**SILENT SPRING REVISITED – have things changed since 1962?**

David Pimentel writes his viewpoint on progress over the last 40 years in dealing with the environmental problems highlighted in Rachel Carson’s book, *Silent Spring* (1962). Rachel had, David says, the foresight and knowledge to warn us about the ecological hazards of pesticides to public health and health of other organisms.

**Introduction**

It took 10 years from the time that Rachel Carson’s book was published before DDT was banned in the U.S. in 1972. By the time that DDT was banned, pesticide use had increased 10-fold to about 500,000 kg per year. The total quantity of pesticides used in the U.S. in terms of pounds has not increased since 1972, but the actual toxicity of the pesticides has increased 10 to 20 times (Pimentel *et al.*, 1993). The prime benefit with the new, highly toxic pesticides that replaced DDT and similar chemicals is that the new toxicants do not persist for long periods of time in the environment.

The major problem with the recommended use of pesticides is that so little actually reaches the target pests. Estimates are that less than 0.01% of the pesticides that are applied reach the target pests (Pimentel and Levitan, 1986). This, of course, means that 99.9% of the pesticide that is applied pollutes the environment.

In this article, I will briefly review the impacts of pesticides on human health and the environment (including birds, beneficial organisms and aquatic ecosystems).

**Human pesticide poisonings**

In the United States, as mentioned, more than 500,000 kg of pesticides is applied and worldwide about 3 billion kg is applied each year. Some humans are directly exposed to the pesticide sprays, especially those people who apply pesticides. In addition, pesticides contaminate human food and water resources. For example, about 35% of the food that is purchased by consumers has measurable levels of pesticide residues, with 1% to 3% having residues that are above the accepted tolerance level.

In the U.S., about 110,000 humans suffer adverse effects from pesticides, with about 25 accidental deaths each year (Benbrook, *et al.*, 1996). Worldwide the situation is far more serious with 26 million people poisoned, with about 220,000 deaths each year (WHO, 1992). In addition, pesticides cause cancer and the estimate is that more than 10,000 cases of cancer annually are the result of pesticide exposure (Pimentel and Hart, 2001). Pesticides also disrupt the endocrine and immune systems, as well as neurological responses in humans and other animals (Colborn *et al.*, 1996).

**Bird poisonings**

Like humans, birds are also poisoned by pesticides. Birds, like the canary in the coal mine, make excellent ‘indicator species’. In fact, the suggestion in the title of Rachel Carson’s book was that if we continued to apply DDT and other pesticides we would have a SILENT SPRING, without birds singing. Birds are poisoned by the direct exposure to pesticides, poisoned by feeding on contaminated prey, and have reduced growth and reproduction because of sub-lethal exposure to pesticides. In the United States, approximately 3 kg of pesticide is applied per hectare per year on about 160 million hectares (Pimentel *et al.*, 1993). The full extent of bird kills by pesticides is difficult to determine, because birds are often secretive, camouflaged, highly mobile, and live in dense grass, shrubs, and trees.

The conservative estimate is that about 72 million birds are killed each year because of direct exposure to pesticides (Pimentel, 2002). This 72 million does not include the nestlings lost because one or more parent is killed and/or the fact that pesticide contaminated insects and earthworms are brought to the nest and fed to the nestlings. The actual number of birds killed might be twice the estimated 72 million figure.

**Beneficial natural enemies**

In both natural and agricultural ecosystems, a large number of species of predators and parasites control and limit the feeding pressure of plant feeding arthropod populations (Pimentel, 1988). The biological control organisms help ecosystems remain ‘green’ with foliage on trees, shrubs, and other plants. The beneficial parasites and predator help control pest arthropods in agricultural crops (Pimentel *et al.*, 1993).

