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SPISE

Standardized **P**rocedure for the **I**nspection of **S**prayers in **E**urope

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Advice for functional inspection of soil disinfection equipments

Part 2: solid formulation application equipment

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This document has been compiled by the SPISE Technical Working Group 10

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Content

1 Introduction

In the Article 8 of the EU Directive 128/2009/EC it is foreseen that all Pesticide application equipment should be inspected before the end of 2016. The number of machines in use is not large, but the products that are used with this type of machine are generally harmful being classified as toxic and harmful for the environment [Liquid formulation: 1,3 dichloropropene, chloropicrin, metam-natrium and metam-kalium, dimethyldisulfide DMDS (under registration). Solid formulation: dazomet]. This SPISE inspection advice not only focuses on a good functioning machine, but also takes into consideration important health precautions for inspectors and users from this type of machines. On top of that, because of the small number of such machines, an economical approach was made so the inspection of this type of machines doesn't require large investments for the inspection services.

Soil disinfection machines are historically used in vegetable growing, and mostly in greenhouses, even if extensive uses are reported in open filed too (tobacco, carrot, perennials, etc.) The treatment is performed periodically and the aim is to get a disinfested soil after the treatment (free from fungi, insects, nematodes and weeds). The treatment gets it's good functioning out of the evaporation from the soil-disinfectant into the soil. In a first stage the soil is loosened and the disinfectant is injected into the soil at the desired depth by means of the soil-disinfection machine and in a second stage the injected area is covered immediately with plastic foil to prevent evaporation from the disinfectant into the air. Such activities in term of modalities and timing are clearly described and stated by the formulation labels and must be strictly followed during the application.

In greenhouses the plastic covering is performed mostly manually, while outside used machines mostly have the possibility to cover the treated area automatically with plastic foil. At this regard, as already reported, the activities allowed during the soil fumigation done under greenhouse conditions are clearly described and stated by the formulation labels.

2 Solid fumigant formulation applicator

Machines for the distribution of fumigants in solid form, as a dry granule or micro granules, in a downwards direction. The distribution can be both full-width as well as in strips / rows. The machine can be dedicated machines (really rare) or the solid fumigant applicator can be mounted on other machines (very common).

2.1 Description

It typically consists of a hopper, a metering device and a distribution system to distribute the granules in a broadcast way (Fig. 1).

A granulate spreader can be configured in many different ways depending on the distribution system, on the size and quantity of hoppers, the number of outlets and the drive type. Hopper size is generally between 30 and 150 L. Working width can go up to 3 m.

Fig. 1 – Example of different solid fumigant applicators

Hand-operated portable solid fumigant applicator drag behind by an operator also exist.

Solid fumigant applicator are solely used to apply solid fumigants.

Solid formulations of fumigants are safe for operator, bystander, resident and the environment if properly used in accordance with the instruction manual and the solid fumigant label. Only residues of solid fumigant formulation can be a serious risk for the operator, during maintenance operations and also for the inspector.

In this SPISE Advice there will be a division in:

- Type A: Applicator combined with a soil rototiller
- Type B. Applicator not combined with a soil rototiller.

2.1.1 Applicator combined with a soil rototiller (a)

The applicator combined with a soil is used without any overlapped application. In principle the applicator includes following parts.

Fumigant hopper: provided with a top cap firmly closing the hopper avoiding any accidental granules/dust leak.

Mechanical or agitation mixer: the mechanical mixer delivers the solid fumigant to the soil trough distribution pipes or other driving device. The mechanical mixer can be mechanically or electronically DPA driven during the solid fumigant delivery.

Distribution/draining pipes: distribution pipes drive the solid fumigant from the hopper throughout the mechanical mixer to the soil eventually throughout a soil injector. The number of distribution pipes might depend on mechanical mixer characteristics and on the injection/distribution system. When available the soil injector allows the distribution of the solid fumigant deep into the soil. Injection depth can be adjusted. The number of injector depends from working width.

Soil mixer: the soil mixer is basically a rotary tiller made as common soil tiller

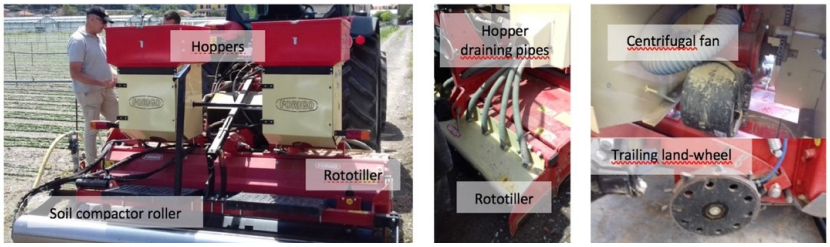

Fig. 2 - Example of solid fumigant applicator combined with a soil rototiller (Photo G. Oggero)

