Inadequacies of the Single Chemical Probabilistic Risk Assessment Approach For Regulating OP Pesticide Aquatic Life Toxicity[1]

G. Fred Lee, PhD, PE, DEE
G. Fred Lee & Associates, El Macero, CA
E-mail: gfredlee@aol.com

Chemical companies, Superfund Principal Responsible Parties (PRPs) and others have been promoting probabilistic risk assessment as an approach that can be used to evaluate the potential water quality significance of hazardous chemicals in the aquatic environment. This approach is now being applied to the regulation of organophosphate pesticide aquatic life toxicity. Novartis (1997) and Giesy *et al*. (1999), on behalf of Dow AgroSciences have developed probabilistic risk assessments for assessing the water quality significance of *Ceriodaphnia* toxicity associated with the use of diazinon and chlorpyrifos. These risk assessments purport to show that, based on the information available, there is a potential impact of OP pesticide toxicity on aquatic life resources of a waterbody. However, this impact is within the promoted level of aquatic life toxicity that is claimed to be acceptable, i.e., 10% of the species within a waterbody can be killed 10% of the time without significant adverse impact on the ecosystem functioning. The OP pesticide ecological risk assessment work that has been done thus far confirms what was known from the exceedance of a water quality standard approach, that there are potentially significant water quality problems associated with the OP pesticide aquatic life toxicity that need to be better understood before it can be concluded that this toxicity is not significantly detrimental to the designated beneficial uses of a waterbody.

Further, such issues as additive and synergistic effects of various toxicants, including other OP pesticides, are thus far ignored in the probabilistic risk assessments that have been conducted. Basically, the probabilistic risk assessment shows that the cladoceran *Ceriodaphnia* is highly sensitive to OP pesticide toxicity. It is not, however, the most sensitive organism known. The amphipod *Gammarus fasciatus* is about twice as sensitive to diazinon toxicity as *Ceriodaphnia dubia* (Novartis 1997). A similar situation exists with respect to chlorpyrifos, where the amphipod *Gammarus fasciatus* is about twice as sensitive to chlorpyrifos as some cladocerans. There is a potential, through further study, that other organisms will be found to have even greater sensitivity to diazinon and chlorpyrifos toxicity than *Ceriodaphnia*. This points to the need to better understand the ecological role of cladocerans such as *Ceriodaphnia* and amphipods in providing food for key higher trophic-level aquatic organisms of concern to the public.

While an ecological risk assessment is an interesting initial step in an evaluation of the potential water quality significance of OP pesticide toxicity, at this time ecological risk assessment falls far short of providing the information needed to assert that the toxic pulses caused by OP pesticides that occur in receiving waters for urban area and some agricultural area stormwater runoff are not adverse to key aquatic

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organisms of concern to the public. Further, and most importantly, the ecological risk assessment approach places a great demand for high quality data far beyond that available. The only possible way that ecological risk assessment can be an effective regulatory tool is for those who want to maintain the use of OP pesticides, such as the chemical manufacturers, agricultural interests, and the members of the public who wish to use these pesticides, fund the studies needed to reliably evaluate the potential ecological significance of toxic pulses of OP pesticide toxicity associated with urban stormwater runoff events.

Ecological risk assessment can be a reliable base for developing regulatory approaches for chemicals in the environment as they may impact public health and/or aquatic/terrestrial ecosystems. However, in order to use this approach, there must be a substantial database of reliable information which rarely, if ever, exists. It is inappropriate for chemical companies and pesticide users to expect that regulatory agencies and members of the public who do not use these chemicals will pay for the studies or wait for the studies to be done until regulatory decisions are made. The OP pesticide aquatic life toxicity problem has been known for many years. Little has been done, however, to obtain the necessary information to properly evaluate the ecological significance of the OP pesticide-caused toxicity associated with urban area stormwater runoff.

An aspect of the ecological risk assessment issue that needs to be understood is that environmental groups who are largely behind the current pressure to control the OP pesticide aquatic life toxicity will not likely accept the premise that OP pesticides can kill 10% of the species and not be adverse to the beneficial uses of a waterbody of concern to the public. In order to make a convincing argument for this position, it will be necessary to provide substantial, site-specific data. Simply stating, as is done in support of ecological risk assessment that some group somewhere stated that the appropriate approach for protecting ecosystems is to protect 90% of the organisms 90% of the time is not adequate. There is no justification for this approach that would be acceptable to the majority of the environmental groups, as well as many regulatory agencies and members of the public. While there is an attempt to shift the burden of showing that killing 10% of the species 10% of the time does not represent a significant adverse impact to the public or those who represent their interests, in fact, the burden of proof should be on the pesticide manufacturers and users, i.e. those who benefit through profits or the availability of the pesticides, to convincingly show that the pesticides can be used safely without significant adverse impacts to public health and the environment.

Anyone who is sufficiently naive to believe that environmental groups who have, through litigation, been able to force the US EPA and the state water pollution control agencies to finally conform to the regulatory process that has been in effect for many years of controlling exceedances of water quality standards through the 303(d) listing and the implementation of TMDLs to eliminate this listing, does not understand the current situation in the water pollution control field. Environmental groups have for years been trying to get the US EPA and states to implement the Clean Water Act in accord with regulatory requirements. While there is considerable justified concern about the appropriateness of some of the Clean Water Act requirements as set forth in the original Act and in various amendments to the Act, until the Clean Water Act is changed the US EPA and the states have no choice but to fully implement its

requirements for the control of exceedances of water quality standards, including the narrative standards of no toxics in toxic amounts. The special regulatory provisions provided to pesticides of requiring the control of pesticide-caused toxicity that is significantly adverse to the beneficial uses of the waterbodies will not likely prevail over long periods of time in the current regulatory situation.

Additional information on the regulatory issues that should be considered as part of developing control programs for OP pesticide caused aquatic life toxicity is available from Lee, et al. 1999.

REFERENCES

Giesy, J.P., Solomon, K.R., Coats, J.R., Dixon, K., Giddings, J., Kenaga, E., "Chlorpyrifos: Ecological Risk Assessment in North American Aquatic Environments," Reviews of Environmental Contamination and Toxicology, 160: 1-129, Springer, New York, NY (1999).

Lee, G.F., Jones-Lee, A., and Taylor, S, "Evaluation of the Water Quality Significance of OP Pesticide Toxicity in Tributaries of Upper Newport Bay, Orange County, CA," *Ninth Symposium on Environmental Toxicology and Risk Assessment: Recent Achievements in Environmental Fate and Transport, ASTM STP 1381* (1999) in press, preprint available from www.gfredlee.com.

Novartis, "An Ecological Risk Assessment of Diazinon in the Sacramento and San Joaquin River Basins," Novartis Crop Protection, Inc., Technical Report: 11/97, Greensboro, NC (1997).

SETAC (Society of Environmental Toxicology and Chemistry), Aquatic Risk Assessment and Mitigation Dialogue Workgroup, Final Report, SETAC Foundation for Environmental Education, Inc., Pensacola, FL (1994)

Solomon, K.R., "Overview of Recent Developments in Ecotoxicological Risk Assessment," Risk Analysis, Vol. 16:627-633 (1996)