Pesticide Use and Surface Water Quality Issues

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Water quality regulations in California stem from the Federal Clean Water Act (CWA) of 1972, which prohibits the discharge of pollutants in water ways at levels that affect the beneficial use of the waters, including drinking, recreation, aesthetics, fishing, and irrigation. The law focuses on both point and non-point source pollution. Point source refers to the discharge of pollutants from factories or sewage treatment plants directly into waterways. Non-point source refers to the discharge of pollutants from indirect sources such as agriculture, timber, mining, dust, and stormwater runoff into water bodies. For 25 years the CWA focused on point source pollution and cleaning up waste from discharge pipes. This has improved water quality, but not enough. As a result, the focus of water quality protection is now on cleaning up problems associated with non-point source pollution.

The amount of pollutants allowed in water bodies is set by TMDL's (Total Maximum Daily Loads) which defines the amount of a contaminant that a water body can tolerate with out adversely affecting the beneficial use of the water. For example, the insecticide chlorpyrifos is found in several of our rivers and the Sacramento Delta at concentrations that cause mortality to the aquatic test organism *Ceriodaphnia dubia* (a water flea and EPA indicator of water quality). As a result many waterways have been listed as impaired, which means that the concentration of chlorpyrifos must be reduced to levels that are not toxic to *C. dubia* (likely 80 ppt). The RWQCB is responsible for enforcing the CWA and state water quality laws. They are the lead agency that develops TMDL plans for water bodies that are adversely affected by one or more pollutants. This involves identifying pollutants, allocating loads, implementing plans, setting numeric targets, and developing and implementing plans to meet water quality standards.

There are 694 high priority TMDL's in California including pesticides, sediments, nutrients, pathogens, metals, and ammonia. Of the 125 high priority pesticide pollutants, 61% are still DDT and *chlordane*, which are no longer registered in the US. In the Central Valley, 80% or 30/37 of the listed TMDL's come from crop production, grazing, and dairies. Irrigated agriculture has had a waiver to discharge irrigation and storm water from agricultural lands but this expired in 2000. Current law states that farmers must comply with one of the following to discharge irrigation or storm water from their farms 1) apply for a waste discharge permit, 2) apply for an individual waiver, or 3) join a watershed group. Applications for waste discharge permits are not economically feasible for growers because of the high cost of permits and complying with California's Environment Quality Act. Applications for individual waivers may also be too costly because of the requirement for extensive water quality monitoring and reporting for individual farms (including metals, pesticides, pathogens, sediments, and temperature). The best choice for most growers that discharge irrigation or storm water from irrigated lands may be to join a watershed group. This group will be lead by an agency such as

the Farm Bureau or Natural Resources Conservation and will work together with farmers to pool resources for monitoring and reporting water quality in select drainages. Applications for individual and group waivers are reviewed yearly by the SWRCB and attempts to improve water quality from farms must be documented.

The likelihood that a pesticide will move offsite depends on its 1) persistence, 2) soil adsorption value, and 3) aqueous solubility. Persistence or half-life refers to how long the pesticide remains active (depends on light, temperature, microbial activity and pH). The soil adsorption coefficient (Koc) refers to how tightly a pesticide binds to the soil, and aqueous solubility refers to the concentration at which a particular pesticide will dissolve in water. In general, pesticides with a long persistence, high solubility, and low binding coefficient are the worst for ground and surface water. The toxicity of a particular pesticide to aquatic life is also important to understand for water quality protection. Some pesticide (such as chlorpyrifos) are highly toxic to aquatic life, others such as bacterial insecticides are seemingly innocuous. A list of insecticides and their likelihood of moving offsite and toxicity to aquatic life can be found at http://ceyolo.ucdavis.edu pest management. Some pesticides (such as pyrethroids) that bind to sediments can move off site attached to soil particles where they may cause problems to benthic organisms. For these classes of insecticides, it is important to look for ways to reduce silt coming off the application site, including the use of sediment traps, ponds, or grass filter strips.

As an example of ways to mitigate off site movement of pesticides from farm fields, Long et al., (2000) conducted a 3-year study in alfalfa to look at pyrethroids versus organophosphates (OP's) for insect control and secondary impacts to water quality. Results showed that where OP's were applied, there was 100% mortality to *C. dubia* in irrigation tail water, compared with insignificant mortality in water from pyrethroid treated fields. Chemical analyses of tail water samples confirmed the absence of pyrethroids at 50 ppt. Although pyrethroids may move off site attached to soil particles, this does not appear to be a problem for alfalfa because the fiberous root system traps sediments. Based on the chemical properties of OP's and pyrethoids the results that Long obtained are not surprising. OP's, in general, are fairly water soluble and do not bind to sediments so will move in water. In contrast, pyrethroids are water insoluble and bind to sediments, so will not move in water, except bound to sediments.

This paper addressed concerns with pesticide contamination of surface water. To prevent offsite movement of pesticides from the site of application it is important to understand how different classes of insecticides behave in the environment and to know where irrigation and storm water flows. If water from a farm or other site drains into a natural waterway, it is important to choose a pesticide that sticks to the soil, has a low half life, is water insoluble, and has a low toxicity to aquatic life. For pesticides that move offsite attached to soil particles, growers should install sediment traps, vegetation filter strips, tail water ponds, or return systems on their farms to prevent sediments from moving offsite.

References

Long RL, Nett M, Putnam DH et al. 2002. Insecticide choice for alfalfa may protect water quality. California Agriculture 56(5):163-69.