Work Safety and Risk Prevention in Mechanical Harvesting of Olives

Almeida A.
Escola Superior Agrária de Bragança - Centro de Investigação de Montanha
Apartado 1172 – 5301-855 Bragança - PORTUGAL
E-mail: acfa@ipb.pt

Abstract

The Northeast of Portugal is a mountainous region with an important olive production. Slopes difficult mechanical harvesting, being necessary to adopt strategies to face the problem. Special trajectories to move the harvesting equipment inside olive orchards are necessary when slopes increase the risk of accidents. These solutions are necessary for a safe work, but can jeopardize the equipment performance. Some of the solutions adopted are described, and consequences evaluated.

Keywords: mechanical harvesting; olives, slopes

Introduction

In Portugal one of the most interesting zones for olive production is located in the Northeast of the country (Trás-os-Montes region).

The olive oil has excellent quality and assumes a high economic and social importance.

The mechanization of harvesting is adopted by significant number of olive producers.

The region is mountainous. The majority of olives orchards are placed in soils with significant slopes, sometimes superior to 15%.

This factor increases dramatically the risk of accidents with the equipment for mechanical harvesting, jeopardizing the work safety.

The objective is to reveal some solutions adopted for a safe work and evaluate the consequences in work rates.

Field tests carried out to compare three different systems to mechanize olive harvesting: System I, System II and System III. In all of them a trunk shaker detaches olives. The difference is in the collecting procedure. In System I olives are collected by canvas placed under the trees and moved by labourers. In System II a mechanical rolling canvas was used to collect olives. In System III olives detached are collected on an inverted umbrella.

System III revealed to be the most advantageous when not enough labourers are available for System I.

All of the systems need special attention when working in slopes, with emphasis on System III.

In slopes superior to 15% alternative trajectories are necessary for a safe work, with consequences in work rates.

Material and methods

Olive orchards

Field trials carried out in seven traditional olive orchards (sites) over three years. Traditional olive orchards vary from 100 to 150 trees per hectare. Three of the olive orchards are in Trás-os-Montes region and four are in Alentejo region. A total of 1768 trees were used in the field trials.

In Alentejo olive orchards are placed in flat areas. Olive orchards in sloping areas are in Trás-os-Montes.

In Trás-os-Montes there are three main cultivars: Cobrançosa, Verdeal and Madural, whereas in Alentejo, Galega is the main cultivar.

Harvesting systems

The mechanical harvesting systems studied are based on a trunk shaker mounted on the front loader of a 60kW four wheel drive tractor. Three different systems were used to collect olives detached.

The experimental design was a randomized complete block with three treatments (system I, II and III) and three replications.

In system I (Fig 1) the olives detached are collected on a 10m × 10m canvas placed under the canopy projection, and moved by four labourers. In a parallel row, a second group was placing another canvas under the next tree to be shacked (Fig 2). A second tractor and trailer was standing by to collect the olives when canvas became too heavy, as well as to provide transport to the processing unit.

Figure 1 - System I

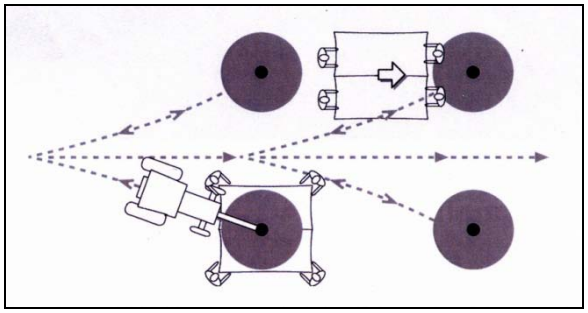

Figure 2 - System I: equipment trajectory

In system II (Fig 3) the olives detached are collected on a rolling canvas catching frame mounted on a second tractor. Two labourers are necessary to support the canvas movement. The canvas is made by two 4m × 8m separate parts, laid down on either side of the tree.

