INTERNATIONAL STANDARD

ISO 22522

First edition
2007-04-01

Crop protection equipment — Field measurement of spray distribution in tree and bush crops

Matériel de protection des cultures — Mesurage au champ de la répartition de la pulvérisation pour arbres et arbustes fruitiers

Reference number
ISO 22522:2007(E)

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Published in Switzerland

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 22522 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 6, *Equipment for crop protection*.

Crop protection equipment — Field measurement of spray distribution in tree and bush crops

1 Scope

This International Standard is applicable to the field measurement of quantities of spray deposit, applied using ground sprayers, on tree and bush crops.

It covers measurements of the volume or mass of spray deposits (both absolute and distribution) on target structures such as leaves, fruits and ground losses.

It does not deal with spray drift measurements. However, its use in combination with the protocol for field measurements of spray drift given in ISO 22866 can result in a good evaluation of spray mass balance in tree or bush spraying when measuring airborne drift.

This International Standard allows for flexibility in the arrangement of field tests, specifying standardized measurement procedures that are useful for comparison of the results from different field experiments or laboratory tests, for example, using a vertical patternator.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 9898, *Equipment for crop protection — Test methods for air-assisted sprayers for bush and tree crops*

ISO 10627-1, *Agricultural sprayers — Data sheet — Part 1: Typical layout*

ISO 10627-2, *Hydraulic agricultural sprayers — Data sheets — Part 2: Technical specifications related to components*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
plot
one or several adjacent rows to be sprayed

3.2
tracer
traceable material representing a plant protection product formulation

4 Elements of a test

A spray distribution test comprises the application of a tracer to the canopies by travelling at a measured forward speed along defined tracks, and the measurement of spray deposit on the target canopy (leaves and/or fruits), if available and/or appropriate structures (artificial targets), to determinate the spray cover and collectors for the measurement of ground losses.

An appropriate tracer in a water solution may be used for field measurements. Where possible, all measurements shall use a tracer of low toxicity that can be safely applied with no associated risks of environmental contamination. The spray liquid shall have physical properties representative of liquids typically used in the application of plant protection products. Other products that can be added to more closely mimic an actual pesticide solution, such as surfactants, should be described in the test report.

Tracers that allow several applications on the same target can be used to decrease variability attributable to structural changes within the sampled biological targets.

5 Trial design

The plots shall be located inside a uniform, representative and well cared for orchard.

In order to prevent interactions with other treatments and/or edge effect, at least two further rows of trees or bushes shall be present on each side of the plot.

An appropriate length of rows shall be sprayed, on one or both sides. This length shall ensure the output of the intended spray volume over the plot.

Details of the spraying layout shall be fully reported within the results.

6 Description of sprayer settings

At least the following items shall be described.

a) Sprayer:

- manufacturer;
- type and model;
- travel speed (km/h);
- overall liquid flow rate (l/min).

b) Nozzles and liquid distribution:

- one side (left or right) or two-sided application;
- working pressure (MPa);
- nozzles characteristics and positions (see Table 1 and Figure 1);
- position of nozzles in relation to the air stream (in or out);
- nozzle flow direction (front, central or rear);
- droplet size data (D_{v10}, D_{v50}, D_{v90}) for hydraulic nozzles (including the measuring system).

c) Air flow distribution (for air-assisted sprayers):

— fan type;

— gear position;

— PTO (power take off) speed (min^{-1});

— rotation direction – clockwise or anticlockwise (counter-clockwise);

— deflector characteristics (air-directional) description according to ISO 10627-1 and ISO 10627-2 (see Table 2 and Figure 2);

— air speed and airflow rate of the sprayer according to ISO 9898.

