Conference proceedings "Pesticide behaviour in soils, water and air", B 34. York, 14-16 September 2009

Occurrence of pesticides in stream water from regions with horticultural production

Sarah Graaf[1], Jenny Kreuger[1], Johan Patring[2] and Stina Adielsson[1]*

[1] Swedish University of Agricultural Sciences, Dept. of Soil and Environment, P.O. Box 7014, SE-750 07 Uppsala, Sweden
[2]Swedish University of Agricultural Sciences, Dept. of Aquatic Sciences and Assessment, P.O. Box 7050, SE-750 07 Uppsala, Sweden
*Jenny.Kreuger@mark.slu.se

Introduction

Open ground horticultural production is generally pesticide intensive, but the areal extent of this cultivation is quite limited in Sweden. Thus losses of pesticides related to horticultural production have been overlooked. The Swedish National Environmental Pesticide Monitoring Programme has since 2002 monitored transport losses of agricultural related pesticides from catchments characterised by intensive agriculture. However, during 2008, a screening programme was set up including four catchments located in south Sweden where cropping of traditional garden vegetables and fruits is well established, horticulture occupying approximately 11 to 20 per cent of total arable land. The sizes of the four catchments are between 5.46 to 18.64 km^2. Additionally, two areas with extensive greenhouse production were monitored to challenge the assumption that pesticide application in greenhouses takes place in closed areas, thus posing a negligible risk to the aquatic environment. The overall aim of the screening study was to investigate possible losses of pesticides from open ground production and greenhouse horticultural production under Swedish conditions. The screening presented is so far the most extensive in Sweden regarding the number of pesticides analysed in Swedish surface waters.

Material and methods

Sites were selected based on regional statistics from the Swedish Board of Agriculture and GIS terrain data.

Time of sampling was adjusted to the main application period for the dominant horticultural crops in each catchment and coincided with the start of the treatment period and continued to some time after.

Surface water from the streams draining the catchments were sampled as momentary samples approximately every 14th day with exception for one area where time integrated samples were collected with an automatic sampler every 80th minute to compose a weekly average. All samples were analysed for 126 substances known to be used in pesticide products common in agricultural and/ or horticultural production of which 12 were specific to horticulture. Additional information on field activities, precipitation data and measurements of water flow rates were compiled.

Results

Results show that there was, in addition to the expected losses of pesticides used in agricultural production, a substantial contribution of pesticides used exclusively in horticulture to the overall losses into surface waters.

Table 1. Site information and monitoring results

Site	Dominant horticultural produce	No. of substances detected	No. of substances exceeding the water quality objective	No. of samples with concentrations exceeding the water quality objective
1	Strawberries, cucumbers, potatoes	25	1 (126)	2 (9)
2	Carrots, onions, potatoes, strawberries	44	4 (126)	9 (11)
3	Apples	24	1 (126)	1 (11)
4	Potatoes, canning peas	41	7 (126)	6 (21)
5	Greenhouse: ornamental plants, cucumbers	43	10 (126)	7 (7)
6	Greenhouse: tomatoes, cucumbers	40	8 (126)	5 (5)

A total of 75 different pesticides, out of 126, were detected in the 64 analysed water samples. 9 among 12 horticulture specific substances were found. During the survey 19 substances and one degradation product exceeded the Swedish surface water quality objectives. The largest numbers of substances were present in the catchments dominated by intensive vegetable and greenhouse production while the lowest findings occurred in the catchments dominated by strawberry and apple horticultural production (Table 1). A possible explanation could be that the relatively low rainfall during the time of sampling caused a very low surface flow. Higher concentrations could be detected from the other sites with higher precipitation. Differences between pesticide application equipment used for the various crops might contribute to the overall result. Instantaneous spray drift from fan sprays might occur in apple fields outside the time of sampling and thus overlooked.

Conclusion

The result indicates that pesticide application within horticultural activities contributes to the overall occurrence of pesticides in Swedish surface waters. Distinguishing for the greenhouse areas (i.e. sites 5 and 6) was the continuous detection of the degradation product endosulfan-sulphate (75% of all samples) despite the withdrawal of endosulfan from the Swedish market in 1995, where it previously was used in greenhouse production. Also the insecticide hexytiazox (80% of all samples) only used within horticulture was detected throughout the sampling period. Imidacloprid was detected in elevated concentrations (up to 15 µg/l) and exceeded the water quality objective in all samples from these sites. At present the environmental risk assessment during the process of registration of pesticides for greenhouse production is based on the assumption of that the greenhouse is a closed system, from which the risk of pesticide loss to surrounding water can be excluded. Possible detrimental effects on surrounding water are thus at risk of being overlooked and these results motivates further development in identifying risk elements coupled to pesticide use within greenhouse production.