Figure 3 - System II

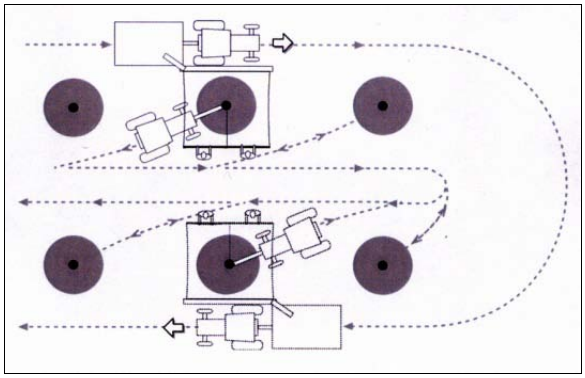

Figure 4 - System II: equipment trajectory in light slopes or flat soils

In system III (Fig 5) the olives detached are collected by a 9 m diameter inverted umbrella linked to the tractor front-end-loader under the trunk shaker frame. The inverted umbrella can store temporarily 200/250 kg of olives in a collecting tray. Under the collecting tray a lead may be hydraulically open to allow discharge of the olives.

Figure 2 (System I), Figure 4 (System II) and Figure 6 (Systems III) show the equipment work progression in olive orchards placed in flat soils.

Figure 5 - System III

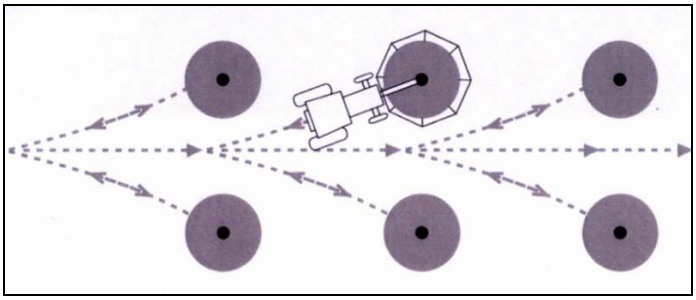

Figure 6 - System III equipment trajectory in light slopes or flat soils

In olive orchards placed in slopes between 15% to 25% alternative trajectories are needed.

With System II, the rolling canvas catching frame is mounted on the left side of the tractor. In consequence, 62% of the total weight (4455kg) is on that side of the tractor. To ensure a safe work the equipment follows the contour lines, with the rolling canvas always in the higher operation zone (Fig 7). To maintain this work methodology, when harvesting finish in one tree line, to change to the next, the equipment must go backwards for the beginning of the next line, instead of simply 180º turning.

With System III, to guaranty a safe work, the equipment must move through trajectories perpendicular to contour lines (Fig 8). In this system, 70% of the total weight is on the front side of the tractor.

With System I work in slopes did not require different trajectories, but more time to move between trees. It is necessary a lower velocity.

