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Agriculture and Agricultural Science Procedia 7 (2015) 2 – 5

Agriculture and Agricultural Science Procedia

Farm Machinery and Processes Management in Sustainable Agriculture, 7th International Scientific Symposium

Data used as an indicator of mechanical olive harvest season

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Abstract

When and how harvest olives are among the most important issues to improve quality and quantity to ensure the best net return to growers. Trunk shakers are commonly used in mechanical harvesting to detach olives. Field trials showed that with this equipment less than 100% of the production is detached, usually 70% to 90% (Michelakis, 2002).It is important to increase the percentage of fruits harvested, to reduce losses. To achieve this goal factors affecting mechanical olive harvesting must be known, to be used in the definition of harvest season. Some of these factors are the result of the orchard management, like tree shape, canopy density, pruning methods. Others depend on the cultivar, such as fruit removal force (FRF), fruit weight (P) and the ratio between them. FRF and P are considered decisive in the detachment process. Results of field trials carried out in the Northeast of Portugal with "Cobrançosa Transmontana" cultivar show the FRF, P and their ratio evolution in the ripening period. They have potential to become indicators of the mechanical olive harvest season.

Peer-review under responsibility of the Centre wallon de Recherches agronomiques (CRA-W)

Keywords: Olive harvesting season; efficiency; trunk shaker.

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doi:10.1016/j.aaspro.2015.12.006

1. Introduction

Olive production faces problems, some of them related to the low product price and high production costs.To face these difficulties it is important to reduce costs and improve fruit quality. Low mechanization level penalizes the sector due to the high cost of hand harvesting.

Olive harvesting mechanization systems allow reducing costs (less manpower needs) and increasing quality (better work rates make possible to harvest in the most convenient period) (Amirante et al, 2012).

Focusing on olive production for oil, the definition of harvesting season depends on some factors. The oil content in the fruits is one of the most important, such as the mechanical harvesting efficiency, considered as the percentage of fruits removed from the total crop of the tree (Ferguson, 2006), to reduce fruit losses.

Factors affecting mechanical olive harvesting are tree shape, canopy density, pruning, orchard density and the cultivar (Ferguson et al, 2010).

Tree shape and canopy density can affect mechanical harvesting efficiency jeopardizing the shaker performance to detach fruits. The impediment is the less ability to transmit the force to the fruits bearing surface (Martin, 1994).

Canopy density can affect mechanical harvesting (Tombesi et al, 2002) slowing the operator, jeopardizing trunk shaker performance, or limiting head´s access to convenient trunk.

Adequate pruning must provide trunk or branch clearance to allow convenient access to trunk shaker and vibration transmission to fruits.

Orchard density suitable for trunk shakers can have 150 trees per hectare to 400 trees per hectare. High density orchards limit tree size, due to between tree competition, facilitating fruit detachment and fruit collection with mechanical harvesters (Ferguson et al, 2010).

Among the factors linked to the cultivar, fruit removal force (FRF), fruit weight (P) and the ratio between them are important for harvest efficiency (Tombesi 1990; Ferguson 2006, Farinelli et al 2012).

These factors affect the efficiency of mechanical harvest and can be used as indicator of when to begin and finish harvest season (Ferguson, 2006).

Another harvesting indicator used is maturity indices based on fruits colour development.

Preliminary results of ratio fruit removal force (FRF) / fruit weight (P) are presented. Field trials took place for two years – 2013 and 2014.

2. Material and Methods

Field trials took place in Portuguese Trás-os-Montes region for two years in an irrigated olive orchard with "Cobrançosa Transmontana" cultivar. Olive orchard has 300 trees spaced at 7 m x 7 m (see Fig. 1).

Fig. 1. Experimental olive orchard.

Fig. 2. Mechanical harvesting equipment.

The mechanical harvesting system is based on a trunk shaker to detach olives and an inverted umbrella to collect them (see Fig. 2). The inverted umbrella can store temporarily 200/250 kg of olives. Under the inverted umbrella a gate may be hydraulically open to allow discharge of the olives.

To evaluate fruit removal force (FRF) and fruit weight (P) five repetitions were considered. The olive orchard

was divided in 30 plots with 10 trees each. Five of the plots were selected by randomization. Measurements were made in 10 olives around each tree crown of the five selected plots, each plot as a repetition.

Harvest took place the first week of December 2013 and in the last week of November 2014.

Measurements of the force required to remove olives were made with a dynamometer Chatillon Model DPP – 2.5 kg. Measurements of fruit weight were made with an analytical balance Mettler Pc 2000.

3. Results and Discussions

The ratio FRF/P is a more useful data than FRF or P by themselves. Fig. 3 and Fig. 4 show the evolution of FRF/P ratio during the ripening period on 2013 and 2014.

