PERFORMANCES EVALUATION OF DIFFERENT VERTICAL PATTERNATORS

Introduction

Vertical patternator

Can be useful to evaluate the vertical distribution of sprayers for bush and tree crops

Sprayer adjustment at the inspection workshop

ISO/FDIS 16122-3
Introduction

ISO/FDIS 16122-3 (2014) Par. 4.9.3.3:

“Optional vertical distribution information.

In order to provide the owner/operator with further information in addition to 4.9.1 and 4.9.3.1 to 4.9.3.2, the **vertical spray distribution information** may be **provided** for example by measurement, **using a vertical patternator**, or by other visualization means.

**NOTE**: Test method and vertical patternator specifications are still under development.”
Introduction

At present different types of patternators are used in the workshop

But generally there are no indications about their technical performances !!
Tests main purpose:

To define methodology and criteria for the vertical patternator evaluation
Materials and methods:

- Use of 5 Patternator types

- Use of different types of spray:
  a) Droplets size
  b) Air speed and direction
The five patternators used:

**Vertical patternator 1) steel plate**

- **Height**: 3320 mm
- **Width**: 1000 mm
- **Vertical resolution**: 100 mm
- **Height of the first collector from the ground**: 455 mm

Three vertical arrays of collectors.

**Dimensions of collectors:**

- **Length**: 300 mm
- **Width**: 100 mm
- **Height**: 3320 mm
The five patternators used:

**Vertical patternator 2) steel plate**

- Height: 3060 mm
- Width: 640 mm
- Vertical resolution: 200 mm
- Height of the first collector from the ground: 465 mm

Two vertical arrays of collectors.

**Dimensions of collectors:**

- Height: 3060 mm
- Width: 640 mm
- Vertical resolution: 200 mm
- Height of the first collector from the ground: 465 mm
The five patternators used:

**Vertical patternator 3) plastic plate**

- Height: 3200 mm
- Width: 640 mm
- Vertical resolution: 200 mm
- Height of the first collector from the ground: 500 mm

Two vertical arrays of collectors.

**Dimensions of collectors:**

- Height: 3200 mm
- Width: 640 mm
- Vertical resolution: 200 mm
- Height of the first collector from the ground: 500 mm
The five patternators used:

**Vertical patternator 4) lamellae**

Height: 3500 mm  
Width: 1800 mm

Vertical resolution: 100 mm (liquid is collected in one tube every 3 grooves)

Height of the first lamella from the ground: 455 mm
The five patternators used:

5) horizontal patternator ISO 5682

Groove width: 100 mm
Groove depth: 200 mm
Groove length: 2000 mm
Hollow cone nozzles used:

<table>
<thead>
<tr>
<th>Nozzles</th>
<th>Type</th>
<th>Flowrate (l/min)</th>
<th>D50 (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TXB 8001 VK</td>
<td>Standard</td>
<td>0.68</td>
<td>70</td>
</tr>
<tr>
<td>TXB 8002 VK</td>
<td>Standard</td>
<td>1.44</td>
<td>80</td>
</tr>
<tr>
<td>TXB 8004 VK</td>
<td>Standard</td>
<td>2.75</td>
<td>105</td>
</tr>
<tr>
<td>AITXB 8001 VK</td>
<td>Air induction</td>
<td>0.70</td>
<td>245</td>
</tr>
<tr>
<td>AITXB 8002 VK</td>
<td>Air induction</td>
<td>1.45</td>
<td>380</td>
</tr>
<tr>
<td>AITXB 8004 VK</td>
<td>Air induction</td>
<td>2.75</td>
<td>460</td>
</tr>
</tbody>
</table>

Pressure used: 10 bar
The five patternators used:

The equipment used for spraying:

- Tangential fan with only one active nozzle

Distance between the nozzle and the patternator surface: 800 mm
Test description:

Tangential fan with only one active nozzle

Patternator

Tangential fan

Patternator

Tangential fan

800mm

30°

800mm
Test description:

Patternators static and spray unit moving

Patternator and spray unit static

V = ~60 mm/s measured each time

3 replicates for each test
Air speed and direction:

Tangential fan used in two operating modes:

Mode A- With the spraying nozzle and the air flow **perpendicular** to the patternator’s surface

Mode B- With the spraying nozzle and the air flow **rotated 30° vs. the vertical axis**

3 different air velocity measured on the patternator:
- 5,0 m/s
- 8,2 m/s
- 12,5 m/s
Materials and methods:

Vertical patternator performance has been evaluated in terms of

- Recovery capacity
- Reproducibility of the recovery capacity results
- Spray profile reproducibility
Recovery Capacity (RC) = measured amount of liquid collected by the patternator / sprayed amount of liquid

Patternator 1-2-3

\[ RC = \frac{\sum_{i=1}^{n} a_i / s}{Q \times t} \]

where:
- \( a_i \) is the amount of liquid collected in each tube (ml);
- \( s \) is the number of passes of the spray unit in front of the patternator;
- \( Q \) is the flow rate sprayed, expressed in ml/sec
- \( t \) is the time (sec) spent by the spray unit in front of the collector

Patternator 4-5

\[ RC = \frac{\sum_{i=1}^{n} a_i}{Q} \]

where:
- \( a_i \) is the amount of liquid collected in each tube and expressed in ml/min;
- \( Q \) is the flow rate sprayed, expressed in ml/min
Materials and methods:
Reproducibility of recovery capacity

Calculation of Coefficient of Variation between values of recovery capacity obtained in the different test replicates
Materials and methods: Reproducibility of spray profile

Spray Profile Index

\[ SPI = \sum_{i=1}^{n} (\text{max} - \text{min}) \]

0 < SPI < 1

Low value = very similar profile
High value = not similar profile
Test results: Recovery capacity

Air velocity: 8,2 m/s

Droplet size effect

Perpendicular air flow
Test results: Recovery capacity

Air velocity: 8,2 m/s

30° rotated air flow

Droplet size effect
Test results: Recovery capacity

Nozzle: TXB 80 04 VK (VMD = 105 µm)

Perpendicular air flow

Air velocity effect
Test results: Recovery capacity

Nozzle: AI TXB 80 04 VK (VMD = 460 µm)  
Perpendicular air flow

Air velocity effect
Test results: Reproducibility of recovery capacity

Air velocity: 8.2 m/s

Perpendicular air flow
Test results: Reproducibility of recovery capacity

Air velocity: 8.2 m/s

30° rotated air flow
Air velocity: 8.2 m/s

Perpendicular air flow

Test results: Reproducibility of spray profile
Test results: Reproducibility of spray profile

Air velocity: 8.2 m/s

30° rotated air flow
1) The criteria applied for the evaluation of the vertical patternator performance seemed able to discriminate the differences between the five types tested

2) Considerable effect of the droplets diameter (highest spray recovery with medium / coarse drops)

3) Low effect on spray recovery of the air velocity values used in the experiments
4) Acceptable data reproducibility (CV ≤ 20%) with all the test bench assessed

5) Spray profile detected on the different vertical patternator types examined resulted generally similar
6) First experimental data, need to carry out further investigations (e.g. using axial fans and nozzles positioned on semi-circular booms)

7) Possibility to use these first data for starting the development of SPISE Guidelines about a ‘test methodology and requirements for vertical patternator’
Thank you for your attention