MECHANICAL PRUNING ON A VERTICAL SHOOT POSITIONING SYSTEM IN DÃO REGION.

Amândio CRUZ [1*], Chiara PIOVENE [1,3], Aurélio CLARO [2], Ana RODRIGUES [2], Rogério de CASTRO [1]

(1) Instituto Superior de Agronomia, 1349-017, LISBOA, Portugal
(2) Dão Sul-Sociedade Vitivinícola, SA., 3420-909, CARREGAL DO SAL, Portugal
(3) Universitá di Bologna,Via Giuseppe Fanin, 50, 40127 Bologna Emilia Romagna, Italy
*Corresp. author : Amândio Cruz, Tel. 00(351)962685179, Email: amandiocruz67@gmail.com

Summary

With the objective of costs reduction in winter pruning, a trial field was conducted from 2008 to 2010 to compare mechanical pruning (MEC = hedge pruning) with manual pruning (MAN), in the Dão region, Portugal, with the red grape variety Alfrocheiro, one of the most important of this denomination. The different types of pruning had already been introduced in 2007.

The results obtained showed the same effect during the three years. In 2008 and 2009 the MEC yield was more than twice the MAN yield, with minimum differences in the wine quality (alcohol content and colour components). In 2010 there were also significant differences on yield, and mechanical pruning originated more than 50% of production. Also in this year, the differences in wines quality were small.

The high yield in mechanical pruning is mainly due to the higher number of clusters, which compensate the fact that they are smaller.

In 2008, differences in yield were also marked by the occurrence of coulure on manual pruning, a phenomenon not observed in mechanical pruning.

In mechanical pruning, every year was observed a significant and alarming reduction on the vines vigour (shoot weight, shoot and laterals leaf area), although total leaf area per plant was about 4 times higher than in manual pruning.

In 2010 the predawn leaf water potential did not indicate any differences between the two types of pruning.

1- INTRODUCTION

Given the current vulgarization of mechanical harvest, we can consider pruning the operation with more time-consuming activity in wine industry [6, 10, 13, 14, 16, 17]. In Spain [10] it was found that pruning takes up approximately 30% of the total needs of manual work and in Italy [6] it was found that pruning requires about 36% of the total needs of annual hand work. The motivation leading to research on mechanized pruning systems was diverse, but the reduction or optimization of costs was a common objective [1, 3, 6, 16], associated with the scarcity and high cost of skilled manual labour. The adoption of mechanical pruning systems in various regions and conditions didn't have a negative impact on wine quality, except where the production exceeds the capacity of the vines [4].

Overall hedge-pruned vines have typical features such as a greater number of buds per vine [5, 7, 10,12,18], increased number of shoots [5, 10, 14], early development of leaf area [10, 18], resulting in a greater total leaf area [10], higher number of clusters [5, 16] and yield [3, 5, 7, 10, 14], despite showing lower values in some relevant indicators such as bud burst rate [7,12, 18], fertility rate [7] and cluster weight [5, 14].

2- MATERIAL AND METHODS

The experimental trial was installed in 2007, on a vineyard belonging to a private company (Dão Sul, Soc. Vitivinícola, SA), located in Carregal do Sal (40º26'N, 1º6'W), in Dão's demarcated region. The vine grape variety was 'Alfrocheiro' and had been grafted in 1991, onto rootstock 1103 P.

The vineyard was slightly south exposed and row orientation was North-South. Vines were planted with 2,5 x 1,2m spacing and trained onto a Royat bilateral with vertical shoot positioning.

This variety is one of the most important red vine varieties in this wine region, characterized by being very fertile in the basal buds. This way it is well adapted to spur pruning. It produces wines of intense red color and fruity aroma.

According to hydric balance of Thornthwaite, this region's climate is mesothermic, with little or no thermal efficiency in the summer, sub-damp to dry with moderate water superavit in the winter and moderate deficit in the summer (B'3 a C1s). The soil is, according to FAO's classification, a Cambisoil, franc-sandy, acid, with granitic origin and low hydric reserve.

A 'randomized blocs' experiment was designed, with three replications.

The hedge pruning was done by passing a pre-pruning machine and subsequently was made a slight manual correction of the shoots that were not cut by the machine.

