Olive Harvest in Mirandela Region

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Abstract

The olives groves in the North of Portugal present some problems namely those ones related with the harvester. The vibrator mounted in front tractor has became a solution for this agricultural operation but it is necessary to improve its performances why, in this paper, we present the main parameters that must be analysed to increase this work.

Among the main factors those ones related with the plots topography, orchard installation, plants and equipment are analysed in order to know its influence in the vibrator performance, namely the vibration time and its efficiency.

Regarding some of these factors we realize that, for each olive species, size canopy, etc. there is a vibration time, that varies between 13 - 17 s. For the tree distances the tractor way must be previously defined to reduce the travel distance so in the analysed situations the distance forward and backward varied between 8.62-2.40 m and 5.75-2.00 m. For the amount of olive fall down, as the result of the vibration time, its values varied between 85-91%.

Introduction

The olives-growing in Mirandela region are a traditional culture of high economical and social importance for many agricultural farms. The climate, typically Mediterranean, and the low precipitation in the region (± 500 mm) are critical factors for its developing.

In this region the olive grove occupies an area of ± 8.850 ha (Pires, 1999) that is mainly implanted in small plots of irregular topography, in which the predominant tree distances are ± 10 x 10 m and the average plant productions ± 8.5 kg/tree. The most representative varieties are Cobrançosa, Verdeal and Madural, being almost the all production used for olive oil production.

The traditional process of olive harvest is based in hand labour which, nowadays, is more and more difficult to find and has high costs, why the harvest machines, especially mounted tractor vibrators, has been solution chosen for the growers.

This paper is a summary of a school final report done in Mirandela Region, with the purpose of analyzing and improving the vibrator performance.

Material and methods

The material used in the trials included:

- vegetable material;
- olive harvester;
- other material.

The vegetable material consists of the varieties Cobrançosa, Verdeal and Madural which trees present different characteristics, namely age, size, trunk height, etc

The harvester equipment is a tractor mounted vibrator basically constituted by a vibration head (tweezers) and a hat where the fruits fall down. The tractor is a four wheel tractor with 105 kW that, with the vibrator, has 9.5 m length and 2.80 m width.

Figure 1- The tractor and vibrator group.

Besides these material measurement equipments were used, namely dynamometers, chronometer, scales, tape-measures, clinometers, etc., and other related harvest equipments such as awnings, boxes transport, cleaning equipment, sticks, etc.
The methodology followed in the trials was established to quantify the influence of the several factors that direct or indirectly, interfere in the harvest operation.

The data include:
- the tree identification and its variety;
- the defined way between two consecutive olive tree to vibrate;
- the distance between two consecutive vibrated olive;
- the distance and the time since the beginning of the displacement, after the vibration, to the inversion of the displacement sense;
- the distance and the time since the beginning of displacement inversion to the next vibration position;
- the ground slope when the machine is in the vibration position;
- the 90º ground slope in the anti-schedule sense, in relation to the vibration position;
- the height of the trunk, from the soil to the first secondary trunk;
- the trunk diameter at the level where the tweezers arrests to vibrate;
- the canopy diameter determined by the horizontal projection in the ground;
- the height from the soil to the tweezers placement;
- the time of tweezers fixation, awning fit, tree vibration, the awning unfit and olive discharge;
- the weight, in kg, of the olive per tree, as the result vibration;
- the weight, in kg, of the olive per tree, left by the tree vibration;
- the vibrator efficiency, determined by the quotient between the vibrated olive and the total olive tree yield.

To get the data mentioned above a map was previously elaborated for each plot, where the olive trees were identified and defined the ways to harvest them. The trials determinations have been started in middles of November according the direct observation of olive coloration and the determination of the medium strength to detach the fruits (R), measured with a dynamometer. It was considered that when the quotient between this force and the olive medium load (p), was minor than 150 (R/p <150), the olives would be matured enough to be picked.

After each olive tree vibration the yield is left in a awning to be weight and, after this, transferred to boxes and taken to the cleaning machine; the olives that stay in the tree is picked manually with sticks and weighed.

4. Results and discussion

The obtained data were introduced in a worksheet representing the columns the different factors and the lines the number of studied cases; 26 factors were analyzed in 209 olive trees. These data are imported with a statistical software to analyse the parameters variance in order to know which ones are the more time consuming and how to reduce its values to increase the rate work.

Plots

Relatively to the plots (Annex 1) we notice that:

- in Alta da Casinha plot the trees are more close to each other which allow small tracks between two consecutive trees. In this plot the vibration position is upside down;
- the distances travelled backward vary little because it is just the sufficient to remove the tweezers from the trunk and to get a free way to move forward.

Varieties

Relatively to the varieties (Annex 2) we notice that:

- the canopy diameter, trunk height, distance from the tweezers placement to the ground and the trunk diameter vary little, according with the age of the olive trees that is almost the same;
- the average vibration time is greater in Cobrançosa and Verdeal (± 17 s), when compared with Madural (± 13 s);
- the average vibrated olive is greater in Cobrançosa and Madural (± 8 kg) when compared with Verdeal (± 6.5 kg);
- the average olive that remain in the tree after the vibration is greater in Verdeal (± 1.2 kg), and lower in Madural (± 0.45 kg);
- the total olive collected in each variety vary between 8 - 9 kg / tree;
- the vibrator efficiency is greater in Madural (± 94.5%) and lower in Verdeal (± 83.5%).