2.1.2 Applicator not combined with a soil rototiller (c)

Basically, it is similar or identical to the previous, without the soil rototiller. Contrary to applicator combined with a soil rototiller, solid fumigant is always delivered by injection into the soil

Application rate can be mechanically or electronically tuned

Mechanical tuning system: the mechanical tuning system allows the mechanical adjustment of the quantity of test item delivered throughout the mechanical mixer in each single distribution pipe or globally for all distribution pipes. The adjustment is done manually only; moreover, a mechanical lock system guarantees that, after the adjustment, the tuning is not accidentally modified. Finally the mechanical tuning system allows the operator to zero (close) the test item delivery for each single distribution pipe: the maximum test item working width (13 distribution pipes) is approximately of 180 cm, but largest sizes might be expected in the future. A general adjustment empirical correspondence matrix gives approximate indications to be adopted to adjust the mechanical tuning system.

Electronic tuning system act trough a digital or other electronic system to modify the application rate.

2.2 Working principle

All granule applicators consist essentially of three main parts.

- A hopper, which contains the dry granules.
- An agitation system to ensure the flow of material to the metering mechanism
- A metering system to deliver a measured quantity of granules.
- A delivery system, which refers to the part of the machine from the metering outlets to the point where the product is emitted.

Advanced granule spreaders are equipped with a controller box to adjust the setting of the machine

2.2.1 Hopper

The hopper is designed with a sloping floor so that the granules fall to the lowest point of delivery to the metering system. The hopper is generally made in plastic/ metallic and generally do allow the operator to see how much is in the hopper with different mechanisms (mechanical/electronic). The hopper should have a tight water-proof lid to keep the granules dry during application. On the lowest hopper point an agitator is fit to keep the granules flowing, but care is needed to avoid breakage of granules.

2.2.2 Metering unit

From the hopper, granules are metered to the outlet. The simplest metering system is a rotating engraved (splined) cylinder through which granules are collected from the hopper and delivered to the distribution system. The size of the splines can be changed, often mechanically or by replacing the cylinder with one having a different size of the splines.

More accurate dispensing of granules is achieved by having a positive displacement rotor to volumetric meter the particles. Flow rate is regulated based upon the width of the rotor, the number of teeth and the speed of rotation. The speed of rotation is usually governed by coupling the rotor to a trailing land-wheel by a series of pulleys or gears so that the flow rate of granules is directly proportional to the forward speed. On other machines, instead of the trailing wheel (Fig. 3), the metering system is driven by a separate 12V electrical motor. The speed can then be regulated by a controller.

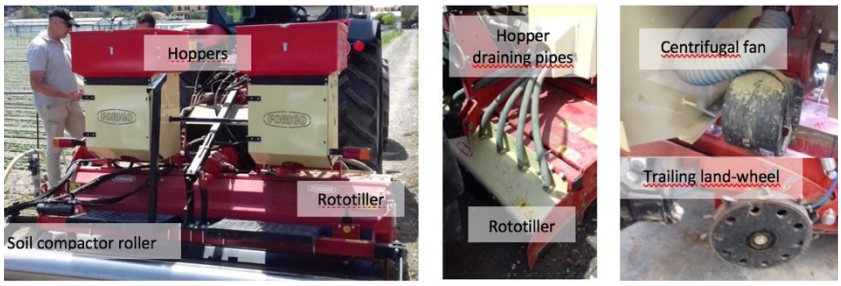

Fig. 3 – Trailing land wheel

2.2.3 Delivery system

The delivery unit particularly depends on whether the granules are spread broadcast onto the entire area to be treated, or whether they are placed in a narrow line or band. Generally, the applicator is combined with a rototiller and the soil mix is provided by the soil mixer. In case of applicator not combined with a soil rototiller the delivery system place the solid formulation in

narrow lines.

Other broadcast spreaders are using gravity (drop). These systems consist of a tube which is positioned as vertical as possible to allow the granules to fall by gravity. With this system there are usually several hoppers each with a metering device often above a pair of down pipes.

At the end of the pipe a soil injector can be mounted to inject the granules below the soil in a narrow line or band. Incorporation of the granules into the soil is possible by opening a furrow ahead of the delivery tube by a chisel.

If several hoppers cannot be used or if there is any horizontal travel of the granules required, or if the formulation can clog the hopper and the delivering system the movement of granules can be assisted by an airstream to convey the granules to the point of delivery. These pneumatic spreaders have a central metering and distribution system that meters granules into multiple streams, which are then carried in pneumatic tubes out to evenly spaced points on a boom or on the implement. An electric or hydraulic driven fan generates the required air stream. Air pressure and volume depend to a great extent on the granule (type and weight), volume, working width and speed.

