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ORIGINAL SCIENTIFIC PAPER

Advances on crop operations for olive production

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Abstract

In the last decades Portuguese olive growers spent a substantial part of their gross return to face costs of manually cultural practices, due to high price of labour. The mechanization of field operations has been the solution for this problem. As a result of research, transplanters with laser systems, pruning equipment and mechanical harvesters are becoming usual on olive growing. However the price of these equipments is high. In order to make the production competitive in a global market a careful equipment management is required.

Key words: mechanization, olive production, Portugal.

Introduction

Olive crop is in a critical situation due to low product price and high production costs. Labour is one of these high costs due to shortage of manpower. Low mechanization level penalizes the sector. The social economic importance of olive table and olive oil justifies the mechanization of field operations such as transplanting, pruning and harvesting. Transplanters guided by laser systems allow an excellent row alignment (mandatory on hedgerow orchards) can achieve work rates from 600 to 700 plants per hour. Pruning equipment in field trials showed work rates from 200 to 300 trees per hour. For mechanical harvesting different types of olive orchards must be considered: traditional (<150 trees per hectare) with work rates from 40 to 70 trees per hour, high density olive orchards (300 to 400 trees per hectare) with work rates from 40 to 50 trees per hour and hedgerow olive orchards (1000 to 2000 trees per hectare) with work rates from 3 to 3.5 hours per hectare.

Material and methods

Transplanting

Experiments took place in the Trás-os-Montes olive production region in Northeast of Portugal, in a hedgerow olive orchard of Arbequina, Cobrançosa and Negrinha cultivars – spacing: 4 m x 1.35 m.

The transplanter (Fig. 1) opens a ditch, place a tutor, plant is placed manually, applies 1 to 4 litres of water per plant and closes the ditch.

Perfect row alignment is guaranteed by a satellite receiver that sends information to the equipment. The perfect alignment is necessary for this kind of olive orchard.

Pruning

Experiments took place in Alentejo olive production region in South of Portugal in traditional olive orchards of Galega cultivar – spacing: 10 m x 8 m and in irrigated olive orchards of Picual cultivar – 7 m x 3.5 m (Dias, 2012).

A disc-saw mounted on the front loader of a tractor (Fig. 2). Experiments included four treatments: no pruning; manual pruning; mechanical pruning by topping and hedging canopy East side; and by topping and hedging canopy East and West side.



Figure 1. Mechanical transplanter



Figure 2. Mechanical pruner



Figure 3. Mechanical rolling canvas



Figure 4. Inverted umbrella

Harvesting

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

Different types of olive orchards were considered:

In the traditional olive orchards (<150 trees per hectare), three treatments were experimented: trunk shakers mounted on the front loader of a tractor was used to detach olives, collected by canvas manually moved or by mechanical rolling canvas (Fig. 3) or by an inverted umbrella (Fig. 4) mounted on the front loader of a tractor (combined with the shaker) (Almeida, 2007a).

In this kind of olive orchards when trees have a big crown, not suitable for trunk shakers, a spike rotor (Fig. 5) is an useful equipment (Almeida, 2007b).

In high density olive orchards (300 to 400 trees per hectare), specific rolling canvas equipment has been designed to collect olives detached by trunk shakers (Fig. 6).

In hedgerow olive orchards (1000 to 2000 trees per hectare) (Fig. 7), olives harvesting and collecting are simultaneously, using an overrow equipment (Fig. 8).



Figure 5. Rotor for fruit detachment



Figure 6. Rolling canvas for high density olive orchards



Figure 7. Hedgerow olive orchard



Figure 8. Overrow harvester for hedgerow olive orchards

Results and discussion

Transplanting

Medium work rate is 500 trees per hour, with a minimum of 300 trees per hour and a maximum of 650 trees per hour.

Work rate depends mainly on the planting distance in the line. Different distances allow different work speed (Table 1).

Table 1. Effect of planting distance in the line on work speed

Line planting space (m)	Work speed (km h ⁻¹)
1,35	1,1 – 1,3
3,0	2,0 – 2,1
5,0	2,5

Other factors influencing work rate are soil conditions and the time needed to turnover in the top of the lines. Soil must be in physical good conditions. A stony soil turns the work more difficult and slow down work rate. Enough space for turnover is needed for a better performance, as well an area shape that reduces the number of turnovers.

Pruning

Work rate show a great difference between manual pruning – 11.7 trees h⁻¹ man and mechanical pruning – 327.3 trees h⁻¹ man for mechanical pruning by topping and hedging canopy East side and 211.8 trees h⁻¹ man for by topping and hedging canopy East and West side (Dias, 2012).

However to maintain a good production, manually intervention is needed combined with

mechanical interventions.

There are no significant differences on yield between treatments.

Harvesting

In the traditional olive orchards field tests show a performance of 40 to 70 trees per hour. (Almeida, 2007a) In this kind of olive orchards when trees have a big crown, not suitable for trunk shakers, a spike rotor is a useful equipment, despite the lower performance – 12 to 25 trees per hour (Almeida, 2007b).

In high density olive orchards, a 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). The reduced space between trees along lines does not allow the inverted umbrella work.

In this kind of olive orchards harvesting procedure is tree by tree. 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.

In hedgerow olive orchards, olives harvesting and collecting are simultaneously, using an overrow equipment. In this case, expected performance is 3 to 3.5 hours per hectare.

In this kind of olive orchards, harvesting is a continuous work, row by row, not tree by tree.

Conclusions

Mechanization of these three field operations allows reducing operational time. Lower costs can be a consequence, but to achieve this goal, a careful machinery management is needed. In fact for these seasonal operations and considering that the equipment has high acquisition cost, it must have an intensive work activity. In small property regions the equipment used in common, have to be considered.

Transplanters became very important for hedgerow olive orchards because alignment must be precise, otherwise mechanical harvesting can jeopardize production. Transplanters with satellite guiding are able for a perfect alignment. A convenient soil preparation is necessary to order to assure an optimum adhesion of the root apparatus to the soil (Salvatore, 2010).

Field tests mentioned show that mechanical pruning does not influence yield per tree. It is now important to know if this is true for how many years (Dias, 2012).

For mechanical harvesting in traditional olive orchards experiments show that the most suitable system is the trunk shaker (to olives detachment) combined with the inverted umbrella (to collected olives detached) (Almeida, 2007 a).

Mechanical harvesting in high density olive orchards the most suitable harvesting system includes a trunk shaker with a mechanical rolling canvas.

For the 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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