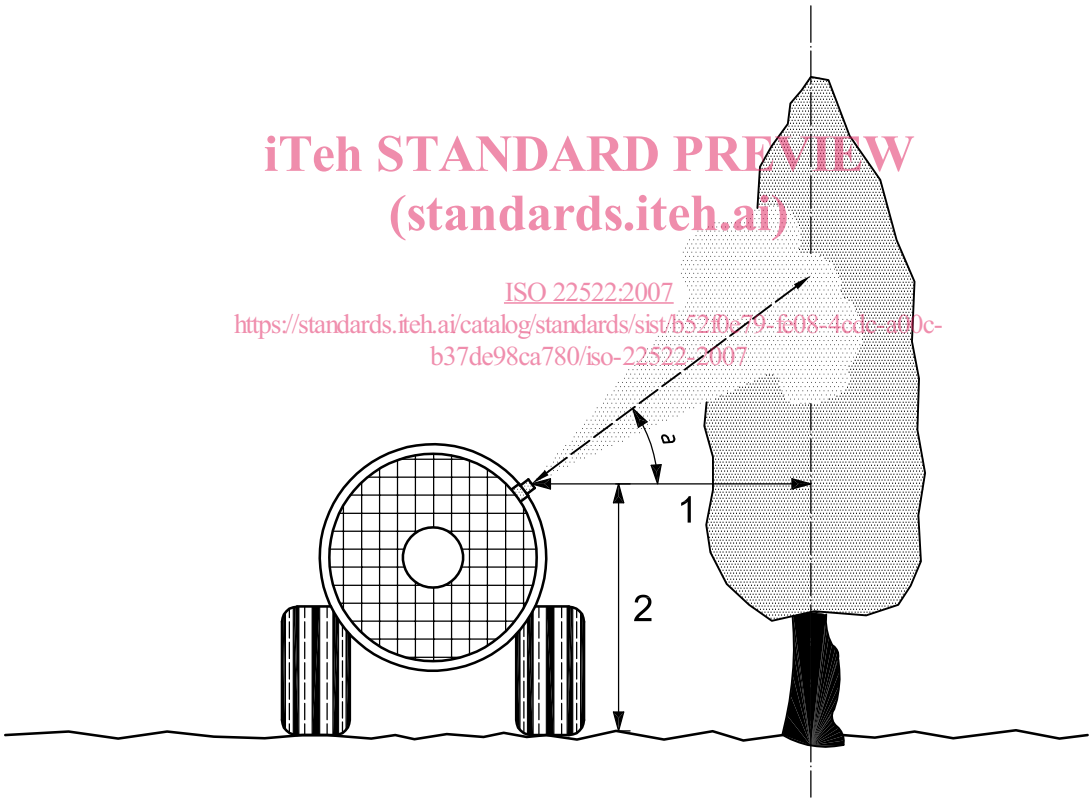
The liquid and air distribution system of the sprayer shall be described using diagrams, pictures and/or photographs in the test report.

If possible, in order to better explain test results obtained from different types of sprayers, it would be preferable also to refer to the vertical spray pattern, measured using a vertical test bench (see ISO 9898).

Table 1 — Nozzle characteristics and position

Left			Nozzle no.	Right		
Model	**Measured flow rate** l/min	**Height | Distance to row axis | Orientation** [a] cm | cm | degree		**Model**	**Measured flow rate** (l/min)	**Height | Distance to row axis | Orientation** [a] cm | cm | degree
		e.g. 150|225|22	1			e.g. 150|225|22
			2			
			n			
Total flow rate				**Total flow rate**		

[a] Angle of orientation, *a*, related to the horizontal level (example of axial fan sprayer). See Figure 1.



