Field testing and monitoring of newly designed airblast sprayers in traditional olive orchards


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Field testing and monitoring of newly designed airblast sprayers in traditional olive orchards

- Introduction
- Objectives
- Materials and Methods
- Results
- Conclusions
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Olive distribution

Olive harvested area (a) and olive production (b) in the main growing countries

Source: FAO (2014)
Olive in Spain

Olive harvested area per autonomous region in Spain (MAPAMA, 2015).

2.65 Mha
4.58 Mt

Olive harvested area in Andalusia (Junta de Andalucía, 2002).
Olive in Spain

Olive plantation systems in Spain
(AEMO, 2012)

74% Traditional
24% Intensive
2% Superintensive
Olive distribution

12 m
Olive distribution

Public administration

MecaOlivar

Olive oil sector

Public research organism
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Objectives

- To assess the work capacity and performance of the sprayers.
- To determine the liquid saving of the prototypes as a consequence of the spray sectorization.
- To assess the coverage produced by the sprayers in the canopy.
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Experimental field

$rs = 12\ m$

$ts = 10\ m$
Experimental field
Sprayers used

Conventional sprayer
Prototype P1
Prototype P2
Prototype P3
Sprayers used
Sprayers used
Sprayers used
Sprayers used
Sprayers used
Sprayers used
Sprayers used
Sprayer monitoring

**Electronic layout**

- **CR 3114** GPS/GSM modem
- **PA 3060** pressure sensor
- **CR 0403** PLC
- **CR 1200** screen
- **Rapid check** flow meter
Sprayer monitoring
Canopy characterization

Mean Vector (MV) method*

\[ MV = \frac{1}{8} \times \sum_{i=1}^{8} V_i \]

Canopy characterization

30 trees selected at random

\[ V_L = 47.364 \times MV - 56.666 \]

\( V_L \rightarrow \) Canopy volume calculated from LiDAR point cloud (m³)

\( MV \rightarrow \) Mean vector (m)
Canopy sampling

1 sampling position per tree (at random)

16 possible sampling positions per tree
Trial development
## Trial development

### Operational parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>P1</th>
<th>P2</th>
<th>P3</th>
<th>Commercial*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nozzle colour*</td>
<td>Black</td>
<td>Orange</td>
<td>Orange</td>
<td>Green</td>
</tr>
<tr>
<td>Number of open nozzles</td>
<td>18 (2 x 9)</td>
<td>36 (2 x 18)</td>
<td>34 (2 x 17)</td>
<td>14 (2 x 7)</td>
</tr>
<tr>
<td>Pressure (bar)</td>
<td>15</td>
<td>15</td>
<td>16</td>
<td>15</td>
</tr>
<tr>
<td>Liquid flow rate (L · min⁻¹)</td>
<td>60.5</td>
<td>60.8</td>
<td>59.2</td>
<td>59.8</td>
</tr>
<tr>
<td>Spray volume (L · ha⁻¹)</td>
<td><strong>907</strong></td>
<td><strong>912</strong></td>
<td><strong>887</strong></td>
<td><strong>897</strong></td>
</tr>
<tr>
<td>Forward speed (km · h⁻¹)</td>
<td>4.05</td>
<td>3.95</td>
<td>4.11</td>
<td>4.02</td>
</tr>
<tr>
<td>Air volumetric flow rate (m³ · s⁻¹)</td>
<td>2.8</td>
<td>12.7</td>
<td>12.7</td>
<td>12.7</td>
</tr>
</tbody>
</table>
Trial development

Liquid flow rate regulation

Tank concentration sampling

Real forward speed measurement

Weather conditions monitorization
Trial development
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Assessment of the work capacity and performance

Work capacity = \( \frac{\text{worked area}}{\text{working time}} \)

Sprayer Performance = \( \frac{\text{Effective working time}}{\text{Operation time}} \)
Assessment of the work capacity and performance

$WC = 2.7 \text{ ha h}^{-1}$

$WC = 2.7 \text{ ha h}^{-1}$

$WC = 3.0 \text{ ha h}^{-1}$
Liquid volume saving
**Liquid volume saving**

<table>
<thead>
<tr>
<th>Table</th>
<th>Diagram</th>
<th>Image</th>
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</table>
Liquid volume saving

Applied volume (L ha$^{-1}$)

![Bar chart showing liquid volume saving](chart.png)

- **Conventional (Conv)**
- **P2**
- **P3**

Error bars: 95% CI

- **a**: $-6.0\%$
- **b**: $-5.9\%$
Spray coverage

Percentage coverage (%)

![Bar chart showing percentage coverage for different sprayers with error bars indicating 95% CI. The chart includes sprayer types C, P2, and P3, with varying percentage coverage values.](chart.png)
Spray coverage

Percentage coverage (%)
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Conclusions

- Good results in spray applications in olive require the adaptation of the spraying machinery.

- The developed prototypes could work in real field conditions over a 30 ha total area, showing their reliability.

- The P3 prototype increased the working capacity by reducing the filling time.

- The prototypes generated a significant volume save, but it was not very important in practice.

- The spray coverage was significantly increased by the prototypes, and specially in the upper positions.

- The proper adjustment of these sprayers can be a first step to improve pesticide applications in olive, but variable application technology must be added.
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Thanks for your attention!


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