2.2.4 Controller

Some devices are equipped with a controller box for an (electrical) adjustment of the metering unit from the tractor cabin to allow an accurate dose regulation. As an option, the metering shaft's speed can be synchronized with the speed of the tractor by using speed sensors or GPS.

Other possibilities are a headland lift switch to automatically engage/disengage the applicator when the fumigation system is lifted/lowered into or out of its working position, without the need for the operator to use the product switch bow.

On the controller, the operator can receive indications of forward speed, total worked areas, product application rate, low hopper level.

3 Pre-inspection

It is important that the inspection can be executed in a way that is safe for the inspector and the environment, and for allowing that a pre-inspection shall be performed. The real inspection can only start when the requirements in the pre-inspection are fulfilled.

These last shall be checked following EN ISO 16122-1 (when applicable).

3.1 Cleaning

The equipment shall be clean. Cleaning shall include internal parts, filters, filter inserts and external surfaces giving special consideration to areas of contamination to which the inspector could be exposed during the inspection.

Method of verification: visual check.

Note: It is usual top find some granules inside the machine. It is recommended that, if you cannot see the rotors, i.e. they are covered over with granules, do not work on the machine until it has been properly cleaned out by the operator.

Used granular applicators machines should always be treated as contaminated. The majority of products uses are nematicides or and insecticides or and herbicide or and fungicide, These are mostly very harmful compounds. Appropriate Personal Protective Equipment (PPE) must be worn by the inspector. This includes boots, coveralls, gloves, face shield and dust mask/respirator (to the correct standard

3.2 Power transmission parts of the equipment

The power take-off (PTO) drive shaft guard and the guard of the power input connection (PIC) shall be fitted and in good condition. In addition:

1) the different parts of the shaft, the universal joints and locking systems shall not show excessive wear, 2) the PTO drive shaft guard shall be present and shall not show any deformations or tears, 3) in case of non-rotating guards, the restraining device that prevents the rotation of the power take off drive shaft guard shall be present and shall work properly.

Protective devices and any moving or rotating transmission parts shall not be affected in their function

Method of verification: visual check.

3.3 Moving parts of the equipment

All guards provided for protection of the operator shall be present and function correctly.

Method of verification: visual check

3.4 Pipes and hose for hydraulic transmission

There shall be no visible leakage from the hydraulic system.

Hydraulic hoses shall not show excessive bending and abrasion through contact with surrounding surfaces.

They shall be free from defects such as excessive surface wear, cuts or cracks. Hydraulic pipes shall be retained in position and be free of significant corrosion or damage.

Method of verification: visual check

3.5 Structural parts and framework

Structural parts and framework of the equipment shall be without permanent deformation, significant corrosion or considerable defects which could affect the rigidity or the strength of the sprayer.

This requirement applies also to the hitching device.

Method of verification: visual check

4 Requirements and methods of verification

4.1 Leakage

4.1.1 Static leakage

With the machine not working and parked on a level surface, there shall be no leakage from any part of the machine in all position of lifter

Test method:

Visual check with a certain amount of dummy material in each hopper (not completely filled)

4.1.2 Dynamic leakage

Working under normal working condition, there is no leakage of product from any part of the machine.

Test method:

Functional check with a working machine with the hoppers filled with a certain amount of dummy material in each hopper (not completely filled).

4.2 Metering unit(s)

4.2.1 Drive

Check if the drive of the metering unit(s) is functioning correctly.
Electric drive:

- Check if the electronic signal and GPS sensors and radar sensors (if present) are functioning correctly
- Check if the drive ids-engagement (on/off) functions correctly (if fitted)

4.2.2 Metering unit(s)

Metering shaft alignment

Check if the drive shaft is in correct alignment and rotated easily without binding.

(More hoppers means more drag factor)

Meter rotor condition

The rotor shall not damaged or dirty, any damaged rotor should be changed.

All rotors and cassettes shall fitted according to manufacturer's guidelines.

All rotors shall be within manufacturers specifications.

The check should regard also the correct functioning of Radar sensors (if present)

The number of hoppers change according to the user needs. This number is not reported into the manufacturer's guidelines

4.3 Hopper(s)

4.3.1 Condition hopper(s)

The hopper(s) shall be free from any defects like holes, cracks, etc.

Test method: Visual check on condition hoppers

4.3.2 Fitting

All hopper(s) are fitted correctly to the machine.

