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Comparison of the effectiveness of standard and drift-reducing nozzles for control of some pests of apple

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Abstract

A comparison of the biological efficacy of pesticides applied against some apple pests with standard versus drift-reducing nozzles was made in trials in intensive orchards in Slovenia. Standard and drift-reducing nozzles were compared by applying 350 L spray per hectare. No significant differences in acaricide/insecticide efficacy between the types of nozzles could be observed when controlling fruit tree red spider mite (*Panonychus ulmi*) and apple rosy aphid (*Dysaphis plantaginea*). However, drift-reducing nozzles reduced the efficacy of insecticides against the codling moth (*Cydia pomonella*), green apple aphid (*Aphis pomi*) and apple leaf miner (*Leucoptera malifoliella*).

Keywords: Apple; Spraying; Drift-reducing nozzles; Biological efficacy; Insecticides; *Aphis pomi*; *Cydia pomonella*; *Dysaphis plantaginea*; *Leucoptera malifoliella*; *Panonychus ulmi*

1. Introduction

Drift reducing nozzles are an important tool for reducing spray drift of plant protection products (Cross et al., 2002; Knewitz et al., 2002a; Koch and Weiser, 2000; Koch, 2003). In recent years many new types of drift reducing nozzles have been introduced to the market by the most important manufacturers (TeeJet, Hardi, Lechler, Agrotop, Albuz and others). The amount of information about their practical usefulness is great but still not adequate for all the nozzle types. Many fruit producers in Slovenia are sceptical about the use of the new types of drift-reducing nozzles and only some have already introduced them. Therefore, more adequate information is needed. In the expectation of new regulations that will prescribe the mandatory use of drift-reducing nozzles, the scepticism among growers is rising. The exact relation between the rate of drift reduction and the rate of change of biological performance is not yet known for many nozzle types, especially if we consider how many other technical and ecological factors can influence the final biological performance of a particular pesticide and its application (Ganzelmeier et al., 1995; Koch and Weißer, 1994, 1995; Chapple et al., 1997; Kaul et al., 2002; Koch, 2003; Cross et al., 2001a, b, 2003).

Some fruit growers were not satisfied with the performance of drift-reducing nozzles when they were controlling codling moth (*Cydia pomonella* L.), leaf miner (*Leucoptera malifolliela* Zell.), San Jose scale (*Quadriaspidiotus perniciosus* Comst.) or pear sucker (*Cacopsylla pyri* L.).

In the case of fungicides used in apple plantations many experts agree that there are, on average, no

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significant differences in biological performance if they are applied by standard or by drift-reducing nozzles (Freißleben and Oeser, 2000; Heinkel et al., 2000; Knewitz et al., 2000, 2002b; Koch, 2003; Freißleben et al., 2003). Many papers present exact comparisons of deposit and distribution characteristics of both groups of nozzles (Heinkel et al., 2000; Koch et al., 2001; Balsari et al., 2001; Jaeken et al., 2003).

Drift-reducing nozzles sometimes have even better deposit (% coverage on WSP) and macro-distribution characteristics than comparable standard nozzles (Knewitz et al., 2002b; Jaeken et al., 2003). On the basis of results obtained from 130 trials carried out in Germany Freißleben et al. (2003) report that drift-reducing nozzles can give slightly better biological performance of fungicides than comparable standard nozzles. According to their results drift-reducing nozzles could be recommended in apple production, regarding efficacy, without any restrictions. Similar recommendations are proposed by some researchers for disease control in vineyards (Baldoin et al., 2003). In the case of insecticides the amount of information is less extensive. It is not yet completely confirmed that the efficacy of insecticides with contact action, when applied by use of standard or by drift-reducing nozzles, is comparable. Use of organophosphorus insecticides with good systemic activity (e.g. dimethoate, fenitrothion, fenthion, azimphos-methyl) is no-longer allowed for control of pests, e.g. apple codling moth, in modern IPM insecticide programs. The use of primarily contact-acting organophosphates (e.g. diazinon, phosalone, chlorpirifos and chlorpirifos-methyl) is restricted because of preservation of natural enemies of pests. Modern insect growth inhibitors and regulators (e.g. lufenuron, hexaflumuron, tebufenozid, fenoxycarb) with contact and digestive action are promoted. Therefore, in IPM programmes the choice of insecticides is quite limited and insecticides with contact action prevail for control of some important pests. Of the systemic insecticides, neonicotinoids are accepted in IPM because they have short-lasting contact-activity and long-lasting systemic activity. The need for good and more equal spray deposition is greater when contact-acting insecticides are applied than when insecticides which have also systemic and good respiratory action are applied. The manufacturers of the nozzles sometimes are ready to give clear information that in the case of applying contact-acting insecticides with drift-reducing nozzles in orchards with trees of greater volume, some reduction of efficacy should be expected (personal communication with experts from Lechler company).

The primary aim of our research was to make comparisons between the biological performance of insecticide preparations (whole spray programmes) applied by standard nozzles and those applied by drift-reducing nozzles. Especially we were interested in obtaining more information on biological performance of insecticide preparations against codling moth, apple leaf miner and aphids.

2. Materials and methods

2.1. The experimental orchards

Two orchards in the north-western part of Slovenia were selected as trial locations. The first orchard (HOCE location, 2 ha) was situated in the middle of 20-h plantation of apples. This plantation was a part of an experimental station managed by the Faculty of Agriculture (Maribor University). In 2001 and 2002 the experimental area was under a reduced IPM plant protection programme. The number of usual pesticide applications was halved and many biological preparations were used. Also, mating disruption was used to control pests such as codling moth. Because of this approach, the populations of pests increased significantly. Conditions favoured the appearance of pests. All the cultivars (Golden Delicious, Idared, Jonagold, Braeburn and Elstar) were grown, pruned and trained in the same manner. The average crown height of 7-year old super-spindle shaped trees grafted on the rootstocks M 9 was 2.7–2.8 m. The spacing within the rows was 0.7 and 2.7 m between the rows. Fertilisation and irrigation were performed according to the IPM regulations that are in force in Slovenia.

The second trial was carried out at the GRAJENSCAK location, where the Agricultural College of Ptuj has orchards for training purposes and experimental activities and where pest populations have been great in recent years. In the Grajenscak orchard, the trial was performed on two apple cultivars (Jonagold and Idared). Dwarfed trees trained in slender spindle form were grafted on M 9 rootstock and were 12 years old. The average height was between 2.5 and 2.6 m. Spacing within the row was 1.3 and 4.0 m between the rows.

2.2. Lay-out of trial plots and statistical analysis

In both trials randomised complete block design with four replications was used. The plots were 6 rows wide and 30 trees long. Only the central 4 rows were sprayed. 30 trees in the central 2 rows (in each central row 15 trees in the middle) were selected for assessments. Treatments were: (a) whole season spraying with drift-reducing nozzles, (b) whole season spraying with standard nozzles, (c) no spraying—control plots. We did not intend to make comparisons between different apple cultivars, only the differences between treatments with standard or drift-reducing nozzles and the control were studied. Student's t-test was used at ($P<0.05$) for determining the differences between treatment means.