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CONTENTS

APPROPRIATE MECHANICAL HARVESTING SYSTEMS FOR DIFFERENT TYPES OF OLIVE ORCHARDS

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1. Introduction

In the last decades olive growers spent a substantial part of their gross return to face high costs of manually cultural practices, due to shortage of manpower.

Olive crop is in a critical situation due to low product price and high production costs.

In order to face the problem it is mandatory to increase competitiveness on the global market, reducing costs and improving fruit quality. Low mechanization level penalizes the sector.

Olive harvesting mechanization systems allow achieving these goals [Amirante, Tamborino 2012]: costs – reducing manpower needs and quality – better work rates make possible to harvest in the optimal harvest timing.

For mechanical harvesting, different types of olive orchards must be considered: (a) traditional (<150 trees per hectare), (b) high density olive orchards (300 to 400 trees per hectare) and (c) hedgerow olive orchards (1000 to 2000 trees per hectare). For each olive orchard type, an appropriate harvesting system is required.

2. Material and methods

2.1 Traditional olive orchards

First experiments took place in Northeast of Portugal (Trás-os-Montes) in Verdeal, Cobrançosa and Madural cultivars and in the South of the country (Alentejo) mainly with Galega and Picual cultivars.

Three treatments were compared: trunk shakers mounted on the front loader of a tractor was used to detach olives, collected by manually moved canvas (system I) or by mechanical rolling canvas (system II) or by an inverted umbrella (system III) mounted on the front loader of a tractor (combined with the shaker) [Almeida, 2007a].

Trees with large canopies (volume superior than 100 m^3 / 200 m^3 and trunk perimeter superior than 2 m / 3.5 m) are not suitable for trunk shakers.

So other experiments took place in Northeast of Portugal (Trás-os-Montes) in Verdeal, Cobrançosa and Madural cultivars to evaluate the performance and operational conditions of a spike rotor able to turn around

its axle providing the brushing action to detach olives [Almeida, 2007b]. This equipment work in conjunction with hand held shakers concentrated in lower branches.

Trees are harvested one by one in this type of olive orchard.

2.2 High density olive orchards

Experiments took place in Northeast and South of Portugal mainly with, Cobrançosa and Picual cultivars. Specific mechanical rolling canvas equipment has been designed to collect olives detached by trunk shakers.

Trees are harvested one by one.

2.3 Hedgerow olive orchards

This kind of olive orchard is becoming usual in some olive producers regions. Observations in order to evaluate equipment performance and operational conditions took place in central region of Portugal.

An over row equipment is an appropriate equipment. Olives are detached and collected simultaneously row by row, not tree by tree.

3. Results

3.1 Traditional olive orchards

In this type of olive orchards field tests show a performance of 40 to 70 trees per hour (Fig.1) is easily achieved [Almeida, 2007a], considering the harvesting systems using a trunk shaker. Trunk shakers can detach 80% to 90% of olives produced [Michelakis, 2002].

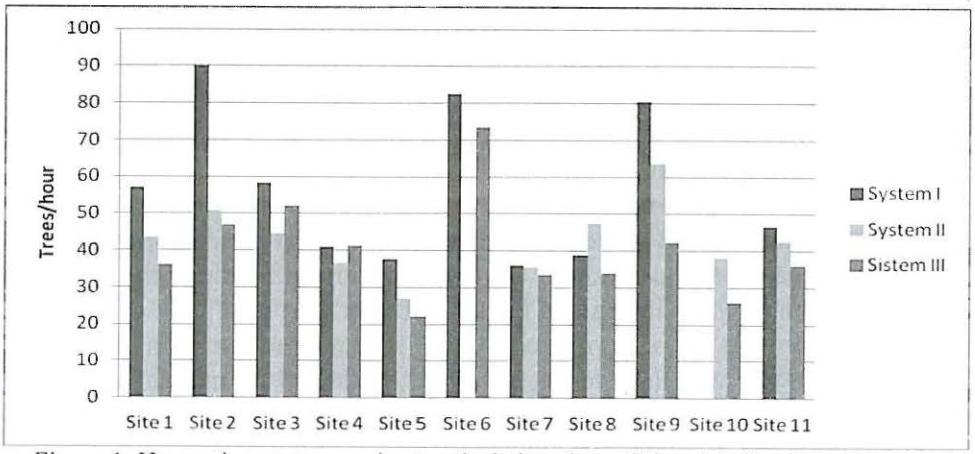

Figure 1. Harvesting systems using trunk shakers in traditional orchards.