Key

a angle of orientation related to horizontal level (example of axial fan sprayer)

1 distance to row axis

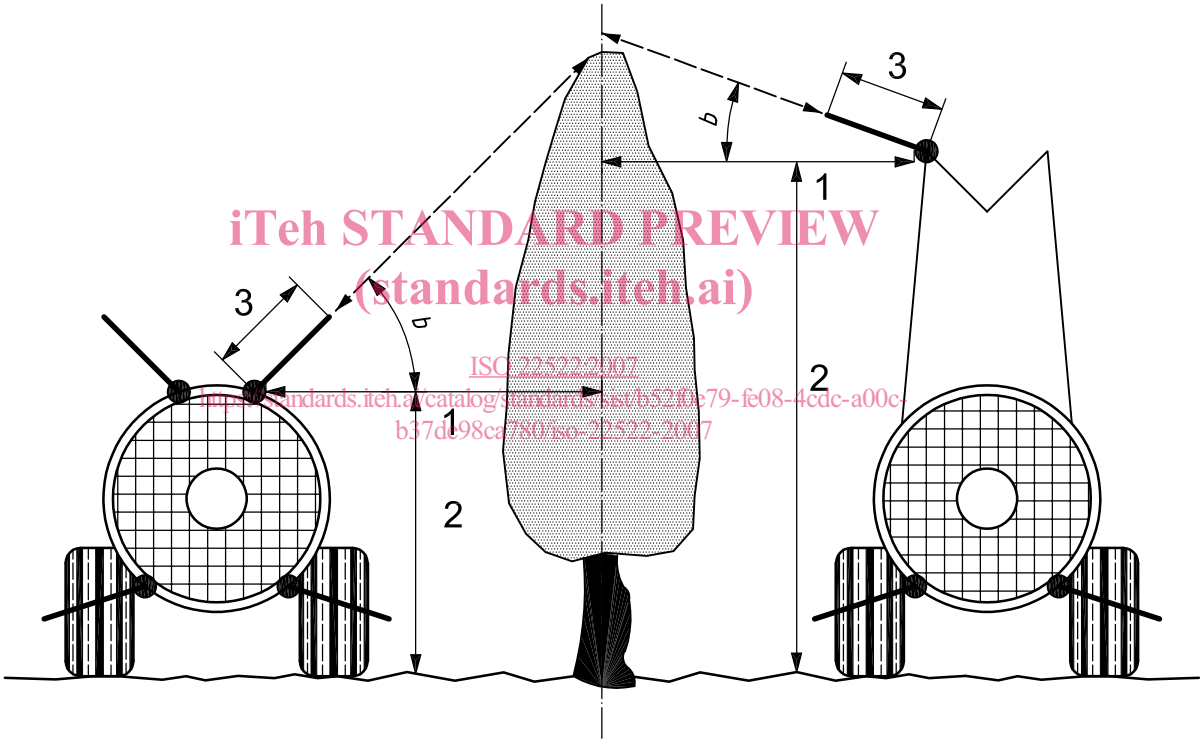
2 height

Figure 1 — Nozzle position

Table 2 — Deflector characteristics

Left			Nozzle no.	Right		
Position	Length cm	Height | Distance to row axis | Orientation [a] cm | cm | degrees		Position	Length cm	Height | Distance to row axis | Orientation [a] cm | cm | degrees
e.g. upper	e.g. 25	e.g. 10|200|45	1	e.g. upper	e.g. 25	e.g. 185|200|30
			2			
			n			

[a] Angle of orientation, *b*, related to the horizontal level (example of axial fan sprayer). See Figure 2.



Key

b angle of orientation related to horizontal level (example of axial fan sprayer)

1 distance to row axis

2 height

3 length

Figure 2 — Deflector position

7 Description of tree or bush orchard

The description of the tree or bush orchard shall include at least the following information:

a) crop, variety and rootstock;

b) age (years);

c) training system (pruning type);

d) phenological stage in the trial date (growth stage), if available, using code standards;

e) parametric dimensions (average volume or mass measurements), comprising

- average distance between rows (m),
- average distance between trees or bushes in the row (m) (describe positions by means of diagrams, if necessary),
- average height (cm),
- average vegetation width (cm), geometry, shape, gaps, number of layers, and
- average vegetation volume per unit area;

f) mass measurements (optional, however, if done, the methodology shall be described) consisting of

- leaf area index (one-sided green leaf area per unit ground area), and
- leaf density (one-sided green leaf area in a defined volume within the canopy).