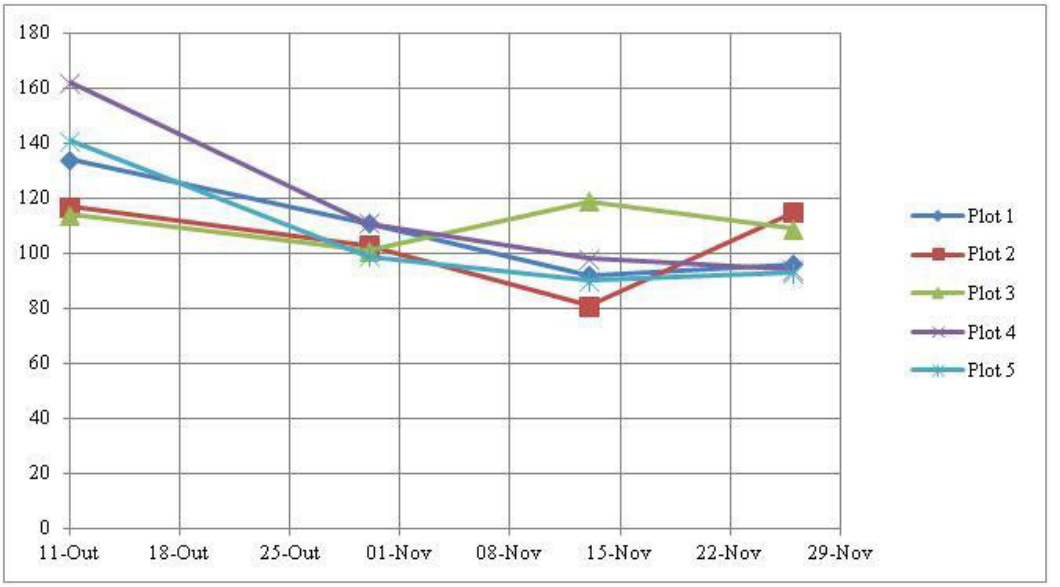

Fig. 3. Evolution of FRF/P ratio during 2013 ripening period.

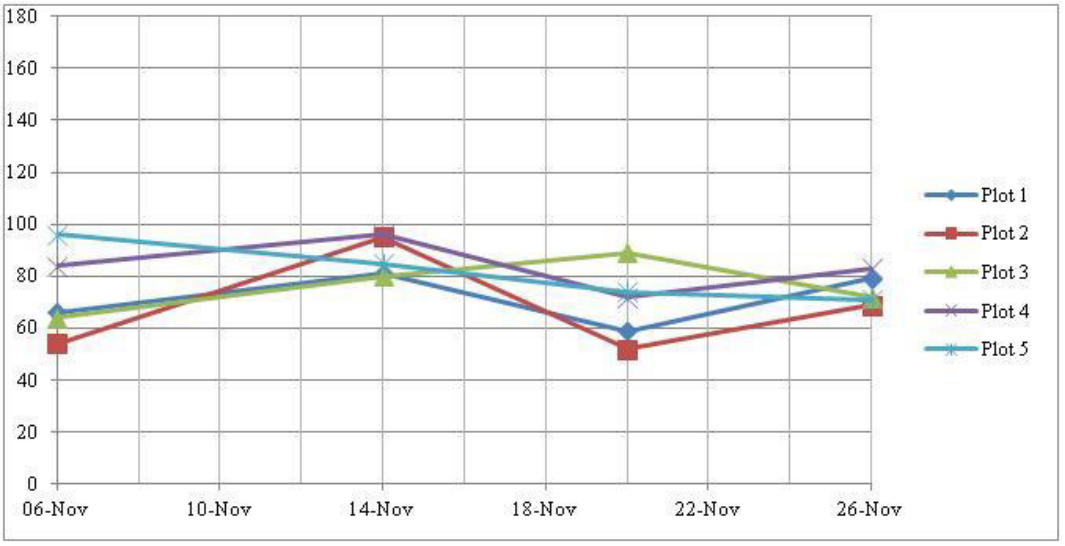

Fig.4. Evolution of FRF/P ratio during 2014 ripening period.

In both years the ratio has predominantly descendant values during the ripening period; in 2013 from 162 to 81, and in 2014 from 96 to 52, as a result of a FRF downward variation and an upward variation of P. In both years the ratio values stabilize the decline in the second half of November, just before harvesting, registering in some plots, in this period, a slight increase in consequence of a FRF increase higher than P increase (contrary to the tendency of previous weeks).

Two main reasons can justify the lower ratio values in 2014, compared with the values of 2013: (1) 2014 summer 2014 had a lower temperature than summer 2013; (2) in 2014 the olive orchard sanitary conditions were worse than in 2013 because *bactrocera oleae* attack.

4. Conclusions

FRF/P ratio can be used to improve harvest efficiency. Harvesting yields equal to or higher than 85% are considered the breakeven point for mechanical harvesting of olives with trunk shakers (Farinelli, 2012).

The establishment of a FRF/P ratio value related to the referred breakeven point, allow using FRF/P as an important indicator of the most appropriate period of time for harvesting with trunk shakers. This study must be done on various cultivars and in different regions.

In the future more field trials are needed to better understand the FRF/P ratio evolution.

Acknowledgements

The authors want to thank to the Program PRODER Medida 4.1 nº 44663 for the financial support, to the farmer of Quinta do Carrascal – Viaz and personnel involved in the field trials.

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