In the US, it is estimated that while pesticides provide approximately 10% of pest controls, natural controls provide about twice this amount of control (Pimentel and Hart, 2001). Many cultural controls such as crop rotation, soil and water management, fertilizer management, planting time, crop-plant density, trap crops, mechanical cultivation, and polyculture provide additional benefits for pest control. Together, these non-chemical controls could be used effectively to reduce U.S. pesticide use by more than 50%, without any reduction in crop yields and/or cosmetic standards (Pimentel *et al.*, 1993).

Confirmation that pesticide use in the United States could be reduced by 50% comes from the fact that Sweden reduced pesticide use by 50% from 1992 to 1997 and is now on a program to reduce pesticide use by another 50% (Pimentel, 1997). In Indonesia, where most of the pesticide was applied to rice, Dr. I. N. Oka was able to reduce...
pesticide use by 65% and increase rice yields by 12%. This illustrates what can be done, if pesticides are used judiciously.

Pesticide resistance
The widespread use of pesticides has resulted in the development of pesticide resistance in insect pests, plant pathogens, and weeds. The estimate is that more than 1000 species of pests are now resistant to pesticides. As pesticide use increases, the number of pesticide resistant pests explodes. Increased pesticide resistance in pest populations frequently requires several additional applications of pesticides.

Ground and surface water contamination
Most pesticides applied to crops eventually end up in ground and/or surface water. Aircraft applications of pesticides is the most effective means of contaminating the environment. For instance, under ideal weather conditions only 30% of the spray from an aircraft or helicopter reaches the target area, the remaining 50% drifts off to contaminate the environment. Currently there is increasing use of the ULV (ultra low volume) spray technology. Because concentrated pesticide spray is applied, little or no water is added to the spray and the pesticide is broken into very small particles to obtain good coverage of the crop plants. The very small and light weight droplets are more prone to drift. Thus, under ideal weather conditions, only 25% of the pesticide lands in the target area and 75% drifts off into the environment. For instance, under ideal weather conditions pesticides is the most effective means of contaminating the environment. Currently there is increasing use of the ULV (ultra low volume) spray technology. Because concentrated pesticide spray is applied, little or no water is added to the spray and the pesticide is broken into very small particles to obtain good coverage of the crop plants. The very small and light weight droplets are more prone to drift. Thus, under ideal weather conditions, only 25% of the pesticide lands in the target area and 75% drifts off into the environment (Pimentel et al., 1991).

Pesticide contamination of ground and surface waters is a serious concern in the United States. One study showed that pesticide residues were found in 92% of Midwestern reservoirs (Solomon et al., 1996). Also in the Midwest, in Iowa, herbicide residues were found in 75% of the wells sampled (Koplin, et al., 1998a).

If an adequate job were done in monitoring pesticide levels in ground water, the cost would be about $1.3 billion per year (Nielson and Lee, 1987). Remember this is only monitoring but does nothing to correct the water contamination problem.

Conclusion
We currently spend about $10 billion each year in the recommended use of pesticides and this use of pesticides returns about $40 billion each year. However, these benefits do not include the environmental and public health costs of using pesticides. These costs are estimated to total more than $9 billion per year.

As has been demonstrated in Sweden and several other countries, including Norway, Denmark, Netherlands, Canada and Indonesia, pesticide use in the United States could be reduced by more than 50% without any reduction in crop yields or cosmetic standards. Reducing the recommended use of pesticides would significantly reduce the environmental and public health impacts of pesticides. The time is long overdue for us to reduce the level of pesticide use and to use them in a judicious manner in order to benefit farmers, the environment, and the public.

References


NEW REPORT ON GM CROPS

GM crops have been an economic disaster in the USA and Canada according to a new report published by the Soil Association, entitled Seeds of Doubt.

The Soil Association’s report is the first to reveal the serious widespread impacts of GM crops in North America on the food and farming industry, where three-quarters of the world’s GM food is grown. It is the most comprehensive review of the situation to be produced from a non-biotechnology industry perspective.

Seeds of Doubt: experiences of North American farmers of genetically modified crops, is available from the Soil Association Mail Order Department on 0117 929 0661, mtrowell@soilassociation.org or from http://www.soilassociation.org/gm, price £12.