Agriculture & Biotechnology Facts

POTENTIAL REDUCTIONS IN PESTICIDE USE THROUGH GENETICALLY ENHANCED CROPS

The use of agricultural biotechnology to create crop varieties that are resistant to insects, diseases or herbicides is likely to result in a dramatic reduction in the amount of pesticides used in agriculture. These products offer farmers the opportunity to reduce the use of chemical pesticides, while maintaining, if not improving, yields and profitability. As Canadian farmers adopt the use of genetically enhanced crops, the Canadian public can expect that the quality of the environment will improve, with no deterioration in the quality or safety of our food supply.

AG Care

BACKGROUND

Agriculture is a major user of pesticides. For example, the value of all pesticides sold in Canada in 1997 totaled $1.431 billion. (Source: Crop Protection Institute of Canada). Of this total, approximately 80 percent was spent for herbicides (for weed control); 7 percent for insecticides; 7 percent for fungicides (for disease control); and the remainder for other types of pesticides. In the mid-1980s, the Government of Ontario initiated a program known as Food Systems 2002, with the objective of reducing the use of pesticides in agriculture by fifty percent. This objective was fully endorsed by AGCare and its member organizations. Both the Government of Ontario and AGCare remain committed to attaining this objective.

Every five years, the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) conducts an extensive survey of agricultural pesticide usage in Ontario. According to these surveys, Ontario farmers reduced their usage of pesticides in agriculture by 28 percent between 1983 and 1993. Although the results of the 1998 survey have not yet been released, there is every indication that this trend has continued. Reductions have been achieved largely through changes in cropping practices, use of improved application technology, adoption of integrated pest management and development of pest control products that are applied at lower rates than their predecessors. While additional gains may yet be made through these approaches, use of the products of biotechnology will be a key component in realizing future reductions in pesticide use.

PESTICIDE USE IN CORN AND SOYBEANS

In Ontario, the pesticides used in the production of corn and soybeans represent a major proportion of the pesticides used in agriculture. These are the two most extensively grown cash crops, amounting to over 4 million acres in total, with a value of well over $1 billion. The following three examples serve to illustrate the potential impact that biotechnology could have in reducing pesticide use in these crops.

1. Bt CORN FOR EUROPEAN CORN BORER CONTROL

Through genetic engineering, scientists have transferred genes from a common soil bacterium and organic pesticide, Bacillus thuringiensis, commonly called Bt, into some corn hybrids as a means to control European corn borer. Corn hybrids that have been genetically enhanced in this way are known as Bt corn. Because Bt provides total protection for the corn plant, use of insecticides for corn borer control can be eliminated.

Since the 1920s, the European corn borer has been a major insect pest of corn. It has been estimated that the damage done by European corn borer costs Ontario corn producers over $40 million per year. In North America, the cost of the damage is said to exceed $1 billion (US). In field corn, the damage caused by borer larvae (caterpillars) reduces yields, causes harvesting difficulties because of broken corn stalks and promotes infection of the corn by ear moulds responsible for the production of poisonous mycotoxins. In sweet corn, ears that have been damaged by corn borer feeding often are rejected by the consumer.

Sweet corn growers have traditionally protected their crops from corn borer, and a similar pest called corn earworm, by spraying with insecticides. Depending on the severity of the infestation, a field may be sprayed several times during the growing season. Formulations of Bt insecticide can be used for this purpose, but it is usually more economical and effective to use synthetic insecticides. To protect their crops from insects – primarily, corn borer and corn earworm – Ontario sweet corn growers applied a total of about 11,000 kilograms of insecticides (active ingredient) in 1998. (Source OMAFRA. Preliminary figure.) Field corn growers in the mid-western United States, where corn borer damage is perhaps more severe than in Ontario,

have increasingly been spraying field corn with insecticides to control corn borer. In 1998, the value of insecticides purchased for application to corn exceeded $100 million (US). (Source: American Crop Protection Association.) Much of this total would have been applied for corn borer control.