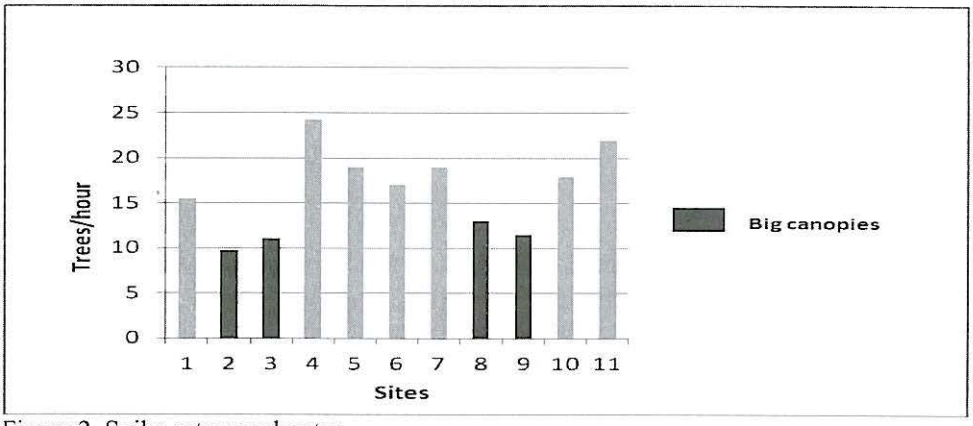

Figure 2. Spike rotor work rates

For trees with a canopy and trunk not suitable for shakers, a spike rotor is a useful equipment, despite the lower performance – 12 to 25 trees per hour [Almeida, 2007b], but this equipment usually detaches 100% of the olive production (Fig. 2).

In slopes special trajectories to move the harvesting equipment inside olive orchards are necessary to minimize the risk of accidents. These solutions are necessary for a safe work, but can jeopardize the equipment performance.

Work rates in slopes are lower than in olive orchards in flat areas. In these field trials, in average, System I work rate have a reduction of 36%; System II work rate have a reduction of 26%; System III work rate have a reduction of 20% (Fig. 3).

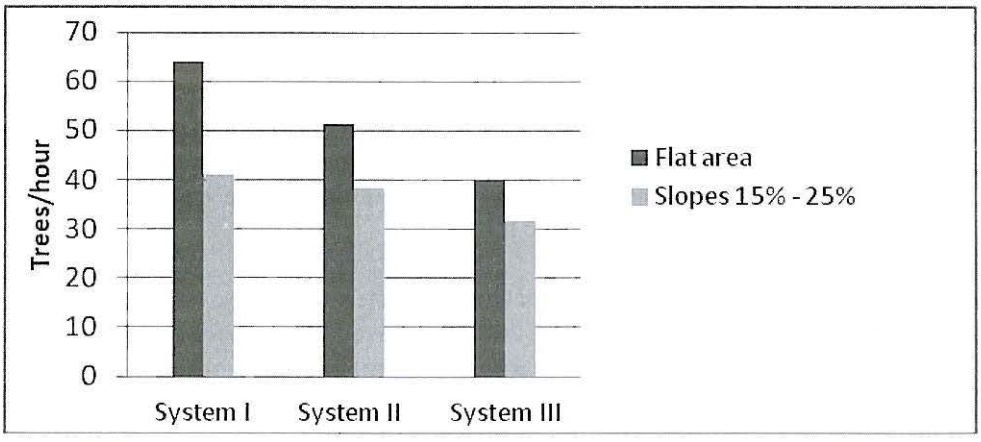

Figure 3. Average work rate results in traditional orchards according slopes

3.2 High density olive orchards

The reduced space between trees along lines does not allow the inverted umbrella work or a satisfactory work of conventional mechanical rolling canvas.

A specific mechanical rolling canvas has been designed to collect olives detached by trunk shakers. The performance achieved is 40 to 50 trees per hour [Peça, 2008].

3.3 Hedgerow olive orchards

In this kind of olive orchards, harvesting is a continuous work, row by row.

Olives are harvested and collected simultaneously, using an overrow equipment. In this case, expected performance is 3 to 3.5 hours per hectare.

4. Conclusions

4.1 Traditional olive orchards

Experiments and their evaluation show that the most suitable system is the trunk shaker (to detach olives) combined with the inverted umbrella (to collect detached olives) [Almeida, 2007a]. Despite the performance is not the best, it needs the minimum of manpower and the costs by production harvested are lower.

The system using the spike rotor in conjunction with hand shakers may be regarded as a useful tool for olive harvesting of trees with large canopies (volume between 100 m^3 and 200 m^3 and the trunk diameter between 2 m and 3.5 m), bearing in mind that values close to 100% of detachment can be reached and that for such trees trunk shakers are inadequate. However, to make operational costs competitive it is important to improve work organization and above all to increase olive production on these traditional olive orchards. In the former aspect, the increase in the number of hand held shakers concentrated in lower branches should be envisaged in the near future.

Some of these old traditional olive orchards with autochthonous cultivars with large canopies are able to produce high quality olive oil, factor of a great importance in a so competitive market.

4.2 High density olive orchards

In this case the most suitable harvesting system includes a trunk shaker with the specific mechanical rolling canvas referred. The performance can be greatly improved if two rows are harvested simultaneously, using one trunk shaker and two mechanical rolling canvas.

In these two types of olives orchards - traditional olive orchards and high density olive orchards, trees are harvest one by one - the most important factor affecting performance is the operational time to move equipment from

one tree to the next. In order to get a better performance a good trafficability conditions for equipment is needed. This objective can be achieved by an adequate soil management that reduces the soil water content in harvesting season.

4.3 Hedgerow olive orchards

The continuous harvesting system with an overrow equipment is by now the recommended procedure. This harvesting system requires a tree below a certain height, width, and with trunk access or clearance below the canopy for the fruit catching frame. It is not been fully demonstrated that the topping, hedging and hand pruning required to maintain the adequate tree size will produce annual economic crops [Ferguson, 2006].

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