Leaf water potential (Ψ_f)was measured with a pressure chamber (Scholander type). In each day, Ψ_f was measured at predawn and thereafter, 3 times a day (10 am, 2 and 6 pm) along the season. Measurements were made on twelve leaves per treatment.

Leaf area was determined with the method proposed by [9]. The canopy structure was evaluated by Point Quadrat method [17].

Wines were analysed by the OIV methods [20].

3.1- RESULTS AND DISCUSSION

3.1- Canopy structure

The characterization of canopy structure in 2010 is presented on table 1, and it shows an increase of canopy density with the hedge pruning, with higher LLN, shaded leaves and clusters.

The total leaf area per vine was also influenced by the pruning method, with higher values in MEC, principally due to the greater number of shoots per vine (table 2). MEC also significantly reduced the lateral leaf area per shoot, while the principal leaf per shoot was not affected. The mechanical pruning, also tend to reduce the size of the leaves. Similar results were found in Ribatejo region by (7).

Table 1 – Influence of pruning system on canopy structure during the ripening in 2010. MAN – manual pruning; MEC – hedge pruning**.** Significance level: (*) - $p \leq 0.05$, (**) - $p \leq 0.01$, (***) - $p \leq 0.001$ and n.s.: not significant by F test.

Pruning	LLN	Shaded leaves (%)	Shaded clusters (%)
MAN	3,85	45,5	77,9
MEC	4,78	55,3	90,0
Sig	***	**	*ns*

Table 2 – Influence of pruning system on leaf area during the ripening in 2010. MAN – manual pruning; MEC – hedge pruning**.** Significance level: (*) - $p \leq 0.05$, (**) - $p \leq 0.01$, (***) - $p \leq 0.001$ and n.s.: not significant by F test.

Pruning	Total LA (m^2/vine)	Primary LA (cm^2/shoot)	Lateral LA (cm^2/shoot)	Major leaf (cm^2)	Minor leaf (cm^2)
MAN	4,5	1588	1516	159,1	116,8
MEC	16,5	1534	862	140,1	98,9
Sig	***	*ns*	*	*ns*	*ns*

3.2- Water relations

Regarding to basal leaf water potential no significant differences were found between treatments in any date (figure 1 and 2). At harvest (October 1st), MEC shows tendencies to higher hydric stress. Similar results were found by other authors [7, 8, 12].

Diurnal evolution of leaf water potential during ripening (August 19th) harvest also didn't show any difference between pruning methods.

The obtained results didn't reached values of strong hydric stress as those referred at bibliography [11].

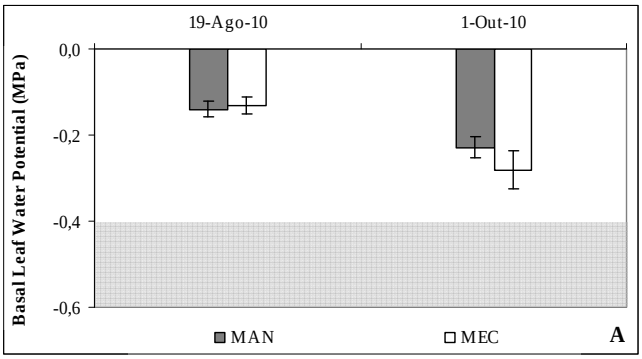

Figure 1 - Basal leaf water potential. Alfrocheiro, 2010. Average ± SE (n = 12).

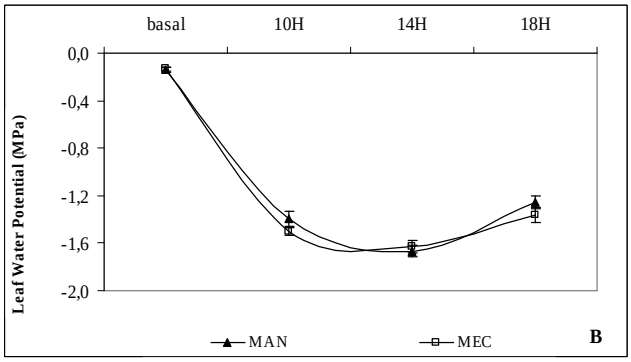

Figure 2 - Diurnal leaf water potential (B) during the ripening (August 19th). Alfrocheiro, 2010. Average ± SE (n = 12).