There has been relatively little use of insecticides for corn borer control in field corn in Ontario in the past. However, problems with corn borer appear to be increasing, and it is possible that the use of insecticides for this purpose here may increase were Bt corn not available.

Bt corn provides a safe, effective means to control European corn borer and its use will enable almost total elimination of the use of insecticides for this purpose.

2. Bt CORN FOR CONTROL OF CORN ROOTWORM

Other strains of Bt corn promise to preclude the potential need for insecticides to control another corn pest, the corn rootworm. The larvae of this pest feed on the roots of young corn plants, reducing yields and causing the plants to tip over, thereby reducing crop yields and making the crop difficult to harvest. During the 1970s and early 1980s, damage caused by corn rootworms cost Ontario corn growers millions of dollars annually. In corn grown following a previous corn crop (even for one year), control can be obtained only through the application of insecticides to the soil.

According to a survey conducted by the United States Department of Agriculture, 32 percent of the corn acreage in the United States was treated with an insecticide in 1996. (Agricultural Chemical Usage: 1996 Field Crops Summary) In that year, American farmers applied over 6 million kg of corn insecticides. While the survey did not report which pests were being targeted, it is likely that most of this was applied to control either European corn borer or corn rootworm, predominantly the latter. The 1998 Industry Profile from the American Crop Protection Association indicated that American corn growers spent over $254 million (US) to purchase soil-applied corn insecticides. Most of this would have been applied to control corn rootworm.

In Ontario, corn producers used a total of approximately 16,000 kg of rootworm insecticides in 1998 (Source OMAFRA. Preliminary figure.) This compares to 145,000 kg used in 1983. This reduction of 89 percent results mainly from more extensive use of crop rotation as a pest control measure. Unfortunately, strains of western corn rootworm that cannot be controlled by crop rotation have evolved in the United States. It is expected that these strains will reach Ontario within a few years, potentially returning us to the insecticide usage patterns of the early 1980s. Development of corn hybrids containing a type of Bt corn toxic to corn rootworm (expected by 2002) could mean the difference between continued reduction in the use of insecticides for rootworm control versus the use of hundreds of thousands of kilograms per year in Ontario, and millions of kilograms in the United States.

3. HERBICIDE RESISTANT CROPS

Herbicide resistant or tolerant crops are not new. Indeed, natural crop resistance or tolerance to certain herbicides is a prerequisite for herbicide-based weed control programs. Selective herbicides (i.e., those that affect only certain species or families of plants) allow farmers to control a wide range of weeds in a crop with little risk of injury to the crop. Recently, researchers have developed genetically enhanced crops with resistance to non-selective herbicides, such as Roundup and Liberty, that kill almost all plants upon which they are sprayed. Development of resistant varieties has now made it possible to use these herbicides in a growing crop. Previously, non-selective herbicides could only be used when a crop was not growing in the field (e.g., before planting or after harvest) or the crop would also have been killed.

Use of crops resistant to non-selective products offers growers the potential of reduced weed control costs through the use of fewer and less expensive herbicides. For example, some growers have indicated a reduction in herbicide cost of $30.00 per acre, depending on their previous program.

Environment quality will benefit from the likely reduction in total herbicide use and from the use of products which have less environmental impact. For example, the toxicity of Roundup to humans, animals and livestock is quite low – less than that of table salt. Roundup also affects only those plants upon which it is directly sprayed. Once it contacts the soil, it is deactivated within days – versus months for many of the other products – and there is no concern about residues in the soil or contamination of water through either runoff or leaching. As a result, the Ontario Ministry of the Environment considers Roundup to be safe enough for use by homeowners, enabling it to be sold through garden centres and hardware stores. In contrast, most of the pesticides which the use of Roundup on resistant crops would replace can be purchased only by farmers who have completed an approved certification course in the safe use of agricultural pesticides.

POTENTIAL DISADVANTAGES

The greatest potential disadvantage arising from the use of either insect-resistant or herbicide-resistant crops is the potential evolution of resistant pests or weeds, as a result of repeated use of the respective product. Crop producers throughout North America are implementing strategies to prevent this from happening.