FIGURE 1:
PHOMA MACROSTOMA
ON CANADA THISTLE

PHOMA MACROSTOMA: A BIOHERBICIDE IN THE MAKING

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A 2009 OTS Highlight Article. A good stand of turfgrass provides numerous benefits that contribute to our quality of life. When weeds invade our lawns, parks and golf courses, they disrupt the vigour, uniformity and aesthetics of established grass. Weeds are also a major source of pollen, which contributes to allergies and other irritations. Integrated weed management systems emphasize prevention of weed problems by maintaining vigorously-growing lawns with a combination of biological, chemical, cultural, manual and mechanical methods. However, pesticide bans in some municipalities and provinces across Canada have reduced the options available for weed control.

Bioherbicides are an alternative weed control option to traditional herbicides that are permitted to be used where herbicide bans are in effect. Bioherbicides, often made from naturally-occurring fungi or bacteria found on plants or in soil, can suppress weed growth and development, or result in weed mortality. There are opportunities for commercial applicators, farmers and homeowners to use microorganisms for biological weed control in agriculture, forestry and turfgrass situations.

Presently, the number of bioherbicides commercially available in Canada is fairly limited. But innovative research by public institutions and industry partnerships for new product development will bring more biological control projects to fruition, such as the project between Agriculture & Agri-Food Canada and The Scotts Company to develop the naturally-occurring fungus *Phoma macrostoma* for broadleaved weed control in turfgrass.

Government scientists discovered *Phoma macrostoma* on Canada thistle plants growing in Alberta, Saskatchewan, Ontario, New Brunswick and Nova Scotia (Figure 1). The fungus only caused small, insignificant lesions when sprayed onto leaves, but when added to soil, emerging Canada thistle plants came up white. Host range studies were conducted to determine which weed and non-target plant species were susceptible to the fungus. Weeds such as Canada thistle, dandelion, scentless chamomile, white clover and chickweed emerged white and died when the fungus was pre-emergently placed in the soil. However, there was no bleaching or mortality on weeds like green foxtail or wild oats. Among the non-target plant species, broadleaf plants such as canola or lentil were affected, but monocot plants like wheat, barley, oat, millet, canaryseed and grasses were unaffected.

To test whether biological control would work in the field, methods were developed to grow *Phoma macrostoma* in the laboratory and formulate it as a granule or powder for broadcasting to the soil surface. Conceptually, the granules would either be applied together with grass seed to establish a weed-free lawn (Figure 2)

FIGURE 2A: UNTREATED

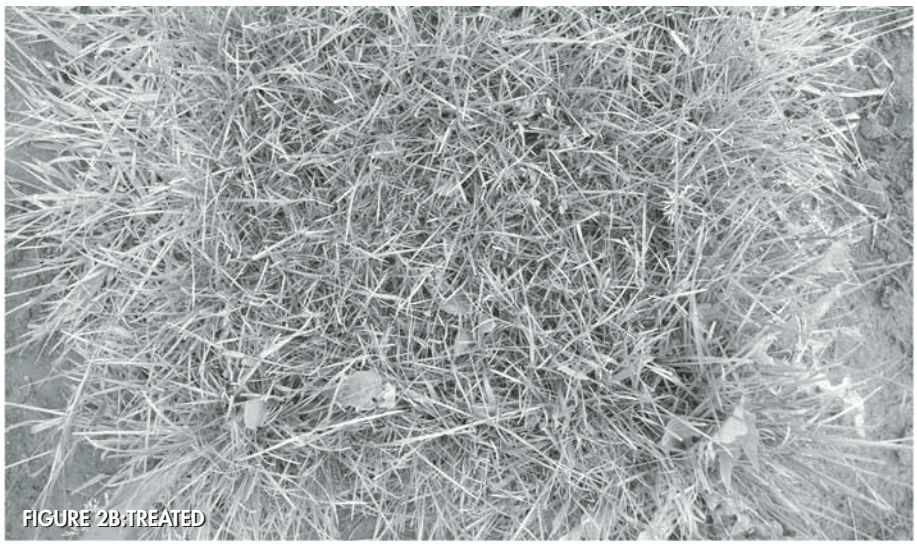

FIGURE 2B: TREATED

TABLE 1. DANDELION CONTROL (%) AT 28, 56 AND 84 DAYS AFTER APPLICATION (DAA) OF *PHOMA MACROSTOMA*, GUELPH, ON

Rate	% Dandelion Control at 28 DAA	% Dandelion Control at 56 DAA	% Dandelion Control at 84 DAA
1 x	83 ab	92 a	92 a
1/2 x	76 abc	72 ab	76 abc
1/4 x	51 cde	52 bc	52 bcd
1/8 x	48 de	26 cd	41 d
0 x	0 f	0 d	0 e

There are no significant differences among treatments followed by the same letter within a column. (P=0.05, Duncan's multiple range test)

or be broadcast over turfgrass and soil to prevent new weed emergence and kill previously established weeds. Field tests were conducted at several sites and over several years to determine efficacy and application parameters such as the lowest effective dose (Table 1), number of applications needed, timing of the application during the growing season, and weather conditions affecting efficacy.

It was also important to monitor the behaviour of the fungus in the environment to provide information on persistence, dispersion and survival for the assessment of environmental risk. Using genetic markers specific to the fungus, it was shown that *Phoma macrostoma* had limited mobility in the soil and its presence declined with time such that it was not detectable after one year. There were no persistent effects on susceptible crops such as peas the year following the first application.

The bioherbicide has limited soil mobility. Research showed that its presence declined with time such that it was not detectable after one year.

As the research continues, it becomes more apparent why R&D partnerships are necessary for achieving success in biological control. There are five major categories for which sufficient information must be acquired in order to determine if an organism has potential to be an effective and safe bioherbicide. These categories are concerned with the characterization and biology of the organism, the interaction of the organism in the environment and associated environmental risks, the commercialization aspects of production and formulation, the toxicological safety towards human and animals, and the regulations that govern the research process and final product registration.

The partnership between Agriculture & Agri-Food Canada and The Scotts Company has addressed the biological, environmental and toxicological aspects with *Phoma macrostoma* for use in turfgrass, and are currently working on the final development and commercialization stages to bring this innovation to the marketplace. ♦