Assessment of the Oli-Picker Harvester in Northeast Portugal

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Abstract

Trunk and bough shakers are common equipment for olive harvesting, and therefore information about their performance is becoming available. For less common equipment like canopy shakers, there is a lack of information relative to their field work capacity. The Oli-picker harvester is commercially available, and operates brushing the tree canopy with a spiked cylindrical comb mounted on a hydraulic articulated arm, making possible operation, inside or around the olive tree crown. This paper presents results from three years of observation of the Oli-picker harvester in Trás-os-Montes (northeast of Portugal), including the methodologies of work followed in the field, the work rates found and expected costs.

INTRODUCTION

The Oli-picker harvester is commercially available, and operates brushing the tree canopy with a spiked cylindrical comb (Fig. 1) mounted on a hydraulic articulated arm, making possible operation, inside or around the olive tree crown. In contrast to trunk shakers the Oli-picker is unusual in Portugal, and therefore not much information related to this equipment is available.

Previous field observations, over a period of two campaigns (Almeida, 2007) revealed work rates of 10 to 25 trees per hour depending on the work methodology and canopy volume, which is a modest result compared to the 50 to 80 trees per hour of trunk shaker based harvesting systems (Almeida, 1999; Peça, 2002). However, the advantage of the Oli-picker relative to trunk shakers can be found in large trees common in old traditional orchards of the northeast of Portugal, Spain and Italy. In such large trees trunk shakers are not efficient (Peça, 2002) or simply impossible to use due to trunk diameter.

This paper adds up the results of a third harvest campaign with the Oli-picker and makes an attempt to present harvesting costs in olive orchards with trees unsuitable for trunk shaking.

MATERIAL AND METHODS

The Oli-picker is mounted in the back of a 59 kW agricultural tractor, which provides pto power for the hydraulic power pack of the equipment. A spiked cylindrical comb which can turn round its axle provides the brushing action to detach olives. The comb is mounted at the end of an articulated arm, allowing freedom to brush the canopy around or inside the tree crown (Figs. 2 and 3). Main characteristics are in Table 1.

The Oli-picker was observed in traditional olive orchards of Trás-os-Montes. These are orchards without irrigation, and mainly with large trees of three main cultivars: 'Verdeal Transmontana', 'Cobrançosa' and 'Madural'.

Field observation showed two different methods of work organization. Work rates were measured for both methods.

Work method 1 - The Oli-picker is positioned in the field (station) to make possible to reach one or two trees (in a few occasions four trees) from that particular station (Fig. 2). Different stations were required to complete the harvest of a single tree. At the same time four labourers shake the canopy with long wood poles, to complete the harvest of each tree.

Work method 2 - For a particular tree (sometimes a pair of trees), the Oli-picker is

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positioned in a single station. It will only be moved from that station after the tree had been totally harvested. To assist in the detachment of fruits out of reach three labourers shake the canopy with long wood poles while a fourth labourer operates a mechanical branch shaker (Fig. 3).

In both methods olives were collected on 10×10 m canvas placed under the canopy projection of each tree by more four labourers.

An average of 50 days at 7 hours/day of work is assumed to be the average within the harvesting season, which spreads from November till January.

To evaluate the annual total costs of the Oli-picker a purchasing price of 24000 € was assumed and 10 years of expected life. Table 2 show the different items of the total annual costs spread according to annual use.

The annual costs of other equipment and labour were also assumed as follows:
- 10 canvas (10×10 m) at 80 €/year;
- 3.5 ton trailer at 2.87 €/hour (300 hours of total annual use);
- Tractor 1 (59 kW) to support the Oli-picker at 30 €/hour (800 hours/year);
- Tractor 2 (40 kW) for trailer work at 25 €/hour (800 hours of total annual use);
- 8 men at 40 €/day/man.
- Mechanical branch shaker at 120 €/year;

Costs were evaluated for method 2, according to the following equation:

$$C = \left(\frac{CT1 + CT2 + TC}{WR} + \frac{OC + CC + SC}{TNT} + \frac{8 \times LC}{WR \times HWD} \right) \times \frac{1}{OPT} \quad (1)$$

where: C - cost/kg of olives harvested; CT1 - cost/hour of tractor 1; CT2 - cost/hour of tractor 2; TC - trailer cost/hour; OC - Oli-picker cost/year; CC - canvas cost/year; SC - mechanical branch shaker cost/year; LC - labour cost/day; WR - Oli-picker work rate; TNT - total number of trees harvested/year; HWD - hours of field work/day; OPT - olive production per tree.

RESULTS

The work rates found in field observations method 1 and method 2 are shown in Figure 4. The work rate is 10 to 15 trees per hour in method 1 and 13 to 24 trees per hour in method 2. The lower values of each interval are associated to observations in olives orchards with predominantly large canopy trees.

