Thesis of PhD Dissertation

IMPACT OF YIELD REGULATION ON RED GRAPE VARIETIES

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The applicant met the requirement of the PhD regulations of the Corvinus University of Budapest and the thesis is accepted for the defense process.

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1. INTRODUCTION

The oversaturated wine market stimulates winegrowers to explore new methods more and more. Reasons for this are to exert their wines, to provide a better life or maintain living standards of their families. Easily workable and most influential quality improvement techniques include ways of limiting the yield. The use of yield regulation we get the positive effects on grapes and wine quality .

One of the best known and the most widely used practice within the methods of yield regulation is the cluster thinning. However there are several other alternative way to lower the yield int he vineyards such as the cluster tippping, the defoliation at flowering and the cluster shredding. These methods were compared on Kékfrankos, Cabernet Franc and Turán varieties. The experiment was adjusted between 2005-2008 in Eger.

2. AIM OF THE STUDY

In the experiment I compared four treatments cluster thinning, cluster shredding, cluster tipping and defoliation at the flowering. Vegetative growth, yield, and fruit composition were examined. The experiments were conducted in the Eger wine region, on three important red wine grape varieties (Kékfrankos, Cabernet Franc, Turan), in four year (2005-2008).

In my work I was looking for the answers to these questions:

- What are the effects of treatments on the grapevine vegetative growth, yield, and fruit composition?
- Are there qualitative, applicability differences among the examined varieties?
- Is there a better way to cluster thinning?
- How to characterize the treatments in terms of economy?

3. MATERIALS AND METHODS

Cultivars

Three red grape varieties were included in the experiment. Two varieties, Kékfrankos and Cabernet Franc has nationally and in the Eger wine region the major surface area. The third, Turan variety is also red wine variety and it has the largest area in the Eger wine region.

The parameters of the vineyard

Investigations was carried out in northwest of Eger. The vineyards are located: 47°55'N, 20°20'E, their altitude was between 216-248 m.

The vines were planted in 2000 (Cabernet franc E.11.), 2001 (Kékfrankos Kt.1.) and 2002 (Turán) on a deep clay loam soil and grafted on Teleki-Kober 125AA rootstock. All wines were trained to Royat-cordon with two arms. Row and vine spacing was 3.0 m between rows and 1.0 m within the row. Direction of rows are NW-SE. 12 buds per vine were retained at pruning, resulting 4 buds/m^2. This value was less than 6 buds/m^2 which is the maximum by regulation of Superior category of Denomiation of Origin of Eger region (102/2009. (VIII. 5.) FVM). During the canopy management desuckering, shoot thinning, topping (aprox. three time per year) and the fruit zone was deofoliation at the veraison were applied. Thin, 1,6m high foliage wall was created.

Treatments, date of treatments

In the experiment four treatments: cluster tipping (CTipp), the cluster shredding (CS), the cluster thinning (CTh), and the defoliation at flowering (DF) were compared.

The investigation was established on 7 vines/each treatment in 4 replications in completely randomized design.

The defoliation at flowering was implemented at the beginning of flowering (*1. table*). I removed the leaves surrounding each flower cluster. The other treatments (CS, CTh, CTipp) were implemented at shot berry size. The lower cluster/shoot was left at cluster thinning.

The experiments have been carried out for four years (2005-2008). In 2006 plant protection problems occurred on Cabernet Franc and Turan varieties and final evaluation of the treatments became impossible. On Kékfrankos variety all four years of the experiment were evaluated. Other discontinuities, in 2005, defoliation at flowering treated with the Kékfrankos variety, was adjusted.

1. table: The dates of treatment settings

Year	Date of defoliation at flowering	Date of CTipp, CS, CTh
2005	08. 06. (only Kékfrankos)	15. 07.
2006	01. 06.	10. 07.
2007	30. 05.	18. 07.
2008	28. 05.	22. 07.

Methods

Leaf area measurement was completed by method of SMART – ROBINSON (1991). 4 shoot/ vine of every replicates were evaluated , at harvest time for each year.

The pruning weight of 3 vines/each replication was weigheted. The number of clusters/vine, the yield (kg/m^2), average of cluster and berry weight (g) values at harvest (*2. table*) were determined.

The dry matter content (ref.%) was determined with a hand-held refractometer (100-100 berries). The titratable acidity (g / l) determination of 0.1 N sodium hydroxide by titration, the addition of bromothymol blue indicator is realized. The musts of pH measurement was completed by potentiometer Total polyphenol and anthocyanin content measurement - ILAND et al. (1996, 2000) method was used, (20-20 berries). The mineral element content measurements processing was carried out by ICP OES instrument on the FFS BCE Department of Applied Chemistry.

2. table: Experimental years, date of harvest

	2005	2006	2007	2008
Kékfrankos	10. 10.	09. 10.	25. 09.	11. 10.
Cabernet Franc	10. 10.	-	25. 09.	11. 10.
Turán	06. 09.	-	10. 09.	04. 09.

The evaluation of the data was used ROPstat statistical software package.

