Evaluation of the influence of mechanical pruning in the performance of the Row-Side Continuous Canopy Shaking Harvester Prototype

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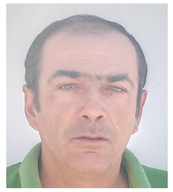


Introduction, context and objectives

In high density olive orchards, mechanical harvesting is made by trunk shaking requiring a high demand of manual labour. The use of over-the-row grape harvesters is not available in these groves due to large canopies dimension. The row-side canopy harvester principle imposes fewer limitations on tree growth. Authors developed a prototype of a Row-Side Continuous Canopy Shaking Harvester - RSCCSH (Peça *et al.*, 2014). In a previous trial, the RSCCSH prototype had obtained an harvesting efficiency ranging between 70% and 76% of yield, without differences between the pruning treatments tested (Dias *et al.,*2020). The objective of this trial was the evaluation of different mechanical pruning solutions in the efficiency of the RSCCH prototype.

Mat & Methods

Tab.1 Olive orchard

Site	Variety	Irrigation	Plantation date	Array
Torre de Figueiras (39º 03' 34'' N; 07º 28' 22'' W)	Picual	Drip	1996	7m x 3.5 m

Tab. 2 Experimental design

Experimental design	Replications	Pruning block size
Completely randomised design	3	30 trees

Equipment

Fig. 1 "Topping" with disc-saw pruning machine

Fig. 2 "Hedging" with disc-saw pruning machine

Fig. 3 Manual pruning complement on the side faces of the canopy

Fig. 4 Side view of RSCCSH prototype

Fig. 5 RSCCSH prototype units working

Treatments

Tab. 3 Sequence of pruning interventions by treatment

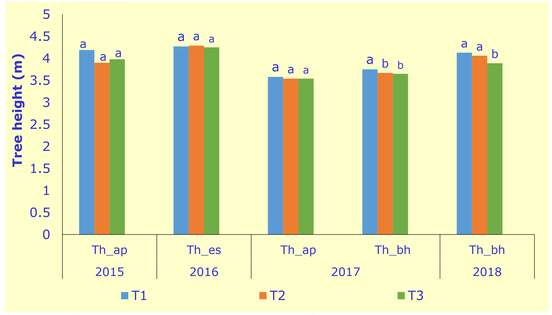
Treatment	2015	2016	2017	2018
1				
2				
3	+ Manual compl.		+ Manual compl.	

Legend: Manual compl. – manual pruning complement

topping + hedging 2 faces of canopy; topping + hedging 2 faces of canopy

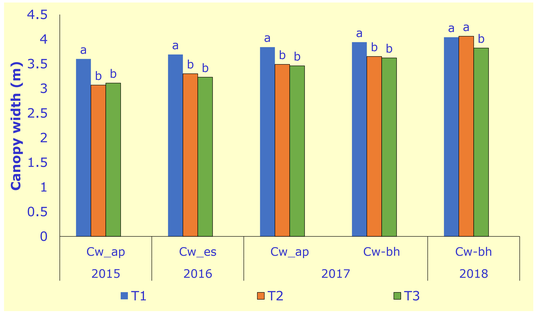
Note:
Topping: 2015 - at 3.5m high; 2017 – at 3.3m high;
Hedging: T1 – at 1.4 m from tree trunk;
T2 – at 1.0 m from tree trunk;
T3 – at 1.0 m from tree trunk.

Results



Legend: Th_ap – tree height after pruning; Th_es – tree height in early spring; Th_bh – tree height before harvest
Columns with the same letter are not significantly different - Duncan test at P ≤ 0,05

Fig. 6 Average tree height by treatment



Legend: Cw_ap – canopy width after pruning; Cw_es – canopy width in early spring; Cw_bh – canopy width before harvest
Columns with the same letter are not significantly different - Duncan test at P≤0,05

Fig. 7 Average canopy width by treatment

Tab. 4 Olive yield per tree from 2015 until 2018 (kg tree^{-1})

Treatment	2015	2016	2017	2018	Average by treatment
T1	25.4 a	24.7 a	14.7 a	27.8 a	**23.5 A**
T2	20.2 b	26.1 a	15.5 a	30.5 a	**23.1 A**
T3	23.4 ab	28.1 a	14.9 a	29.9 a	**23.7 A**
Average by year	**22.9 C**	**26.3 B**	**15.1 D**	**29.4 A**	**23.4**

Significant differences (P ≤ 0.05) between years in olive yield

On average, no significant differences (P>0.05) between treatments

Tab. 5 Harvester efficiency from 2015 until 2018 (%)

Treatment	2015	2016	2017	2018	Average by treatment
T1	84.9 a	86.9 a	77.2 a	77.2 a	**81.6 A**
T2	81.0 a	84.1 a	75.5 a	76.6 a	**79.3 A**
T3	79.1 ab	82.4 a	78.4 a	79.1 a	**79.7 A**
Average by year	**81.7 A**	**84.5 A**	**77.0 B**	**76.6 B**	**80.0**

Harvester efficiency:
Significant differences (P ≤ 0.05) between years:
- differences in the RSCCSH working parameters;
- differences in the canopy dimension.

No significant differences between treatments (P>0.05).

Conclusions and perspectives

Adequacy of olive canopy to RSCCSH prototype should consist on:
- topping below the upper limit of vibratory rotor (3.6 m);
- hedging the two faces of canopy with higher intensity (for example at 1.0m from tree trunk);
- remove exposed wood stumps on the sides of the canopy, manually; all in the first year;
A second topping should be performed two years later to control tree height.

Evaluation of other olive canopy shapes in RSCCSH efficiency: hedge training system and "modified" vase shape

References: Dias et al. (2020) Front. Plant Sci. 10:1631; Peça et al. (2014) Acta Hort. 1057, 391-397
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