Total times

Relatively to the total times (Annex 3) we notice that:

- the displacements are the main time consumer (± 35%);
- the vibration time (± 25%) is the second one;
- the olive discharge time represents only ± 5% of the total time.

5. Conclusions

From the data results analysis it is possible to improve the work rate of the harvest olive, namely:

- the distances among trees should be the strictly necessary to allow the equipment manoeuvrability, in order to minimized the displacements times which represent the biggest time consuming;
- it is fundamental that the trees training system allow an easy tweezers trunk embracement and a easy open and close awning. The pruning training trees with only one and right trunk and with enough height, are fundamental to improve the vibrator efficiency;
- the vibration time should be determined to each variety because it was verified that after some seconds the amount of olive that continue to fall down do not justify to continue the vibration;
- the olive discharge, that is a fast operation, should be done frequently to avoid the fruit deterioration;
- the olive groves slope where the trials were done didn't reduced the equipment performance, however it is important to "attack" the trees always from the down to the upper slope, to facilitate the olive fall down. These position minimize the risk of tractor slippage which can damage or root up the smallest trees.

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Annex 1- Travelled distances and slopes in the several plots.

Variables / Plots		Alta da Casinha	Coitada	Lamela	Salgueirinha
	Min.	0.00	6.50	7.00	7.00
Distance among olive trees (m)	**Avg**	**6.71**	**9.67**	**9.90**	**9.58**
	Max.	12.50	12.70	19.00	17.00
	Min.	0.00	1.30	1.70	1.50
Distance travelled backward (m)	**Avg**	**2.00**	**2.52**	**2.40**	**2.35**
	Max.	5.00	5.50	3.50	3.20
	Min.	0.00	3.00	3.70	4.00
Distance travelled forward (m)	**Avg**	**5.75**	**8.81**	**8.62**	**9.09**
	Max.	11.50	13.50	14.00	18.70
	Min.	0.00	0.00	6.20	6.50
Total distance travelled (m)	**Avg**	**7.75**	**11.04**	**11.04**	**11.44**
	Max.	13.50	16.50	16.70	20.70
	Min.	-15.00	-14.00	-13.00	-10.00
Slope of vibration position (%)	**Avg**	**-0.58**	**7.98**	**2.18**	**12.78**
	Max.	17.00	20.00	14.00	33.00
	Min.	-13.00	-14.00	-17.00	-25.00
Slope perpendicular to vibration position (%)	**Avg**	**0.73**	**1.86**	**1.69**	**-1.81**
	Max.	15.00	17.00	16.00	20.00

Annex 2- Average, minimum, maximum, and standard deviation of some factors

Variables / Varieties		Cobrançosa	Madural	Verdeal	Salgueiral
	Min.	1.30	1.50	1.80	4.00
Canopy diameter (m)	**Avg**	**3.99**	**3.75**	**4.46**	**4.40**
	Max.	6.00	5.80	6.80	5.00
	Min.	0.70	0.60	0.80	1.20
Height trunk (m)	**Avg**	**1.27**	**1.14**	**1.18**	**1.27**
	Max.	1.80	1.70	1.50	1.40
	Min.	1.00	1.00	1.00	2.00
Height of tweezers position (m)	**Avg**	**1.52**	**1.38**	**1.34**	**2.00**
	Max.	2.00	2.00	2.00	2.00
	Min.	0.05	0.06	0.08	0.17
Trunk diameter (m)	**Avg**	**0.18**	**0.16**	**0.18**	**0.20**
	Max.	0.32	0.30	0.31	0.25
	Min.	0.00	5.00	3.50	6.00
Vibration time (s)	**Avg**	**17.17**	**13.06**	**16.81**	**13.50**
	Max.	28.00	23.00	30.00	21.00
	Min.	0.00	1.00	1.00	1.00
Vibrated olive (kg)	**Avg**	**8.21**	**8.09**	**6.71**	**2.00**
	Max.	35.00	43.00	17.00	3.00
	Min.	0.00	0.10	0.10	0.20
Olive not vibrated (kg)	**Avg**	**0.78**	**0.47**	**1.22**	**0.30**
	Max.	4.00	1.90	4.00	0.40
	Min.	0.00	1.10	1.10	1.20
Total weight olive (kg)	**Avg**	**9.00**	**8.57**	**7.94**	**2.30**
	Max.	37.50	44.80	20.00	3.40
	Min.	0.00	83.00	67.00	83.00
Vibrator efficiency (%)	**Avg**	**89.39**	**94.36**	**83.61**	**85.50**
	Max.	99.00	98.00	91.00	88.00

Annex 3- Operations time

Variables / Trees		Trees	%
	Min.	0.00	
Displacements total time (s)	**Avg**	**21.23**	**34.9**
	Max.	45.00	
	Min.	2.00	
Tweezers adaptation time (s)	**Avg**	**8.62**	**14.2**
	Max.	32.00	
	Min.	5.00	
Awning fit time (s)	**Avg**	**6.99**	**11.5**
	Max.	9.00	
	Min.	0.00	
Vibration time (s)	**Avg**	**15.43**	**25.4**
	Max.	30.00	
	Min.	5.00	
Awning unfit time (s)	**Avg**	**6.95**	**11.4**
	Max.	14.00	
	Min.	0.00	
Olive discharge time (s)	**Avg**	**3.44**	**5.7**
	Max.	10.00	
	Min.	25.50	
Total time per tree (s)	**Avg**	**60.77**	**100.0**
	Max.	139.00	