Biocontrol of Broadleaf Weeds

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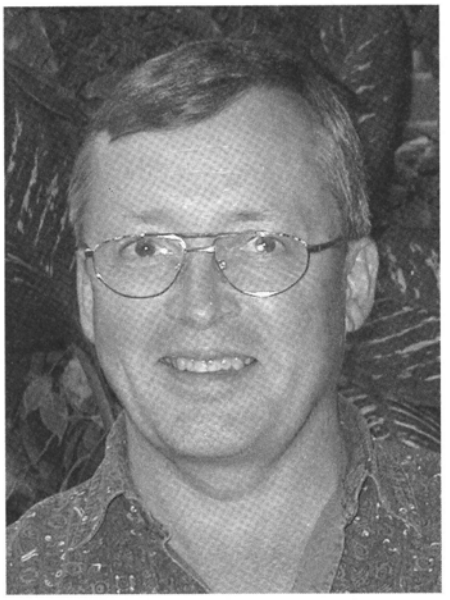
The Problem

Dandelion (*Taraxacum officinale* Weber) is a major turfgrass weed in golf courses, sports turf, municipal parks and home lawns. There are several herbicides registered for the control of dandelion and other broadleaf weeds. These herbicides generally provide good weed control but there have been mounting concerns about the potential negative effects of pesticides on humans, animals and the environment.

These concerns have resulted in numerous municipalities in Ontario, Quebec and elsewhere to ban or severely restrict the use of 2,4-D and related herbicides on public and private property. In Canada, most pesticides (91%) are used for agricultural purposes, and herbicides account for 85% of the market. 2,4-D still accounts for 1/4 of all pesticides used in Canada and it is the most common herbicide used for domestic purposes. Similarly in the United States, 2,4-D has the largest volume of usage in non-agricultural sectors (23-26 million lbs. in 1997).

Project Team

A Collaborative Dandelion and Broadleaf Weeds Bioherbicide Project was established in 1994 supported by a NSERC TPP grant involving three academic institutions, McGill University, University of Guelph, Nova Scotia Agricultural College, and several industrial partners including BioProducts Centre Inc. (Saskatoon), Saskatchewan Wheat



moved with his family to Ontario to manage the turf market for Ontario, Manitoba and Saskatchewan. Gregory resides in Guelph and is the Area Specifications Manager working closely with landscape architects, city park managers and water conservation authorities.

The Olympic Experience

Becky Kellar will share her journey with the Women's Olympic Hockey Team to Salt Lake City and, ultimately, the gold medal game which saw Team Canada victorious over the United States with a 3-2 win. No stranger to the world arena, Becky was a member of the silver medal team at the 1998 Olympic Games in Nagano, Japan and played in three World Championships in 1999, 2000 and 2001, winning three gold medals. She graduated from Brown University in 1997 where she played hockey for the Brown University Bears for four seasons. An Academic All-Ivy Award winner (academics and athletics), Becky is also well acquainted with turf, having played four years on the Brown University softball team.

Introduction to Turf Covers

Although still in the experimental stage on soccer, ball and football fields, covers have long been relied upon on golf courses to protect turf. Whether the renovation season must begin later due to late fall permitting or trying to get that germination in early April for mid-May use, covers can extend your germination window. With both successes and failures under our belt, here is what the sports turf industry should know. Reduction of winter damages (freezing temperature, desiccation, ice), enhancement of turf establishment, and other potential uses of covers will be discussed.

Dr. Julie Dionne is the new Turf Management Faculty Member with the Department of Plant Agriculture at the University of Guelph. Her research interests include physiology of turfgrass species in relation to environmental stress tolerance; winter protection of golf greens; biology and physiology of annual bluegrass; turfgrass management and fertilization; and, integrated pest management in urban landscapes and golf courses.

The Ace of Diamonds

Mel Lanford, a 30-year veteran of the groundskeeping industry, is the creator and host of the Ace of Diamonds Tour. A former professional groundskeeper at the collegiate and minor league level, Mel travels across the United States year-round presenting hand-on seminars, demonstrating proper infield and sports turf maintenance materials, equipment and techniques to athletic field managers. We are fortunate to have the opportunity to import Mel and his expertise over the border and into Ontario for the day!

For More Information

The complete Field Day brochure with registration details will be forwarded soon to all STA members. For more information, contact Lee Huether at the STA office. ♦

Pool and Dow Agro-Sciences Canada Inc. The overall goal of this project was to develop a natural, safe alternative to traditional chemical pesticides, an environmentally benign product for the biological control of dandelion and other broad leaf weeds. Moreover, this product should be competitively priced, easy to use, well packaged and have good storage stability.

