Proposal of an inspection methodology for pneumatic drills

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Summary
In recent years the contribution of pneumatic drills to the dispersion in the environment of insecticides particles derived from the abrasion of dressed seeds has been studied and different devices aimed at reducing the dust drift have been proposed. The European Directive 128/09 on the sustainable use of pesticides aims to achieve a more sustainable use of pesticides and introduces the compulsory inspection of equipment for pesticide application.
At the present time, an official methodology to inspect both new and in use drills and the effectiveness of drift reducing devices is still lacking. The aim of the paper is to present a simplified methodology that can be applied to periodical inspection of the above mentioned equipment. Such a methodology has been elaborated basing on the results of a three-year activity, carried out at CRA-ING within the APENET research project.

Introduction
The article 8 of the European Directive 128/09 is related to the inspection of equipment in use and it stated that "Member States shall ensure that pesticide application equipment in professional use shall be subject to inspections at regular intervals". The pneumatic drills sowing dressed seed are not directly included in this group of machines even if they distribute a certain dose of pesticide associated with the seeds in the soil. Moreover it is ascertained that they release a part of the applied pesticides in the environment as dust losses (Greatti et *al.*, 2006; Pochi et *al*., 2011). At the moment, the inspection methodologies are available for a limited number of equipment, namely the sprayers (equipment for application of liquid products); for other equipment (as duster, foggers, granules applicators, seed treatment equipment, mist blowers/generators, wipers) the inspection methodologies are lacking (Harasta and Polvêche, 2009).
An inspection methodology is generally derived from a certification method for new models and represents a chain of controls and inspections aimed at restoring the initial functionality of the machines, within a given level of tolerance. As to the dispersion of active ingredients by using new pneumatic drills, some countries adopt methods with national valence (Rautmann et *al*., 2009) but certification methods recognized as international standard do not exist.
In this work, the pneumatic drills are taken into consideration as distributors of dressed seeds and granular products, contributing in such functions, to the dispersion of chemical products in the environment. Basing on a test method developed at CRA-ING during the APENET Research Project (Apenet, 2011) for the study of abrasion dust emissions during the sowing of maize seed dressed with insecticides, this paper proposes some ideas for a simplified approach to the inspection of the pneumatic drills in use, from the point of view of the containment of the dispersion of active ingredients during the sowing.
A methodology based on static tests was developed in order to obtain reproducible test conditions and comparable results. It is based on the sowing simulation of the of maize seed under artificial wind conditions (Fig. 1). The seeder was operated "*sur place*" by means of electric engines allowing to exactly reproduce the speed of the driving wheel (virtual working speed) and of the vacuum fan (depression value) and distributed seed dressed with insecticides. The active ingredients were detected at ground level and in the air by means, respectively, of a series of Petri dishes (with a water-acetonitrile solution) and air samplers with PTFE membrane filters placed at five sampling distances. The chemical analyses of the samples revealed the chemical residues at ground and the concentrations in the air. The method has been used for assessing the efficiency of devices applied to the seeder, aimed at the drift reduction, in comparison with the emissions of the conventional machine (i.e. the same drill without deflectors). Through a data processing method, from the data provided by these static tests it is possible to foresee the field active ingredients dispersion that would occur under similar atmospheric and operative conditions (Biocca et *al*., 2011).

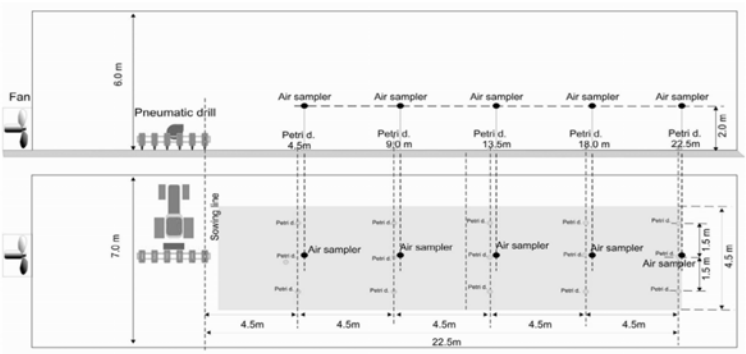

Fig. 1. The layout of CRA-ING testing area for checking pneumatic drills.

Results

The method provides accurate description of the behaviors of dust drift at ground and in the air, allowing precise evaluation of the reduction obtainable with the devices for the reduction of dust dispersion and it could be adopted for certifying the characteristics of new machines. This method can be a starting point for an inspection methodology for pneumatic drills in use. For this purpose, the methodology could be suitably simplified in order to: 1) avoid long and expensive analytical procedures; 2) avoid the risk of operator exposure to the active ingredients during the tests. In order to produce this methodology the following steps are needed.

