Followup Aquatic Life Toxicity Testing

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Questions have arisen about the followup toxicity testing that should be conducted in the CVRWQCB Ag Waiver water quality monitoring program. Presented below is guidance on a recommended approach to address this issue. The guidance evolved from a three-year, $500,000 study of the aquatic life toxicity in stormwater runoff in the Upper Newport Bay, Orange County, California, watershed that was conducted by Lee and Taylor (2001).

Define Potential Sources of Toxicity

The first step in developing an appropriate followup Ag Waiver toxicity testing program is to define all potential sources of aquatic life toxicity in the monitoring location watershed. Work with the DPR Pesticide Use Report database and the County Agricultural Commissioner to define for the past three years of record:

- Pesticides that have been used in the watershed
- Amounts of each pesticide used and purpose
- Location(s) where used
- When used by month.

Since the data in the most recent DPR Pesticide Use Report are likely one or more years old, the County Agricultural Commissioner may be able to provide more recent data pertinent to pesticides used in the several months prior to the sampling where toxicity was found. This several-month period is typically the effective lifetime in soils of many of the currently used pesticides.

In those situations where there is an urban community in the Ag Waiver monitoring location watershed, there is need to consider the types of pesticides used by the urban residents. The DPR Pesticide Use database lists the amounts, types and purposes of pesticides used in urban areas that are applied by commercial applicators. However, this database does not provide information on the types and amounts of pesticides used that have been purchased at a garden supply or hardware store. In order to determine the types of pesticides used in an urban area on residential property by the public, it is necessary to review the types of pesticides being sold to the public in the area.

Lee (2005a,b) and Lee and Jones-Lee (2005a) have discussed the changing situation that is occurring in the use of pesticides in urban areas. At one time the OP pesticides diazinon and chlorpyrifos dominated residential use. With the US EPA prohibiting the sale of OP pesticides for residential use, pyrethroid-based pesticides now dominate residential sale and use. As discussed by Lee (2005a,b) and Lee and Jones-Lee (2005a), there is increasing evidence that

pyrethroid-based pesticides are causing toxicity in waters receiving runoff from where they have been applied in the water column during the runoff event and in receiving water sediments just downstream of runoff from an application area. Amweg et al. (2006) and Raloff (2006) have provided information on the aquatic life toxicity issues associated with the use of pyrethroid-based pesticides.

It is becoming increasingly clear that currently available/formulated pyrethroid-based pesticides are causing violations of the CVRWQCB Basin Plan, which will ultimately result in preventing their use in those situations where there can be runoff containing the pesticides to the State's waters. Other types of pesticides are being sold for residential use. Lee (2005a) has reported that neonicotinoid-type pesticides are now being sold for residential use. With the aquatic life toxicity problems that are being found caused by pyrethroid-based pesticides, it is likely that a number of new types of pesticides will start to be sold/used on residential properties. It will be important to evaluate the potential for the new or expanded-use pesticides to cause aquatic life toxicity in the receiving waters' water column and/or sediments. This information needs to be considered in developing Ag Waiver monitoring programs for those conditions where there is an urban area in the Ag Waiver monitoring station's watershed. It is also likely that the replacements for the pyrethroid-based pesticides will be used in agricultural areas.

Toxicity Testing Approach

The toxicity testing should include not only measuring the presence of toxicity but also, for those samples that show toxicity, should include followup dilution series testing on the same sample that has been stored in the dark at just above freezing. This followup dilution series testing should be conducted just as soon as it is evident that substantial toxicity was present in the sample. The dilution series should include incubation with and without piperonyl butoxide (PBO) at 100 µg/L. As discussed by Lee and Jones-Lee (2005b), this approach will provide an estimate of the total toxicity (toxic units) and the potential for the toxicity to be caused by OP and pyrethroid-based pesticides.

Toxicity investigation evaluations (TIEs) beyond those recommended above (involving PBO addition in a dilution series) can, in some instances, help identify the chemical(s) responsible for the toxicity. It has been found that large amounts of funds can be spent on TIEs, yet fail to identify the cause of the toxicity.

Followup Toxicity Testing

There are two types of toxicity situations (event-based and continuous) that need to be addressed in developing followup toxicity testing. For toxicity that is related to a stormwater runoff event, such as in the winter, the followup testing should be at the next stormwater runoff event even though no new pesticide application has occurred since the runoff event that was associated with a toxic hit. Except for very small runoff events, stormwater runoff from an area that contributes sufficient pesticides to cause aquatic life toxicity at a downstream monitoring station will in many situations also contribute pesticides in the next runoff event.

In those cases where repeated event-based toxicity is found, the followup toxicity testing should include sampling at several locations in the watershed to define smaller subunits of the watershed for the toxicity. This approach, when combined with pesticide use information, can help identify

those situations that are contributing pesticides in stormwater runoff which cause aquatic life toxicity in the receiving waters.

During the irrigation season in late spring, summer and early fall, information on the pattern of irrigation in a watershed relative to information on pesticide application may be helpful in defining the source of toxicity that is contributed to a waterbody in irrigation tailwater.

In order to evaluate whether the toxicity is due to a more or less continuous source, the followup sampling should be done just as soon as it is possible to get back to the sampling station. If toxicity is found again in a couple of days after a toxic hit and there has been no additional precipitation/runoff since the hit, then it is likely that the source is not stormwater runoff from an area where the pesticide has been applied. For continuous sources, the forensic approach of sampling upstream at various locations in the watershed could be effective in locating the source. The forensic approach involves essentially simultaneous (i.e., within one day) sampling at various locations within the watershed.

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