

**INTRODUCED LEAF BEETLES OF THE MARITIME PROVINCES, 5:
THE LILY LEAF BEETLE, *LILIOCERIS LILII* (SCOPOLI)
(COLEOPTERA: CHRYSOMELIDAE)**

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Abstract.—*Lilioceris lili* (Scopoli), the lily leaf beetle, is an introduced Palearctic leaf beetle now established in many parts of central and eastern Canada and in New England. It is a voracious feeder on plants in the genera *Fritillaria* and *Lilium*, a cause of concern in North America where it is found. The introduction history and bionomics of the species are briefly reviewed. Its distribution in the Maritime Provinces of Canada is detailed, focusing particularly on its rapid radiation during the past five years. Observations on dispersal phenology and longevity in the region are given. Concerns with respect to its recent spread to the native Canada lily, *Lilium canadense*, are expressed. Biocontrol measures and programs being pursued in the United States are noted in relation to options that could be investigated in Canada to reduce the beetle's impact.

Key Words: Coleoptera, Chrysomelidae, Criocerinae, *Lilioceris lili*, red lily beetle, Canada lily, Canada, Maritime Provinces, introduced species, dispersal

The lily leaf beetle, *Lilioceris lili* (Scopoli, 1763) has a widespread Palearctic distribution. It is found throughout continental Europe (except Greece) and Russia east through Siberia to Tuva, and south to the Caucasus, Kazakhstan, Xinjiang, Inner Mongolia, and in North Africa (Yu et al. 2001, Audisio 2005). While Berti and Rappilly (1976) indicated that China was the original center of dispersal for this species, Yu et al. (2001) disputed this interpretation, given the sparse records of this species in China (and then only in northern regions). In Great Britain, it is an adventive species that was first noticed in the late 19th century in a series of short-lived infestations in England and Wales. In 1940, an established population was discovered in

Surrey (Fox Wilson 1943). The beetle continued to spread and by 2003 was found in every county in England. In 2002, it was first reported in Scotland and Northern Ireland (Salisbury 2003).

The discovery of the lily leaf beetle on the island of Montréal in 1943 is considered the official year of introduction in North America because it is documented and supported by voucher specimens preserved in the Canadian National Collection (Brown 1946, LeSage 1983). However, it is likely that the beetle was accidentally introduced more than a century before but did not become established. This hypothesis is supported by the description of *Lema melanocephala* by Say (1826). Although the type specimen was lost, it is generally agreed

that Say's species is conspecific with *Lilioceris lili* (Henshaw 1885, Monros 1960, LeSage 1983, White 1993, Riley et al. 2003).

Apparently low endemic populations persisted for 30 years, after which the beetle started to expand on the island of Montréal and made a noticeable jump to the Ottawa area by 1981 (LeSage 1983). It was discovered in Halifax, Nova Scotia in 1992, in Toronto, Ontario, in 1993, and was found as far west as Portage la Prairie, Manitoba, Manitoba in 1999 (LeSage and Elliott 2003). In the United States, it was first found in Cambridge, Massachusetts, in 1992. It has since spread to many areas of southern Maine (1999), New Hampshire (1997), some parts of Rhode Island (1999), and Connecticut (2001), and in northern counties in Vermont (1998) and New York (2000) (Gold 2003). Gold (2003) attributed its dispersal in the USA to movement of infested plants and natural beetle dispersal from the Boston area, although populations in northern New York and Vermont are likely attributable to natural dispersal from the Montréal area.

There are published records of *L. lili* associated with a wide variety of host plants, although Clark et al. (2004) stated that only species of *Lilium* and *Fritillaria* should be considered normal hosts. These include *Fritillaria imperialis* L., *F. melaeagris* L., *Lilium aurantum* L., *L. candidum* L., *L. formosanum* Wallace, *L. giganteum* Wallich, *L. hansonii* Leicht ex Baker, *L. henryi* Baker, *L. lancifolium* Thunb. (= *L. tigrinum* L. (synonym), the well-known "tiger lily"), *L. longiflorum* Thunb., *L. martagon* L., *L. philippinense* Baker, *L. regale* Wils., *L. speciosum* Thunb., *L. superbum* L., and *L. testaceum* Lindl.

In continental Europe, *L. lili* is widely distributed but is not considered problematic since its numbers are held in check by native parasitoids including

Tetrastichus setifer Thompson (Hymenoptera: Eulophidae), *Lemophagus pulcher* Szepligeti, *L. errabundus* Gravenhorst, and *Diaparsis jucunda* (Holmgren) (Hymenoptera: Ichneumonidae) (Gold et al. 2001), *Anaphes* sp. (Hymenoptera: Mymaridae), *Meignia simplex* Tschorsnig and Hertning, and *M. uncinata* Mesnil (Diptera: Tachinidae) (Haye and Kenis 2004). In North America, there are no known effective natural enemies of the beetle, and thus *L. lili* has become a serious pest of native and cultivated lilies, in some instances causing extensive damage such as severe defoliation (Gold et al. 2001, Gold 2003). Kenis et al. (2003) concluded that, based on its Eurasian distribution, it seems capable of spreading throughout the North American continent.