Test method: Visual check on fitting

4.3.3 Lid

The hopper(s) is/are provided with a lid that is well adapted and in good condition, This lid shall avoid unintended opening.

Test method: Visual check on presence and condition of lid(s)

4.3.4 Emptying of the hopper

Shall be possible to empty the hopper(s) without the use of special tools or removing parts from the machine, without contamination of the environment and without the risk on contamination of the operator.

All seals must function correctly.

Test method: Functional check on the functioning.

4.3.5 Accessibility

The hopper(s) is/are accessible on a safe way.

Test method: Functional check

4.4 Measuring systems, controls and regulation systems

All the instruments and controls needed for the correct functioning, measuring and regulating the machine are functioning properly.

The provision for the switching on or off of the distributor are functioning properly, it shall be possible to switch all distributors simultaneously on or off.

All controls and instruments needed to operate the distributor shall be reachable and visible by the operator during working.

Test method: Visual and functional check on the presence and functioning of controls and instruments

4.5 Lines (pipes and hoses)

Hoses and pipes shall not show excessive bending, corrosion and abrasion through contact with surrounding surfaces. Lines shall be free from defects such as excessive surface wear, cuts, cracks, vitrify etc. Tubes shall not be pinched or kinked.

All tubes between the meter outlet and the soil injection shall be without internal obstructions.

Shall be not accumulation of product in the tubes.

Test method: Visual check on all tubes and pipes what are part of the distribution system.

4.6 Delivery system

The distance between fish-tails and the ground/target is as per manufacturers guidelines.

Test method: Functional check.

4.7 Output/Distribution

The output measurements should be carried out using blank/dummy material.

Test method: measurement

4.7.1 Output measurement (A)

The measured output per output shall be within +/- 15% of the average output.

Alternatively

4.7.2 Output CV (B)

The measured CV shall be < 15%.

5 Test methods

5.1 Output

5.1.1 Specification for blank/dummy material

This dummy-material has the similar characteristics as the real material (particle size, density, etc.). Dummy material should not be abrasive or corrosive.

5.1.2 Method A – output measurement

For all set up adopted, collect the output of each outlet and compare with the average output. The output test must be carried out over the equivalent of 100 meters or a minimum of 100 grams per outlet. For air-assisted machines, collect granules using a bucket or suitable container which allows air to escape while retaining granules.

Place under each outlet of the machine a collecting container (Fig. 4). The content of each container will be measured with an accurate scale. The individual values will be compared to the average weight.

Fig. 4 – Example of collection of the output of each outlet.

5.1.3 Method B – CV output

For all set up adopted, the transverse distribution shall be verified for the complete working width of the machine. The test shall be carried out positioning a groove patternator directly on the ground under the distribution system (Fig. 5).

Fig. 5 – Example of dummy material collection using horizontal groove patternator.

Collect the output present in each groove. The content of each groove will be measured with an accurate scale. Calculate the coefficient of variation applying the following formula:
CV = 100 x Standard deviation/average

6 Test equipment and material needed

6.1 List

- Scale to weight 100 grams with min accuracy of +/- 2%
- Groove patternator
- Collecting trays
- Rubber granules (see Spise Advice for inspection of micro granulator, Fig. 6)

Fig. 6 - Rubber granules in the hoppers.

6.2 Groove patternator specification

A patternator with grooves 100 mm wide and at least 80 mm deep, measured as a distance between the top and the bottom of the groove, shall be used to measure the uniformity of the transverse distribution of the product. The groove patternator shall be at least 1,5 m long. The groove width shall be 100 mm ± 2,5 mm. The size of the patternator shall be suited to the working width of the machine and shall also ensure that the overlapping range of the output is measured completely

REFERENCES

- EN ISO 16122-1 (2015) - Agricultural and forestry machinery - Inspection of sprayers in use - Part 1: General.
- EN ISO 16122-2 (2015) - Agricultural and forestry machinery - Inspection of sprayers in use - Part 2: Horizontal boom sprayers.
- Spise Advice for functional inspection of granular application equipment

SPISE – Standardized Procedure for the Inspection of Sprayers in Europe
Established in 2004 by founding members from Belgium, France, Germany, Italy and the Netherlands, the SPISE Working Group aims to further the harmonisation and mutual acceptance of equipment inspections. In regular meetings, several Technical Working Groups (TWG) prepare advice about the items taken into account by the

EU Directive 128/2009/EC but still not considered in the actual ISO/CEN Standards. The present document is intended to provide technical instructions and describes

a procedure which is not mandatory but can be voluntary adopted in the course of inspection or calibration.

Further information can be found at **https://spise.julius-kuehn.de**

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