Pesticides and Plastic Mulch Threaten the Health of Maryland and Virginia Eastern Shore Waters

by Greg Kidd, J.D.

"I felt like a canary in a coal mine." These are the words of Mr. R.G. Parks of Parksley, Virginia, an aquaculturist by profession. Mr. Parks first became concerned about the health of the tributaries of the Chesapeake Bay and Atlantic Ocean back in 1993 when he noticed a massive die-off of the shellfish in his hatchery and nursery operation. It is well known that clams, oysters, and other bottom-feeding organisms serve as indicators of water quality. He noted that deaths appeared to be linked to periods of heavy rainfall. Investigating up-stream, Mr. Parks discovered that the increased mortality rate he was observing in his shellfish corresponded with an increase in the use of plastic mulch, known as "plasticulture," used in conjunction with pesticide applications by tomato growers in his area. While this practice is often viewed as reducing pesticide use and drift by the chemical-agricultural industry, Mr. Parks' story, and recent studies make it clear that plasticulture simply substitutes one environmental problem with another.

Runoff, loaded with pesticides, runs directly into Garagathy Creek. *Photo courtesy of R.G. Parks*

Mr. Parks contacted a number of scientists in the early stages of his investigation, including Andrea Dietrich, Ph.D., a professor in the Department of Civil and Environmental Engineering at Virginia Tech. She and her colleagues began collecting water samples from Eastern Shore watersheds. These samples contained alarmingly high concentrations of a variety of pesticides and explained the shellfish mortality. Mr. Parks managed, through legal action, to compel his neighbors using plasticulture to lease land elsewhere, so his immediate problem has been solved. But this has not stopped him from crusading for the health of the bay, the ocean, and their tributaries by becoming a self taught expert on the subject of plasticulture and sharing his knowledge with environmentalists and policy makers.

The practice of plasticulture has been growing in popularity with tomato and pepper farmers along the East Coast. According to the U.S. Department of Agriculture (USDA) the acreage under plasticulture has grown dramatically over the past several years, and it continues to grow. The USDA's website confirms that in Maryland "nearly all fresh market growers [of tomatoes] use black polyethylene mulch for weed control, with herbicide sprayed between rows" (http://pestdata.ncsu.edu/cropprofiles/Detail.CFM?FactSheets__RecordID=57). Closer to Mr. Parks' home, the area under plasticulture on Virginia's Eastern Shore rose from about 500 acres in 1990 to over 6,000 by 1996. (Brumbaugh, 1996). Why has there been this growth in the use of plastic mulch and what are the environmental issues associated with this practice?

Why use plasticulture?

Regardless of the environmental costs, chemical intensive farming has led consumers to demand blemish free tomatoes. Chemical companies and government programs have taught farmers that meeting this kind of consumer demand requires careful control of soil moisture and multiple applications of pesticides. Using sheets of plastic as mulch that cover 50% to 70% of the soil allows farmers to use drip irrigation systems under the plastic to precisely control soil moisture and nutrients, which can be injected directly into irrigation lines. This eliminates any dependence on rainwater. Because rain is not required, plasticulture fields are pitched to encourage the fastest runoff of rain. The bare soil between the plastic covered rows is often compacted to facilitate the runoff of water, inhibit weed growth and allow large trucks to enter the field. (Brumbaugh, 1996).

What are the environmental issues?

The excess runoff associated with plasticulture coupled with the direct application of pesticides can harm the environment as pesticides are transported into environmentally sensitive areas such as wetlands and tidal creeks. In particular the copper-based crop protectants, used to control bacterial and fungal diseases, have a devastating effect on shellfish. Extremely low copper concentrations have been found to cause deformation and death to larval shellfish. (Cheadle, et al., 1999). As Mr. Parks' clams and oysters go, so go the wild populations of shellfish in waters in and around the bay. Other pesticides normally applied to plasticulture fields include endosulfan (an organochlorine), anzinphosmethyl (an organophosphate), fenvalerate (a synthetic pyrethroid),

Plastic Mulch covers 58% of this field, shown before planting. *Photo courtesy of R.G. Parks*

chlorothalonil (a deadly nitrile compound, see Beyond Pesticides/NCAMP's *Technical Report*, Vol. 14, no. 8&9, 1999) and methyl bromide used as a fumigant before planting.

What do the studies show?

During rain events, runoff from the plasticulture fields contains from 20-238 ppb (parts per billion) dissolved copper. Background levels of <1-3 ppb dissolved copper were measured in water samples from Gargathy Creek and Parker's Creek during periods of no rain. The concentrations rose as high as 20 ppb dissolved copper during runoff producing rain events. The LC-50 for dissolved copper (that is, the lethal concentration resulting in 50% mortality) for adult hard clams is 16.4 ppb - well below the measured levels. (Brady, et al. 1999).

These findings were derived from water samples taken during the spring of 1998 through the fall of 1999 from Gargathy Creek, Parker's Creek, and Raccoon Creek on the Eastern Shore of Virginia. (Brady, et al. 1999). Both the Gargathy Creek and Parker's Creek watersheds support plasticulture and drain into the Atlantic Ocean. Raccoon Creek is located in a wildlife refuge and also drains into the Atlantic; it was used as a control.

In another study conducted on Gargathy Creek in 1996, total copper concentrations as high as 700 ppb were observed following rain events and were as high as 1,400 ppb in field runoff. (Brumbaugh, 1996). The values found in both of these studies far exceed the Virginia Department of Environmental Quality saltwater standard of 2.9 ppb dissolved copper.

In the same 1996 study, concentrations of endosulfan in the creek were 0.97 ppb following runoff producing rain events. These endosulfan concentrations far exceed Virginia's water quality standard of 0.034 ppb (acute toxicity) and 0.0087 ppb (chronic toxicity) for endosulfan.

The bottom line is that plasticulture is fundamentally different from other cultural practices used on the Eastern Shore. The decreased permeability of the soil caused by both the plastic and the compaction of the soil encourages high volumes of runoff. Because the runoff contains high concentrations of pesticides and sediment, it has a significant negative impact on the water quality of the Chesapeake Bay, its tributaries and ultimately the Atlantic Ocean.

What about alternative practices?

Recent studies conducted by the USDA's Agricultural Research Service (ARS) show that the use of living plants as mulch, or "green mulch," can make a huge difference in protecting water quality. The ARS found that using hairy vetch, a legume, instead of plastic mulch provides a number of benefits; it cuts pesticide losses by as much as 90%, and it greatly reduces water runoff, which reduces sediment losses. In addition, legumes fix nitrogen, which augments the soil. (Pesticide Report, 1999).

The preliminary results of tests conducted at the University of Maryland's Chesapeake Biological Lab in Solomons, MD are promising. These studies indicate that aquatic organisms suffer significantly less adverse effects when exposed to runoff from fields mulched with hairy vetch compared to plots mulched with plastic. (Pesticide Report, 1999).

For more information explore the USDA/OPMP Crop Profile Database on the web at http://pestdata.ncsu.edu/cropprofiles/.

Pesticides are applied to plasticulture tomatoes on average 30 times per crop.
Photo courtesy of R.G. Parks

References

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