In the Maritime Provinces of Canada, *L. lili* has been reported from specimens collected in Wellington, Nova Scotia in 1992 (LeSage and Elliot 2003) and in Fredericton, New Brunswick in 2002 (Gold 2003). Between 1992 and 2001, the beetle was confined to portions of the Halifax metro area. Since then it has rapidly expanded its range in the region. Here we report the status of this introduced pest in the Maritime Provinces of Canada.

IDENTIFICATION

Among the North American leaf beetle fauna, *Lilioceris lili* is one of the easiest species to identify because of its unique color pattern: bright red pronotum and elytra contrasting with black head, antennae, and legs (Fig. 1). The genus *Lilioceris* Reitter, 1912, was separated by Reitter from the broader concept of *Crioceris* Geoffroy, 1762, based on its divergent tarsal claws not touching at base and strongly constricted pronotum.

METHODS AND CONVENTIONS

Codens of collections (following Evenhuis 2007) referred to in the text are:



Fig. 1. Dorsal habitus photograph of *Liliocerus lili*.

- ACNS Agriculture and Agri-Food Canada, Kentville, Nova Scotia.
- ACPE Agriculture and Agri-Food Canada, Charlottetown, Prince Edward Island.
- CBU Cape Breton University, Sydney, Nova Scotia.
- CGMC Christopher G. Majka Collection, Halifax, Nova Scotia.
- CNC Canadian National Collection of Insects, Arachnids, and Nematodes, Ottawa, Ontario.
- DHWC David H. Webster Collection, Kentville, Nova Scotia.
- GSC Gary Selig Collection, Bridgewater, Nova Scotia.
- JOC Jeffrey Ogden Collection, Truro, Nova Scotia.
- NBFA New Brunswick Department of Agriculture, Fisheries and Aquaculture, Fredericton, New Brunswick.
- NSMC Nova Scotia Museum Collection, Halifax, Nova Scotia.
- NSNR Nova Scotia Department of Natural Resources, Shubenacadie, Nova Scotia.
- UMNB Université de Moncton, Moncton, New Brunswick.
- SCOTIA: *Cape Breton Co.*: Glace Bay, vii.2000, J. Hiscott, (8, CBU); Lingan, 7.VIII.2006, C. MacLean, lily, (2, NSMC); *Halifax Co.*: Clayton Park, D. Hallett, tiger lily, (1, NSMC); Dartmouth, 25.VI.2002 & 27.VI.2002, B. Obee, (1, CGMC; 4, CNC; 6, NSMC); Dartmouth, 5.VI.2005, J. Ogden, (5, NSNR); Eastern Passage, 6.V.2006, D. Bridgehouse, (1, NSMC); Fall River, 31.VII.1992, T. Neil, on lilies, (2, CNC); Halifax, 31.V.2003, C.G. Majka, tiger lily, (2, CGMC); 22.V.2003, D. Cooper, tiger lily, (24, CGMC; 16, CNC); Halifax, 6.VI.1993, E. Georgeson, (1, NSNR); Halifax, 28.IV.2002, S. Bishop, lily, (2, NSNR); Halifax, 19.VII.2002, C.G. Majka, tiger lily, (1, CGMC); Halifax, 18.VIII.2002, C.G. Majka, tiger lily, (1, CGMC); Halifax, 1.VI.2004, C.G. Majka, *Fritillaria*, (5, CGMC); Halifax, 1.VI.2005, C.G. Majka, tiger lily, (10, CNC); Halifax, 6.VI.1993, M. LeBlanc, (1, JOC); Halifax, 21.VIII.1998, M. Turner, (2, NSMC); Halifax, 11.VII.2002, G.C. Moffatt, (3, NSMC); Halifax, 22.IV.2006–17.V.2006, C.G. Majka, *Fritillaria*, (13, CGMC); Halifax, 20.V.2006–6.VII.2006, C.G. Majka, tiger lily, (8, CGMC); Hammonds Plains, 17.VII.2003, C. Stevens, (1, DHWC); Long Lake, 28.VI.2001, B. Beck, (1, NSMC); Porter's Lake, 1.IX.2005, tigerlily, (10, CNC); Waverley, 30.VIII.1992, L. Crozier, (6, NSMC); Waverley, 31.VIII.1993, L. Crozier, (4, NSMC); Wellington Station, 6.VII.1993, E. Georgeson, (1, CNC); Wellington Station, 10.VI.2000, C. Wood, on Asiatic trumpet lily, (8, CNC); *Kings Co.*: Kentville, 23.V.2002, CFIA, lily, (7, ACNS); Wolfville, 5.V.2006, J. Timpa, tiger lily, (5, NSMC); *Lunenburg Co.*: Bridgewater, 11.VIII.2005, 27.IV.2006, & 18.V.2006, G.D. Selig, tiger lily, (5, GSC); Bridgewater, 28.V.2006 & 12.VI.2006, G.D. Selig, tiger lily, (2, NSMC). PRINCE EDWARD ISLAND: *Queens Co.*: Cornwall, 27.V.2004, M.E.M. Smith, tiger lily, (1, ACPE).