3.3- Yield components

In what concerns the yield and its components, the results obtained showed the same effect during the three years (table 3). In 2008 and 2009 the MEC yield was more than twice the MAN yield, with minimum differences in the wine quality (alcohol content and colour compounds). In 2010, there were also significant differences in yield, and mechanical pruning originated more than 50% of production. Also in this year, the differences in quality of the wines were small.

The high yield in mechanical pruning (MEC) is mainly due to the higher number of clusters, which compensate the fact that they are smaller. Same results were observed by the authors at Touriga Nacional variety [2] and by [5 e 10] at Cabernet Sauvignon and Grenache varieties respectively.

Table 3 – Yield parameters on Alfrocheiro vine variety, Carregal do Sal, 2008, 2009 e 2010. Significance level: (*) - $p \leq 0.05$, (**) - $p \leq 0.01$, (***) - $p \leq 0.001$ and n.s.: not significant by F test.

Year	Pruning	Clusters/vine	Cluster weight (g)	Yield (t/ha)
2008	MAN	25,8	97,1	8,3
	MEC	76,5	80,2	19,6
	Sig.	***	**	***
2009	MAN	21,9	88,1	6,4
	MEC	90,2	64,5	19,3
	Sig.	***	***	***
2010	MAN	29,8	128,6	12,8
	MEC	57,1	90,2	17,4
	Sig.	***	***	***

3.4- Vegetative expression and vigour

In all of the three years, the number of shoots was significantly different between the pruning methods (table 4). These results are due to the greater number of buds per vine on mechanical pruning when compared to manual pruning (240.000 vs 80.000 buds/hectare). Also the total pruning weight per vine was reduced by MEC in 2008 and 2009. During these two years an alarming reduction of shoot weight was observed. As a consequence, in the beginning of the 2010 cycle an application of organic matter was made at mechanical pruning vines. As result of

this organic fertilization, an increase of total pruning weight per vine and particularly of shoot weight was observed.

The Ravaz index was higher in mechanical pruning 2009 and 2010. Same results were obtained at Touriga Nacional (2).

Table 4 – Vigour parameters on Alfrocheiro vine variety, Carregal do Sal, 2008, 2009 and 2010. Significance level: (*) - $p \leq 0.05$, (**) - $p \leq 0.01$, (***) - $p \leq 0.001$ and n.s.: not significant by F test. na – not applicable.

Year	Pruning	Shoots/ vine	Pruning weight/vine (g)	Shoot weight (g)	RAVAZ INDEX
2008	MAN	18,8	851	47,1	-
	MEC	41,7	583	14,2	-
	Sig.	***	***	***	-
2009	MAN	13,0	573	46,0	3,4
	MEC	36,1	357	9,7	16,3
	Sig.	***	***	***	*na*
2010	MAN	17,5	650	38,4	5,9
	MEC	46,7	646	18,7	8,1
	Sig.	***	*ns*	***	*na*

3.5- Wine characteristics

The small differences in the grape parameters was reflected in the wines, which proved similar in analytical terms. The alcoholic content was generally very high in all years and tends to be superior in manual pruning (MAN). Only minor differences were found at colour intensity in 2010. The organoleptical results will be presented in a poster.

Table 5- Analytical characteristics of the wines, Alfrocheiro, Carregal do Sal, 2008-2010.

YEAR	PRUNING	Alcohol Content (% vol.)	Titrable Acidity (g tar. ac./l)	Colour Intensity
2008	MAN	16,4	8,2	7,5
	MEC	14,9	8,2	7,9
2009	MAN	16,4	7,0	11,6
	MEC	15,2	7,7	11,1
2010	MAN	16,7	6,3	9,9
	MEC	15,1	6,5	7,5

4- CONCLUSIONS

Mechanical Pruning naturally leads to a higher number of buds per vine associated with a greater number of spurs. The leaf water potential is not reflected in any measurement conditions of severe hydric stress. The total leaf area is significantly higher in mechanical pruning while the lateral leaf area is significantly higher in manual pruning. The mechanical pruning conduces to higher yield, but to lower clusters and to a marked reduction of vigour that recommends caution.

The results of the three years suggest the viability of mechanical pruning, with reduction in manual work, yield gains and without significant differences in wine characteristics.

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