Chapter 11
Impact of Pesticides on Invertebrates in Aquatic Ecosystem

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ABSTRACT

Aquatic ecosystems do not contain more than a fragment of the global water resources, but they are exclusive and complex habitats due to the extremely close association between terrestrial and aquatic habitats. The important fish stocks and a unique set of organisms that provides priceless consumer services, such as chemical water purification and organic matter processing, are affected. The pollution of aquatic ecosystems with pesticides applied in agricultural production is widely acknowledged as one of the greatest anthropogenic stressors to stream ecosystems, and agricultural pesticides are known to cause a threat to all living organisms in stream ecosystems. The general objective of this chapter is to study the effects of agricultural pesticides on invertebrates. There are only a few evaluating effects of pesticide contamination resulting from normal agricultural practice on invertebrates, and there is a lack of studies focusing on the indirect effects of pesticides. The importance of physical habitat degradation in the assessment and mitigation of pesticide risk in agricultural streams will be discussed.

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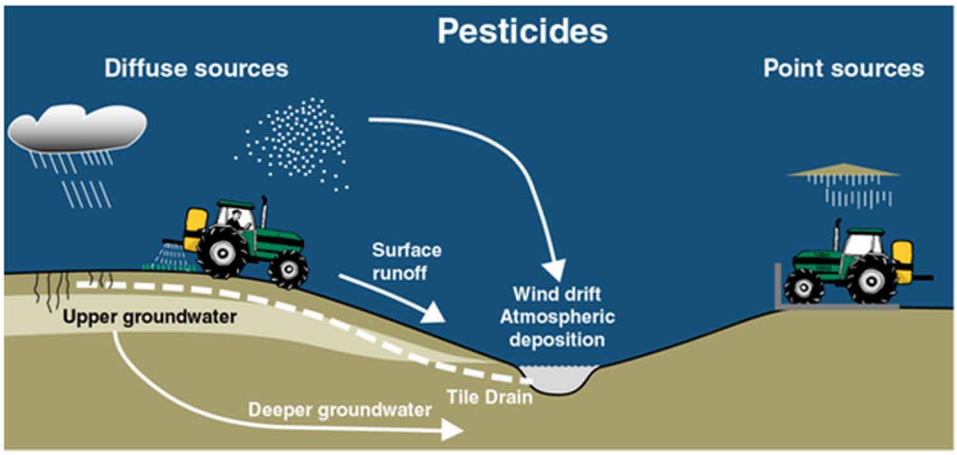
Figure 1. Major transport routes into receiving streams for pesticides that are applied to agricultural fields



INTRODUCTION

The main routes through which the pesticides are transported to water bodies include surface runoff, tile drains, groundwater and leakage from point sources (Schulz, 2004). The transport pathways are strongly governed by climatic and geological conditions of the area and also by the physicochemical properties of the pesticide compound (Figure 1).

Consequently, peak pesticide concentration lasts for short period and occurs during heavy precipitation. The maximum exposure concentration is important for estimating ecological effects (Schulz & Liess, 2000). The combination of extensive agricultural activities and the close connectivity between land and stream makes them more vulnerable to pesticides. Overall, many environmental factors that act on stream ecosystems are directly or indirectly correlated. Pollutants like pesticides have potential impact on agricultural streams and are effected by other local stressors like channelisation and dredging (MacArthur & Wilson, 1967). The stream ecosystem is also influenced by the local factors which are believed to be more important for aquatic biodiversity (Pedersen & Friberg, 2009). The aquatic biodiversity is very sensitive to different xenobiotic substances like pesticides. Pesticides are believed to have more impact on invertebrates as compared to other pollutants (Beketov & Liess, 2012).

Some pesticides have severe impact on organisms even at low concentration while some are less toxic even at high concentration although it depends on the chemistry and properties of the pesticide. Synergetic effects are generally shown by different compounds with similar mode of action, and mostly trigger the effect on the exposed organism (Belden & Lydy, 2000). Few studies have shown that pesticides possess joint toxicity on aquatic invertebrates (Belden & Lydy, 2000). Bailey and coworkers (1997) showed that two organophosphorus insecticides, diazinon and chlorpyriphos, exhibit additive toxicity to Ceriodaphniadubia. Additivity between diazinon and chlorpyriphos is reasonable given that both are metabolically activated organophosphorus insecticides and act similarly with respect to binding with acetylcholine acetrase (AChE) (Ecobichon, 1991).

Indiscriminate use of pesticide spraying may cause ecological disturbance in natural aquatic environments. Lack of information about pesticide is the serious concern for ecosystems. Although mode of action of several pesticides is known (Ecobichon, 1991), however very little is known about their