1) References for the evaluation of the performances of pneumatic drills in use – Since the study aims at defining the criteria for the evaluation of pneumatic drills in use from the point of view of the dispersion of pesticides contained in the abrasion dust, conventional machines cannot be considered, because they are not planned for the reduction of dust dispersion. For each model of drill in use, the reference should be theoretically represented by a new drill of the same model, equipped by the manufacturer with air deflectors (commonly used in several countries for reducing dust dispersion) or other devices. Such a new equipment, should be tested and certified as regards dust/active ingredient emissions, according to a reliable methodology developed on purpose. The values observed in the new machine should be restored in the periodical controls on the machines in use. In practice, this goal could be difficult to achieve in some cases, i.e old machines no more present in the market. A possible alternative consists of the introduction, as a reference, of minimum requirements common to all machines, like levels of dust/active ingredient emissions, that should have been proved to be innocuous for the bees in tests on different new machines.

2) Test methodology for new machines – The above described method is based on static tests and, because of its reliability, reproducibility and accuracy, it seems to be suitable for testing new machines. The evidenced necessity of simplifying the analytical phase and of reducing the risk of exposure could be achieved by using seed dressed with a non-toxic and easily-detectable tracer. An essential point is that the seed should be dressed similarly to commercial seed, in order to have results referable to normal operating conditions. The results should be reported in terms of concentrations, both at ground and in the air. According to the considerations reported at the point 1, the results provided by the certification of the new machines will represent the reference values to be restored in the inspection activity of the machines in use.

3) Simple and reliable methodology for the inspection of pneumatic drills in use – If the criteria proposed in the points 1 and 2 are accepted, the certification data of new precision drills modified with air deflectors or other devices will represent the target of the periodical inspections during the lifetime of all copies of the same model. Although based on the same criteria of the methodology for new machines, the inspection methodology should be more simple and faster, providing results immediately referable to the target values. For instance, the number of samplings can be reduced to one or two distances, deemed as the most significant. The same tracer and analytical techniques proposed at the point 2 will help to speed up the procedure.

4) Sensitive points to be checked during the inspection of pneumatic drills in use - In addition to the presence and efficiency of the specific device for the reduction of the dispersion of dust during the sowing, there are different points through which the dust can be expelled and parts directly involved in the efficiency of the machines These parts (Fig. 2) should be checked periodically in order to maintain the drill efficiency. A possible list of such controls should include: 1) the status of the pipes of the pneumatic system of the drill; 2) the status of the gasket sealing the connection between the flange supporting the deflector pipes and the outlet opening of the vacuum fan; 3) the functionality of the pressure gauge (correct depression value help to limit dust dispersion).

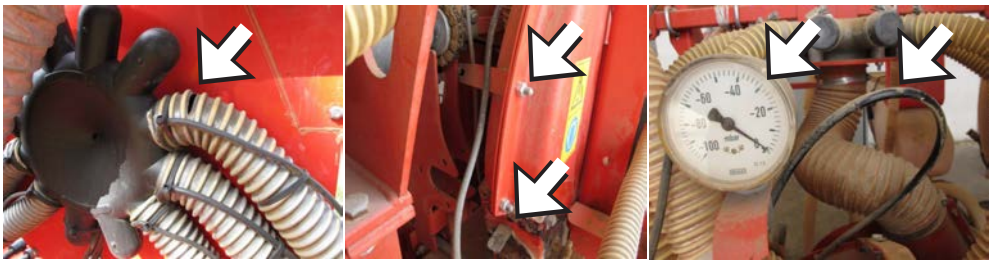

Fig. 2. Some sensitive points to be periodically checked in order to maintain the drill efficiency.

Conclusions

A test methodology for pneumatic drills in use was proposed. Such a proposal is based on static tests realized to verify the efficiency of drift reducing devices applied to new drills. A large scale application of a test methodology for machines in use will require to avoid long and expensive analytical procedures and the risk of operator exposure to the active ingredients during the tests. For this purpose it was proposed the use of seed dressed with a non-toxic and easily-detectable tracer during the test.
The inspection methodology should be more simple and faster, providing results immediately referable to the target values. An essential point is that the seed should be dressed similarly to commercial seed, in order to have results referable to normal operating conditions. The control activity will also concern the inspection of the most sensitive points of the pneumatic drill, from where dust amounts can be emitted, in order to verify their integrity and efficiency.

Reference

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