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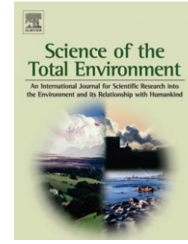

Measures to reduce pesticide spray drift in a small aquatic ecosystem in vineyard estate

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ABSTRACT

A field experiment is reported to ascertain the drift of two pesticides (chlorpyrifos and metalaxyl) in a vineyard in Italian climatic conditions and the effect of mitigation measures, such as buffer zones and tree rows, on pesticide drift contamination in a small aquatic system located inside the field.

Results indicated that, in typical Italian agricultural conditions, spray drift in vineyards occurs at a distance of more than 24 m and adequate buffer zones are required to protect surface water bodies from direct contamination. The presence of tree rows in front of the water body inside the agricultural field, against the main wind direction, resulted in a very high reduction of the spray drift and of the ecotoxicological risk for aquatic ecosystem.

In addition, a comparison between the data obtained in the experiment and the Drift Calculator procedure showed that the model failed when the procedure is used for short distances. However, concordance was found in terms of maximum drift distances.

1. Introduction

Non-point-source pollution is generally considered one of the major threats to surface water quality in rural areas (Loague et al., 1998). Spray drift is an important route of entry and can be considered as a worst case because of the direct input and bioavailability of the applied pesticides (Gil and Sinfort, 2005).

Spray drift is the movement of a pesticide through the air, during or after application, to a site other than the intended target. Drift is considered to be the most challenging problem facing applicators and pesticide manufacturers. Although drift may occur as vaporized active pesticide from the application site, it is usually the physical movement of very small drops from the target area at the time of application.

Spray drift is becoming an increasingly important part of every spraying application. More diversification of crops, more active and non-selective herbicides, and a greater awareness of pesticides in the environment have caused spray drift management to become every applicator's business.

There are several factors that play a significant role in the occurrence and the reduction of drift. They can be grouped into one of the following categories: i) spray characteristics, such as volatility and viscosity of the pesticide formulation; ii) equipment and application techniques; iii) weather conditions at the time of application (wind speed and direction, temperature, relative humidity and stability of air at the application site); iv) operator care, attitude and skill (van de Zande et al., 2000; Hofman and Solseng, 2001; Carlsen et al., 2006).

Efforts have been made to find some techniques and application methods to reduce spray drift. Among others, low drift nozzles, air-assist sprayers, drift control additives and

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sprayer shields play an important role (Pepper et al., 2001). However, drift cannot be completely eliminated and it remains an important route of entry of pesticides into surface water bodies.

In Europe current regulatory procedures for aquatic risk assessment stated by FOCUS (Forum for the Coordination of the Use of Models) are based on standard parameters included in a Drift Calculator, a utility to calculate the amount of pesticide deposits on surface waters, due to spray drift after pesticide application on field crops (Rautmann et al., 2001; Holterman and van de Zande, 2003). The FOCUS simulations were obtained using standard scenarios, and thus field experiments conducted in more realistic and representative conditions are required in order to refine the risk assessment (Linders et al., 2001). Moreover, Ganzelmeier (1995) tables, used in the above procedure, report distances for pesticides spray drift only for some crops under north European climatic conditions, while few studies about the same topic are available under south European climatic conditions. Among those, Meli et al. (2003) conducted trials in Sicily, Southern Italy, in four different citrus fields with chlorpyrifos methyl and compared manual and air-blast applications in orchards. The results showed that the Ganzelmeier tables consistently overestimated spray drift.

In Italy vineyard productivity requires several pesticide treatments especially against pathogen as fungi and insects, and irrigation water is usually needed from little ponds positioned in the middle of the field.

The present experiment reports the results of a drift trial in an Italian vineyard field, with a pond in the middle, separated from the vineyards by vegetative buffer strips and a tree row in the northern side (main wind direction). Two separate treatments were made with the insecticide chlorpyrifos (C) and the fungicide metalaxyl (M), respectively.

The drift distances were measured following the main wind direction and the effects of mitigation measures such as buffer strips and tree rows, for protecting the water body in the middle of the field, were evaluated. Finally, a comparison of the data obtained on drift distances was performed against those estimated by the Drift Calculator (Rautmann et al., 2001) to verify possible discrepancies.

2. Materials and methods

2.1. Field site

The study was carried out in a vineyard situated near Piacenza (Northern Italy). The grown cultivars were Sauvignon, Croatina, Barbera and Malvasia with a Guyot form. Grapevines covered about 3.3 ha and the experimental plot was rectangular in shape. In the middle of the vineyard there was a pond (10×20 m^2 surface $\times$ 1.5 m depth). The pond was encircled by a protected area of 10 m and at the northern and south sides there were rows of trees, *Populus alba* with a leafy foliage of 0.5 LAD (Leaf Area Density, m^2 m^{-3}). A plan of the field is reported in Fig. 1, while Fig. 2 reports the vegetation profile around the pond from the four cardinal points.

2.2. Pesticides application

Chlorpyrifos (C) (DURSBAN 44.6% CE manufactured by DOW Agrosciences) and Metalaxyl (M) (METAMIX M WP manufactured by Agrimix) were used as the test compound.

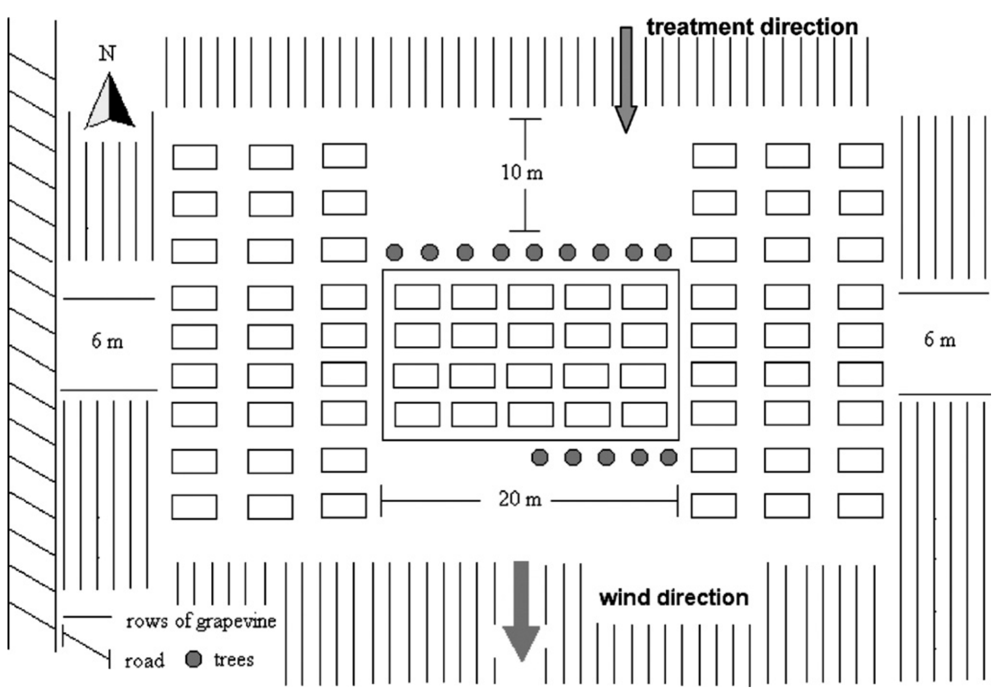

Fig. 1 – Schematic plan of the sampled field (▭ = drift traps; each rectangle represents two collected samples).