4. RESULTS AND DISCUSSION

The cluster thinning, maintaining one cluster/shoot is a common practice regulating the yield of the vine. However the economical, and plant protection aspects of the fruit thinning needs reconsideration. Some new advanced techniques of yield control can be advisable solution. In recent study cluster thinning, cluster shredding, cluster tipping and defoliation at flowering were compared in Eger, examining three red grape cultivars (Kékfrankos, Turán, Cabernet franc). The effect of the yield control techniques on the vegetative (leaf area, pruning weight) and reproductive growth (average cluster weight, berry weight), quality indices (soluble solids, titratable acidity, pH, total polyphenol-, anthocyanin content) of the fruit and the percentage of the bunch rot and -steam necrosis were recorded.

The **leaf area** reminded unaffected by the treatments, even by early leaf removal in every year and on every variety except one occasion.

The **pruning weight** of Cabernet Franc and Turán varieties increased or has not significantly changed depending on the year. There were no any differences registered by the effect of treatments on Kékfrankos variety.

The greatest **yield** loss was recorded on the cluster tipping treatment. The other three treatments also resulted a lower yield, but differences were not always statistically proven. In order for the second most reliable procedure was the cluster shredding. In case of Cabernet Franc the defoliation at flowering caused the greatest yield loss. The yield of Cabernet Franc was not significantly modified by cluster thinning. All of the examined treatments were suitable to obtain the yield limited by regulation of Superior category of Denomiation of Origin of Eger region.

The indices of **vegetative and reproductive balance** of treated vines reminded in the optimal range.

The average **cluster weight** decreased by the treatments reducing berry number per cluster (cluster tipping, -shredding). Cluster thinning head no statistically proved effect on cluster weight, except in 2005, the Kékfrankos (reduced) and in 2008, the Turán (increased). The defoliation at flowering resulted significantly lower cluster weight only on Kékfrankos variety.

The impact of cluster tipping and -shredding on **berry weight** is irrelevant. The positive and negative effect of cluster thinning and the defoliation at flowering was noticed on Kékfrankos and Turán varieties.

The musts quality parameters improved with treatments, but the differences were modest. **Soluble solids**: there were year when each of the treatments resulted higher soluble solid content then the control. Compare to control, negative effect of yield regulation was registered on Turan variety in case of cluster shredding and defoliation at flowering treatments. In case of these two treatments the yield reminded unaffected, abundant yield compensation was recorded.

The **pH** value was mostly effected on Turan variety. The **titratable acidity** was the most variable on the cluster tipping treatment.

Effect of the four treatments on the **polyphenol content** of the juice were diverse. The polyphenol content of juice increased by the cluster tipping, and reminded unaffected by all other treatments on mg phenol per g berry basis.

Similar but less differences marked in the **anthocyanin content** of berries. The treated Turán variety were not presenting higher anthocyanin content than the control vines.

Mineral content of juice was determined on Kékfrankos variety in two consequent years. Yield regulation treatment resulted lower Fe- and Sodium content in 2005 than the control. It also was found that the K/Na ratio in all treatments exceeded the control.

The sensitivity to **grape rot**, and the tendency to **bunch steam necrosis** was reduced by cluster tipping, -shredding and the defoliation at flowering treatments. The cluster thinned vines like controls was the sensitive.

On economic aspect the defoliation at flowering was the most advisable practice for yield regulation.

Time complete of the treatment increased in the following order: cluster thinning, cluster shredding and finally cluster tipping. The cluster thinning treatments increases the affectivity of harvest by the reduced number of cluster per vine. The harvest capacity could be enhanced by defoliation at flowering, where the overview of the cluster zone is better. Cluster shredding and -tipping has irrelevant effect regarding harvest efficiency. The biggest advantage of the cluster tipping is the safe crop reduction, and the improvement of grape quality. The method of cluster shredding can adapt to the structure of the clusters. Dense clusters could be more severely treated according to year and percent of berry set. The defoliation at flowering has also many advantages; impact on must quality is meaningful, moreover indirect effect on ie human physiology. Formation of important phenolic compounds may be the subject of future research.

New scientific results

1. The effect of the moderate defoliation, carried out at flowering (leaf removal surrounding of the clusters was not significant either for leaf area, or pruning weight on Cabernet Franc and Turán varieties.

2. The yield limiting effect of the defoliation at flowering is similar to the effect of cluster thinning (1 cluster/shoot) in Eger, in case of Kékfrankos, Cabernet Franc and Turán varieties. It can be achieved extended yield regulation with the cluster tipping and the cluster shredding.

3. Polyphenol content could be increased with the decreased cluster weight. Highest total polyphenol content (g/berry g) was achieved with cluster tipping treatment in case of Cabernet Franc. On Kékfrankos and Turán varieties significant difference were not observed in total polyphenol content in each year.

4. The treatments resulted decreased Na-, Fe-content and increased K/Na ratio in the juice in case of Kékfrankos. These results could report, that the treatments have positive impact on maturity.

5. Grape botrytis susceptibility (2005), and tendency of bunch steam necrosis (2006) was reduced by cluster tipping, cluster shredding and defoliation at flowering in case of Kékfrankos, Cabernet Franc and Turán varieties, in Eger region.

6. Regardless of grape variety (Kékfrankos, Cabernet Franc and Turán) the defoliation at flowering was the fastest treatment to be performed.

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