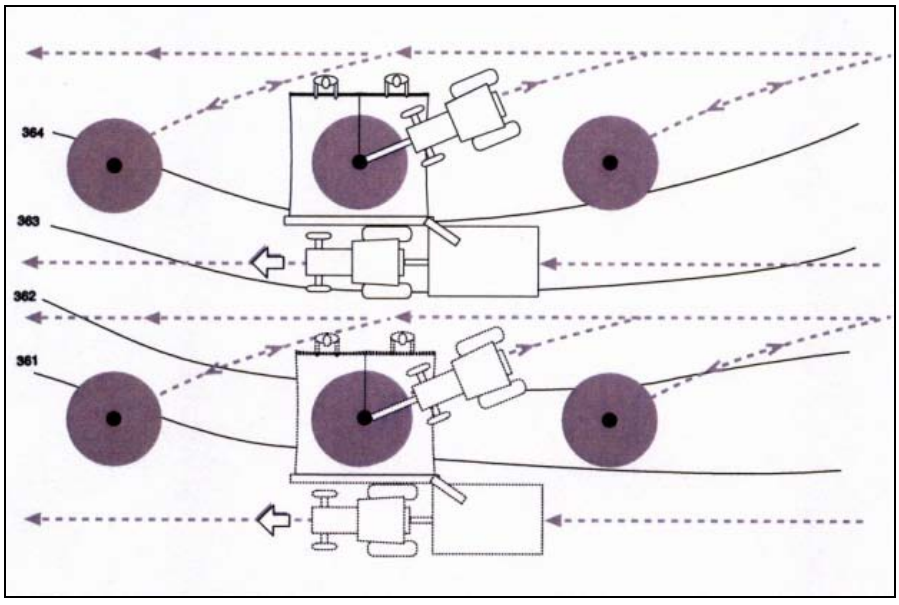

Figure 7 - System II equipment trajectory in slopes.

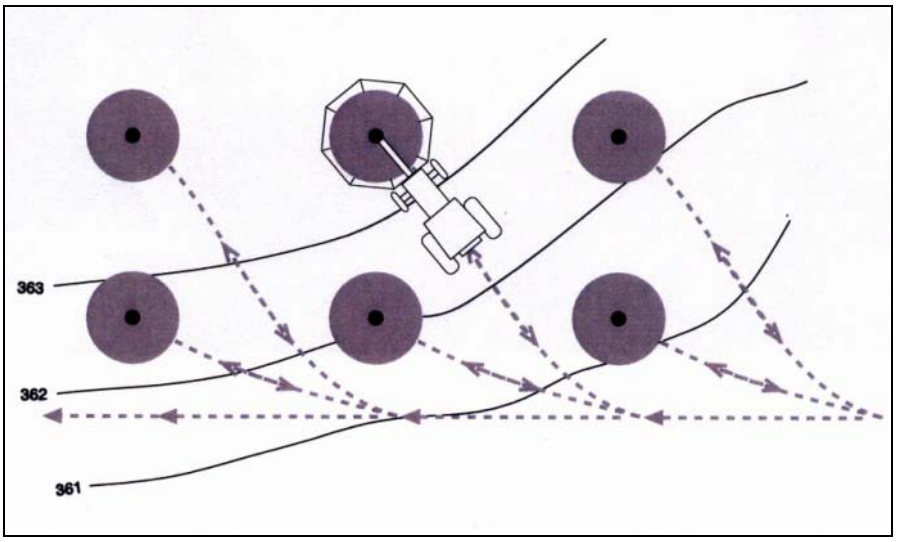

Figure 8 - System III equipment trajectory in slopes.

Results

Tables 1 and 2 show the work rates results, per system and site.

Table 1 – Olive orchards in flat areas: work rates (trees/hour)

Olive Orchards	System I	System II	System III
Site 1	57	43	36
Site 2	80	51	47
Site 3	39	47	34
Site 4	80	64	42
Average	**64**	**51,25**	**39,75**
SD	19,88	9,11	5,91

Table 2 – Olive orchards in slopes (15% to 25%): work rates (trees/hour)

Olive Orchards	System I	System II	System III
Site 5	36	35	33
Site 6	46	42	36
Site 7	41	38	26
Average	**41**	**38,33**	**31,67**
SD	5	3,51	5,13

Conclusions

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%.

This fact, increase harvesting costs.

We used different olive orchards to collect data (in slopes and in flat areas), so we cannot know degree of responsibility of slopes in the work rates decrease, but we assume that slope has an important role in this effect.

Knowing that, olive growers can adopt the alternative trajectories to guaranty a safe work, if the olive oil quality pays the more expensive harvesting in these situations.

References

Almeida, A.; Peça, J. 2007. Performance of three mechanical harvesting systems for olives in Portugal. Proceedings of 35th International Symposium - Actual Tasks on Agricultural Engineering. Agricultural Engineering Department, Faculty of Agriculture, University of Zagreb, pp 461-466, Opatija, Croatia.

Michelakis, N. 2002. Olive Orchard Management: Advances and Problems. Proceedings 4th International Symposium on Olive Growing, Acta Horticulturae Nº 586 pp 239-245, ISHS, Valenzano, Italy.