Since the Oli-picker can only compete with other mechanized harvesting systems in olives orchards with old large trees, work rates of 10 to 13 trees per hour will be considered to estimate harvesting costs. Taking into account the harvesting period of 350 hours and the above mentioned work rates, three scenarios of 500, 2000 and 4000 trees were considered for the number of trees to be harvested annually. In field observations the olive production per tree varied between 15 to 30 kg. Furthermore it was observed that either in method 1 or method 2, the team of men and machinery spread their action over the entire tree canopy, making work rates more influenced by the canopy size than by the quantity of olives present (olive production).

Costs evaluated by equation (1) for method 2, are presented on Table 3.

DISCUSSION AND CONCLUSIONS

The Oli-picker in conjunction with hand shakers may be regarded as a useful tool for olive harvesting of trees with large canopies, bearing in mind that values close to 100% of detachment can be reached and that for such trees trunk shakers are inadequate (Almeida et al., 2007). 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, and a proposal for a R&D project put forward accordingly.

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Tables

Table 1. Oli-picker main characteristics.

Maximum height (m)	8,5
Reach (m)	6,8
Total weight (kg)	600
Rotor length (m)	1,5
Rotor brush pairs	83

Table 2. Oli-picker annual costs.

Machine annual use (hours)	Machine expected life (years)	Depreciation (€)	Interest (€)	Repairs and Maintenance (€)	Other operating costs (€)	Total annual cost (€)
50	10	2400	60	50	250	2760
100	10	2400	60	100	250	2810
150	10	2400	60	150	250	2860
200	10	2400	60	200	250	2910
300	10	2400	60	300	250	3010
400	10	2400	60	400	250	3110

Table 3. Cost/kg of olives harvested according to Oli-picker work rate and olives produced per tree.

WR (trees/h)	TNT	CT1 (€)	OC (€)	CT2 (€)	TC (€)	CC (€)	SC (€)	Product./ tree (kg)	LC (€)	HWD (h)	Cost/kg (€)
10	500	30	2760	25	2,87	80	120	15	40	7	1,1
10	2000	30	2910	25	2,87	80	120	15	40	7	0,8
10	4000	30	3110	25	2,87	80	120	15	40	7	0,7
10	500	30	2760	25	2,87	80	120	30	40	7	0,5
10	2000	30	2910	25	2,87	80	120	30	40	7	0,4
10	4000	30	3110	25	2,87	80	120	30	40	7	0,4
13	500	30	2760	25	2,87	80	120	15	40	7	0,9
13	2000	30	2860	25	2,87	80	120	15	40	7	0,6
13	4000	30	3010	25	2,87	80	120	15	40	7	0,6
13	500	30	2760	25	2,87	80	120	30	40	7	0,5
13	2000	30	2860	25	2,87	80	120	30	40	7	0,3
13	4000	30	3010	25	2,87	80	120	30	40	7	0,3

Figures

Fig. 1. Oli-picker spiked comb.

Fig. 2. Oli-picker can detach olives efficiently in big trees.

Fig. 3. Oli-picker and a mechanical branch shaker working simultaneously.

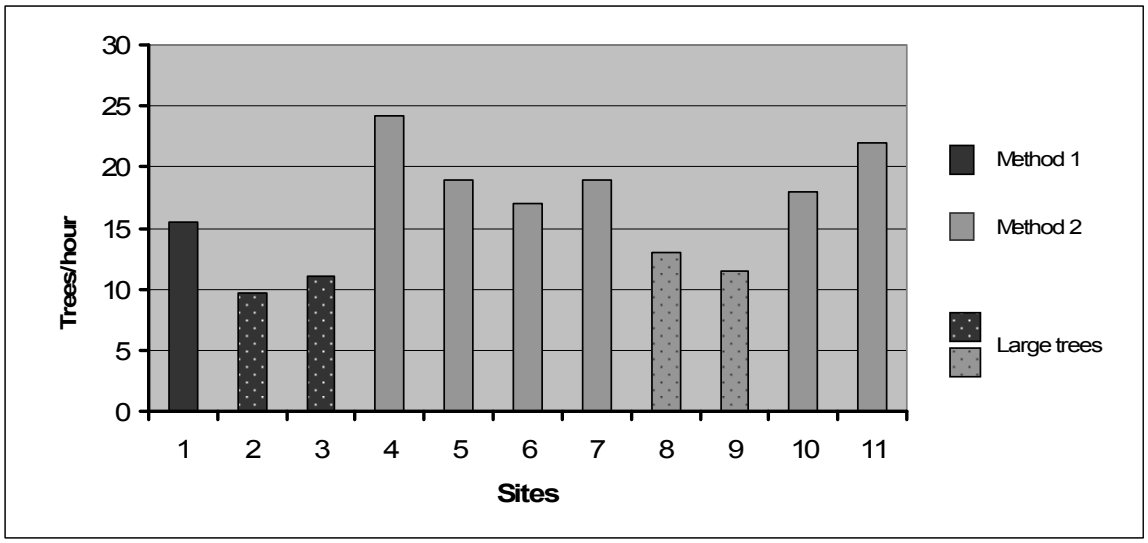

Fig. 4. Work rates considering different methods of work organization and canopies dimension.