in cords and bud loss during winter.

The quantity of wood eliminated through cutting indicates the levels of yearly vegetative accumulations in vine varieties. It was found that Cabernet Sauvignon, which shows high vegetative accumulations, sheds an average of 0.81 kgs/plant, and the highest quantities are shed by the clone 7 – Dg/Crăciunel Selection – 71. For the Merlot and Fetească neagra varieties vegetative accumulations are low, and the quantity of wood shed upon cutting ranges between 0.62 and 0.68 kgs/plant.

The configuration of the root system indicates the rooting strength of vine varieties grafted on various rootstocks and determines the life span of vines in plantations as well as the level of annual grape productions. It was found that the Fetească neagră/Crăciunel Selection – 26 develops the strongest root system, with a total weight of 986 gs at a depth of 40 to 60 cms. The Cabernet Sauvignon USA, clone and 7 – Dg clone develop their strongest root systems on the rootstocks SO 4-4 and Paulsen 1103 (530 – 545 gs of roots).

Statistical Processing and Interpretation of experimental Data. For enhanced accuracy of experimental data, these were processed statistically by means of the ANOVA test (variance analysis). The following indices were computed: measurement variance (S^2); standard deviance (Ds), standard error (Sx), relative error (Er %) and measurement confidence range. The ANOVA statistical test was applied to analyse grape production levels and grape production quality.

Interpretation of experimental data was made by corroborating all the observations and measurements. This resulted in a number of general conclusions concerning the varieties experimented upon: in the conditions of the Cozmești – Bohotin viticultural centre, the Fetească neagră variety makes best use of its quantitative and qualitative production potential, on the Oppenheim – 4 (SO4) selection rootstock; the Cabernet sauvignon variety clone 4 – Iș on the SO 4 and Ru-140 rootstock, and the Merlot variety – clone 8 VL on the Kober 5 BB rootstock.

Employment of the Ru-140, which is drought – resistant, is recommended, given the fact that drought affects grape production practically every year.