Determination of Stomata Densities of Some American Grape Rootstocks in Eğirdir/Isparta

Seçkin GARGIN
Eğirdir Horticultural Research Institute Eğirdir/Isparta
Turkey
secking32@hotmail.com

Abstract It was aimed to determine stomata density of 10 different American grape rootstocks (5BB, 110R, 99R, SO4, 1616C, Rup. Du Lot, Harmony, Fercal, Dodridge, Ramsey) which were located in Eğirdir Horticultural Research Institute in this research. On leaves on 6^{th} node of shoots for each rootstock were collected to determine stomata density in July. Preparations were made using nail varnish on five different parts of leaf. Stomata numbers were counted from area of 0.066 mm^2 by using 10 x 40 magnification of light microscope. The results converted to number of stomata/mm^2. Stomata density changed between 61 and 141 stomata/mm^2. The lowest and highest stomata density was obtained from Rup Du Lot rootstock with 61 stomata/mm^2 and Ramsey rootstock with 141 stomata/mm^2 respectively.

INTRODUCTION

Stomata has an important role in epidermis tissue for plant gas taking and giving. They have already different from epidermis cells. They occur from two cells in shape of bean or kidney. These two cells convex surfaces come together and form stomata cell (Vardar, 1969). Stomatas can be found in the all parts of the plants except roots. Stomatas are small pores and generally can be found in epidermis tissue (Kaçar, 1989). Stomatas make gas diffusion by perspiration with cellular cavities and they control water and plant ratio in plants. Stomatatas in the leaves have an important role in adaptation to environmental factors (Salisbury, 1992).

Stomata means "mouth" in Greek language. Stomatas have important roles in photosynthesis and perspiration in plants. Stomatas can be found in plant tissues and especially they can be found in the bottom surface of *Vitis* leaves. They are in anomocytic type and surrounded by neighborhood cells (Ağaoğlu, 1999). Stomata density can vary according to plant species, varieties, ecology and cultivation practices. Stomata density can be affected by exogenous and indigenous factors (Kaiser, 2001). Leaf maturity and position of the leaves on the shoots affect stomata density (Düzenli and Ağaoğlu, 1992). 1.000 – 60.000 stomata can be found generally in 1 cm^2 leaf surface depending on plant species and environment. Stomata number can change for same plants which are grown greenhouse and natural conditions (Bozcuk, 1997). Stomatas take CO_2 for photosynthesis and also take out water with transportation. Transpiration affects root pressure and prevents leaves from excess heating (Eriş, 1992).

Breeding *Vitis* studies main aim is to increase resistance for drought. Drought resistance is thought to occur from using water efficiently and proportion photosynthesis to transpiration (Duering, 1999). Grapevine is a mezofit plant but like ksefofıt plants. It is resistant to drought that it can be caused by intense stomata density and resistant to drought tolerance correlation (Düzenli and Ağaoğlu, 1992; Kara and Özeker, 1999; Maraşalı and Aktekin, 2003). Also it is known that mesofit plants abscisic acid high levels are more effective for drought tolerance than kserofits. Some varieties can have different stomata number in natural conditions and green house conditions. This event strengthens the thesis about environmental factors affect the stomata number. Plants which are grown in drought conditions it is more important to evaluate their stomata densities according to the variety and ecological conditions.

This study was conducted to determine stomata numbers of 10 different American Grape rootstocks (5BB, 110R, 99R, SO4, 1616C, Rup Du Lot, Harmony, Fercal, Dodridge, Ramsey) in Eğirdir ecological conditions.

MATERIAL AND METHOD

This study's main material was 10 different American grape rootstock (5BB, 110R, 99R, SO4, 1616C, Rup. Du Lot, Harmony, Fercal, Dodridge, Ramsey) which were cultivated in Eğirdir Horticultural Research Institute.

Position of leaf on the shoot affects stomata number (Düzenli and Ağaoğlu, 1992). For this reason each rootstock's leaves were taken from the sixth node (same for all varieties) in July. Leaves were taken from same thickness of shoots with 10 replicates. Colorless nail vanish was used in order to extract samples from the leaves. Samples were prepared from different places on the leaves. Nail vanish was dripped 1-2 drops on the bottom surface of leaf and when it was dried, it was taken off like a pattern form the leaf by the help of a gillette. After the sample was put on a lam and 1-2 water drop was dripped on lam, was covered with lamella (Mısırlı and Aksoy, 1994). Stomata count was done in a 0.066 mm² area by a light microscope with 10X40 magnificent. Stomata numbering 1 mm² was calculated from proportional calculation. Counted stomata numbers were statistically analyzed by Jump software programme.

RESULTS AND DISCUSSION

Stomata density changed between 61 and 141 stomata /mm^2. The lowest and highest stomata density was obtained from Rup. Du Lot rootstocks with 61 stomata /mm^2 and Ramsey rootstock with 141 stomata /mm^2 respectively as seen in table 1.