Research

Experiments were replicated at three locations (McGill, Nova Scotia Agriculture College and University of Guelph) and applied in June, July and September. KILLEX (2,4-D/dicamba/mecoprop) at 1.7 kg ai ha^{-1} was the standard chemical herbicide treatment used in all experiments. A commercial preparation of 0.6% Killex was applied at a rate of 200 ml m^{-2}. Eight fungal isolates were evaluated for their efficacy to control dandelion under field conditions. The fungal isolates included spore and/or mycelial liquid formulations of *Phoma herbarum* (G5/2), *Phoma exigua* (GIII), *Phoma* sp. G961.16), *Myrothecium roridum* (AC133), *Plectosphaerella cucumerina*, MAC2 (*Curvularia inaequalis*), MAC4/H (*Colletotrichum* sp.), and two solid formulations of *Sclerotinia minor* (MAC1a and MAC1b). *S. minor* was applied as sodium alginate granules (MAC1a) and barley grit formulation (MAC1b). MAC1 was consistently the most effective isolate at controlling dandelion in these trials.

Efficacy of MAC1

The product may be broadcast on turf using a drop spreader (1X rate of 60 g m^{-2}) or spot applied to the crown of broadleaf weeds (0.4 g per plant). Best efficacy is achieved with the barley grit formulation, although a kaolin-based formulation of the liquid fermentation product also gives very good results. When conditions are most suitable for activity of MAC1, lesions develop quickly and a complete kill can be achieved within 7 days (about twice as fast as Killex). These conditions include daytime highs of 18-24°C and rainfall or irrigation within 12 h of application. In these conditions, overall activity is as good as, and often better than Killex. The risk of poor performance in hot and dry

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weather can be minimized by applying the product in the evening and irrigating 12 h later. The product showed no effect at 2X on several turf grasses. The product is compatible with normal lawn maintenance operations such as mowing (except for a 3-day post-treatment no-mowing period), fertilization and irrigation.

Production/Economic Considerations

MAC1 is mass produced on barley grits for solid state production or scaled up in liquid fermentation prior to formulation in granular form. Quality control and quality assurance procedures have been developed. Currently, shelf life is approximately 5 months at 5°C and 2-4 weeks at 20°C. Further improvements of the production method and shelf life can be achieved. Preliminary research on the turf weed control market in Canada was performed. Preliminary estimations of field, registration and scale-up R&D, anticipated production costs, target pricing and market penetration demonstrated a high potential profitability with investment recoupment 2-3 years after launch.

Safety and Regulatory Issues

Toxicity studies have not yet been performed, but based on literature and experience, the fungus poses no acute or chronic toxicity concerns. It does not grow at 33°C or above and is not known to produce mycotoxins. A pre-submission consultation with the PMRA has taken place and the studies required and possible waivers were discussed and outlined. Additional information has been gathered since then and a follow-up consultation will take place in the near future.

Damage ranging from small lesions to complete kill may occur on a relatively wide range of desirable broadleaf species (ornamentals, vegetables, etc) when the mycelium growing on barley grit or weed tissue is brought in direct contact with the susceptible plant. Therefore, desirable species should not be treated directly. Similarly, when mowing the treated lawn, use of a mulching mower is recommended. Alternatively, clippings should be directed away from desirable broadleaf plants.

Despite a potentially wide host range in optimum disease conditions, the fungus has an agronomically significant effect on only one minor crop host in Eastern Canada. It is endemic to ecoregions 1 and 4 (BC coastal, Southern Ontario, Quebec and the Maritimes). Formation of sclerotia occurs only rarely following turf application. When it does occur, it is limited and mainly associated with clumps of barley grits rather than infected weed tissue. The viability of laboratory-produced sclerotia decreases rapidly on the soil but a few sclerotia may remain viable for 11 months. Sclerotia are rapidly killed in active compost. Various field experiments using a highly sensitive broadleaf species showed no infectivity of the MAC1 product in the turf environment after only 4 months. Research is underway to develop failsafe mechanisms that prevent sclerotial development by the product.

Summary

MAC1 is a safe and well-characterized plant pathogenic fungus with a narrow agronomic host range. MAC1 can be cultured in liquid or solid fermentation. When formulated as a granular product, an application of MAC1 to dandelions in turf results in rapid control of the weed with no injury to turf grass. Other broadleaf weeds can also be controlled. Direct dosing of desirable broadleaf species should be avoided. ♦