8 Description of the spray liquid

The description of the spray liquid shall include at least the following information:

- tracers, adjuvants, chemical used, with description and concentration reported (see Annex A);
- sprayed dose (liquid, tracer, adjuvant);
- tracer concentration, with representative samples of the spray mixture liquid taken for immediate analysis before and/or after spraying.

If different tracers are used in the same experiment, they shall be allocated at random to each application.

9 Sampling

9.1 General

Depositions are measured using at least three replications within the plot.

In each replication, at least one tree or bush shall be chosen on which to carry out the measurements of spray deposit on the defined targets (leaves or fruits). To prevent “start-up” and “finishing” effects, an appropriate number of trees or bushes shall be ignored in both ends of the rows. This shall be noted in the report.

Before treatment application commences, several replicate blank samples shall be taken so that the pre-spraying amounts of the used tracers (expected to be near zero) can be determined.

A profile sampling strategy (see 9.2.1) or a zone sampling strategy (see 9.2.2) shall be adopted. Optionally, it could be interesting to use both sampling strategies in order to obtain the advantages of both methods. Additional strategies shall be fully reported.

In order to minimize experimental error, the samples shall be taken, stored, extracted and analysed in an suitable way, depending on the tracer used. For instance, it is always important to take the samples as soon as the spray deposit of last application has dried. Also, when using fluorescent tracers, it is important to store samples in dark boxes and, when using metal tracers, it is recommended that leaf sweating be avoided by the use of appropriate bags or by refrigeration of the samples just after collection.

Artificial targets can be used to help the adjusting process of the sprayer or in carrying out preliminary tests. A description of their number, position, material, attaching system and other relevant details shall be provided (see Annex B).

Procedures for handling samples or collectors prior to and post exposure to spray that minimize the risk of cross-contamination shall be established. The potential for cross-contamination and tracer degradation shall be monitored during a trial using clean samples or collectors and those loaded with a measured volume of the tracer solution.

After use, samples or collectors shall be stored for the minimum period possible. The storage shall be in conditions appropriate to the tracer, typically dry, in darkness, and at a temperature of less than 4 °C, minimizing any risk of condensation (since this can result in inaccuracy).

In all cases, measures to prevent samples degradation shall be employed.

Deposits on samples or collectors should be calculated based on the calibration of the tracing technique with samples of the spray liquid taken from a nozzle at the time of the spraying.

9.2 Canopy targets

9.2.1 Profile sampling strategy

A profile sampling strategy is useful when measuring the vertical distribution of tracer in the canopy because it provides information on precise deposition on single leaves along the profile. This strategy brings more variability to the test due to measurements on single leaves, but generates a large amount of samples, making tests more time-consuming and expensive.

Samples represent single target points distributed in levels separated by a maximum of 25 cm [see Figure 3 a)]. In every tree or bush, samples shall be collected following different profiles in the vegetation [see Figure 3 b)]. If the canopy width, in the tangential direction of the sprayer displacement, is less than 50 cm, two peripheral profiles (A and B) shall be followed to collect samples placed on the sides of the tree facing the alleys. If the canopy is greater than or equal to 50 cm wide, at least one further profile (C) shall be added in the middle (central) part of the tree, around the trunk.

One additional profile (D) shall be considered when the maximum overlapped width is lower than half the maximum width of the trees ($a < b/2$) [see Figure 3 b)]. Two additional peripheral profiles (D and E) shall be considered when trees are isolated. These profiles shall be placed in the vertical plane, including the row axle, with one at the beginning of the tree and the other one at the end of the tree.

At least one sample shall correspond to an individual leaf or fruitlet along the profiles. If this is not possible, the solutions adopted shall be reported. The positions of the different sample points shall be reported (see Annex C).