Table 1. Rootstock stomata density in a 1 mm² area

Rootstock name	**Stomata density (number/mm^2)**
Ramsey	141
110 R	136
Dodridge	133
99 R	132
5 BB	131
Fercal	117
1616 C	108
Harmony	98
SO 4	90
Rup Du Lot	61

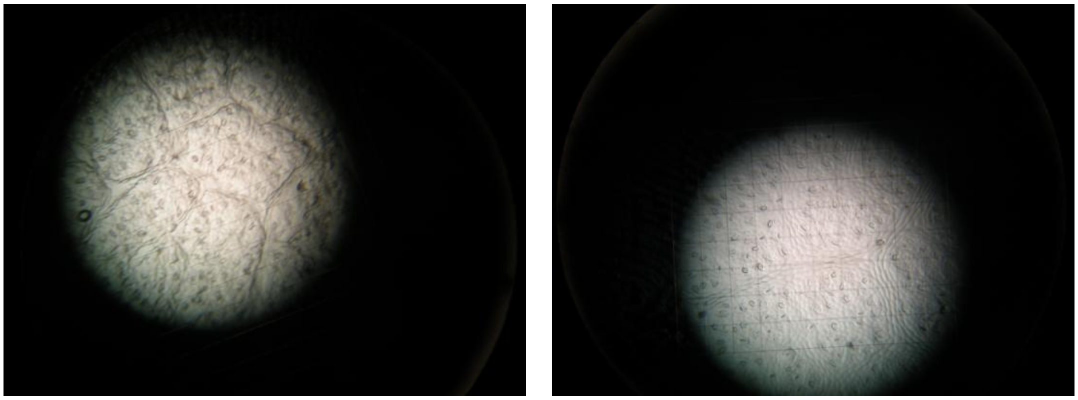

Figure 1. Some rootstocks photos under the light microscope

First stomata number researches in *Vitis* species have been started in 19th century last times. First study about stomata number of *Vitis* was Müller-Thurgau's "Ampalographische Berichte" in 1882. He counted "Riesling" variety that it had 186 stomata/mm² on the bottom of the leaves (Oraman,1972).

Düzenli and Ağaoğlu (1992), found that Razakı grape variety had more stomata number than the other varieties. Razakı grape variety can be grown in different ecological conditions. Razakı variety may be more resistant than other varieties for drought. Other studies showed that stomata number could vary according to ecological conditions. For example Çavuş grape variety stomatas were counted 187 stomata /mm² in Marmara and 277 stomata /mm² in Ankara ecological conditions (Eriş and Soylu 1990). Hegedüs (1974) determined that stomata numbers and volumes could vary in the different places of same plant. He determined that stomata numbers of some varieties Sultani Çekirdeksiz 216, Hafızali 194, Portugieser 206, Pinot Gris 164, Weisse Gutedel 183, Müller Thurgau 158, 5 C rootstock 209, Rup Du Lot'da 171, Portalis'de (*Vitis Riparia*) 194 stomata/mm². Duering (1980) counted the mature leaves of *Vitis rupestris* and *Vitis cinerea* and determined 174 stomata /mm² and 349 stomata /mm² respectively. They determined that stomata number could rarely vary in the same plant's same leaf. Scienza and Boselli (1981), studied about stomata dimensions and they reported that stomata dimensions can be affected from the genotype and position of the leaf on the shoot. Biggest stomata numbers were 1103 P and 3309 rootstocks, 157-11C and 140 R had the lowest stomata number. They determined the stomata number differences between grape varieties and rootstocks. When stomata numbers are counted according to leaf maturity, young leaves have more stomatas than mature leaves. Also it was reported that if there wasn't a much water stress, irrigation conditions wouldn't have an important effect on stomata number (Marasalı and Aktekin, 2003). It is necessary to research ABA synthesis and like similar factors about stomata density for drought resistance.

Yuvarlak çekirdeksiz grape variety grafted on 99 R and 110 R rootstocks had been determined 284.4 and 294.8 stomata numbers respectively. Stomata numbers were determined more than grafted on the other rootstocks.

Stomata number had been evaluated statistically important in this study. Stomata number differences had been evaluated also in different studies. For example in a study *Vitis* species stomata densities had been determined and average stomata number had been found 198.3 stomata /mm². Stomata density of *Vitis berlanderi* was determined 143.6 stomata /mm² and *Vitis cardifolia* was determined 302 stomata/ mm². Stomata density of *Muscadinia rotundifolia* was determined 407.7 stomata /mm². Diploid's average stomata density was 182.4 stomata/mm²and tetrapolid's average stomata density was 114 stomatamm² (Shiraishi and et. all 1996).

Jump software programmes analyse results are given in below.

Table 2. Analysis of Variance

Source	**DF**	**Sum of Squares**	**Mean Square**	**F Ratio**
Model	9	36116,254	4012,92	17,0262
Error	39	9191,950	235,69	**Prob > F**
C. Total	48	45308,204		<,0001

Table 3. Groups of LSD Test

Level					**Least Sq Mean**
RAMSEY	A				141,60000
110 R	A	B			136,20000
DODRİDGE	A	B			133,25000
99 R	A	B			132,60000
5 BB	A	B			131,20000
FERCAL		B	C		117,20000
1616 C			C		107,80000
HARMONY			C		98,00000
SO 4				D	70,20000
RUP DU. LOT				D	60,80000

Levels not connected by same letter are significantly different.

CONCLUSİON

Some grape rootstocks had been evaluated for stomata density in this study and rootstocks had been found statiscally significantly important for stomata density. Stomata density may vary according to ecological conditions and cultivation practices in *Vitis*. Stomata density gets higher by losing water with transpiration but it has not been proved clearly up to now. But sometimes it is seen that stomata density get high in irrigated conditions. Stomata density researches must be continued because of these reasons. Stomata numbers and densities must be evaluated and expect stomata density, stomatata pores, stomata index, transpiration ratios distances between stomatas must be evaluated. Drought resistance and stress studies are getting more important in nowadays stomata studies with plant physiology must be done continuously with the other subjects concerning stomata.

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