Information was compiled from voucher specimens of *Lilioeris lili* from the Maritime Provinces of Canada in the reference collections listed above, as well as photographs and reports from observers in the region. The number of specimens is indicated in parentheses together with the collection coden.

RESULTS

Specimens examined.—NEW BRUNSWICK: *Westmoreland Co.*: Moncton, 2.VI.2003, 5.VI.2003, & 30.VI.2004, C. Maund, tiger lily, (3, NBFA); Moncton, VI.2003, J. MacMillan, (2, CGMC); Moncton, 14.VII.2003, G. Cormier, (1, UMNb); *York Co.*: Fredericton, 7.V.2002, C. Maund, tiger lily, (1, CNC). NOVA

Further records from reports and photographs.—NEW BRUNSWICK: *Westmoreland Co.*: Moncton, 2004–2005, J. Edsall, tiger lily, many; Moncton, 20.VII.2005, A. Wissink, tiger lily; Shediac, summer 2005, L. Forest, several; *York Co.*: Fredericton, summer 2004 & 2005, A. Gloss, tiger lily, many; Fredericton, summer 2005, R. Dyer, tiger lily, several; Fredericton, summer 2005, D. Taylor & D. Myles, tiger lily, several; Fredericton, 16.IV.2006, A. Gloss, tiger lily; Fredericton, 5.V.2006, D. Mercier-Allain, tiger lily, (50); Marysville, summer 2005, C. Maund; Lincoln, summer 2005, C. Maund; Marysville, 10–11.VI.2007, D. Sabine, on *Lilium canadense*, (3). NOVA SCOTIA: *Antigonish Co.*: Town Point (Antigonish Harbour), 3.V.2007, V. Goring, tiger lily; *Halifax Co.*: Clayton Park, summer 2003–2005, R. Owen, many; Cow Bay, spring 2006, on lilies, H. Kwindt; Dartmouth, summer 2005, D. Bridgehouse, many; Fall River, 28.IV.2006, K. Thompson, tiger lily; Fall River, 28.IV.2006, K. Thompson, *Fritillaria meleagris*, (16); Ferguson's Cove, 13.V.2006, S. Archibald, *Lilium lancifolium*; Halifax, 16.IV.2006 & 25.IV.2006, S. Greenberg, near lilies, (7); Porter's Lake, summer 2005, J. Timpa, tiger lily, many; Waverley, summer 2005 & 9.V.2006, L. Payzant, many; *Kings Co.*: Wolfville, 11.V.2004, J. Wolford, tiger lily, (4); Coldbrook, 31.V.2007, A. MacLean, tiger lily; Woodville, 6.VI.2007, A. Bogan, tiger lily. PRINCE EDWARD ISLAND: *Queens Co.*: Cornwall-North River, 2005–06, M.E.M. Smith, tiger lily, numerous.

Figure 2 illustrates the localities where *Lilioceris lili* has been found in the Maritime Provinces. It is newly recorded on Prince Edward Island. Between 1992 and 2001 (NSMC, CNC), the beetle was confined to portions of the Halifax metro area (Fall River, peninsular Halifax, Long Lake, Waverly, and Wellington Station).

There was a short-lived introduction in Glace Bay on Cape Breton Island in 2000, however, this population did not persist. Then in 2002, the species was first found in Dartmouth, NS (CNC, NSMC), Kentville, NS (ACNS), and Fredericton, NB (CNC); in 2003 in Hammonds Plains, NS (DHWC) and Moncton, NB (NBAFA); in 2004 in Wolfville, NS (J. Wolford, pers. comm.), Cornwall, PEI (ACPE), and Lincoln, NB (NBAFA); in 2005 in Bridgewater, NS (GSC), Porter's Lake, NS (CGMC), Shediac, NB (L. Forest, pers. comm.), and Marysville, NB (NBAFA); and in 2006 in Eastern Passage, NS (NSMC), Ferguson's Cove, NS (S. Archibald, pers. comm.), Cow Bay (H. Kwindt, pers. comm.), and Lingan, NS (C. MacLean, pers. comm.); and in 2007 in Coldbrook, NS (A. MacLean, pers. comm.), Woodville, NS (B. Bogan pers. comm.), and Antigonish, NS (R. Lauff, pers. comm.).

It would appear that the Halifax metropolitan area has served as the primary source from which the species has spread by natural and human-assisted means over the past six years, to secondary loci in the Fredericton, Moncton, Annapolis Valley, Bridgewater, Antigonish, and Cape Breton areas. In Halifax, observations by C. Majka and reports from many other gardeners clearly indicate that natural aerial dispersal is taking place. The beetles are adept flyers; during the dispersal phase early in the spring (see below) they readily fly into gardens, alighting directly on *Fritillaria* or *Lilium* plants. In relation to secondary colonization sites in the Maritime Provinces, it seems probable that commerce in lilies, and subsequent movement of plants from area to area, is responsible for the dispersal of the beetles. Indeed, in Kentville, NS the beetles were discovered in a plant nursery.

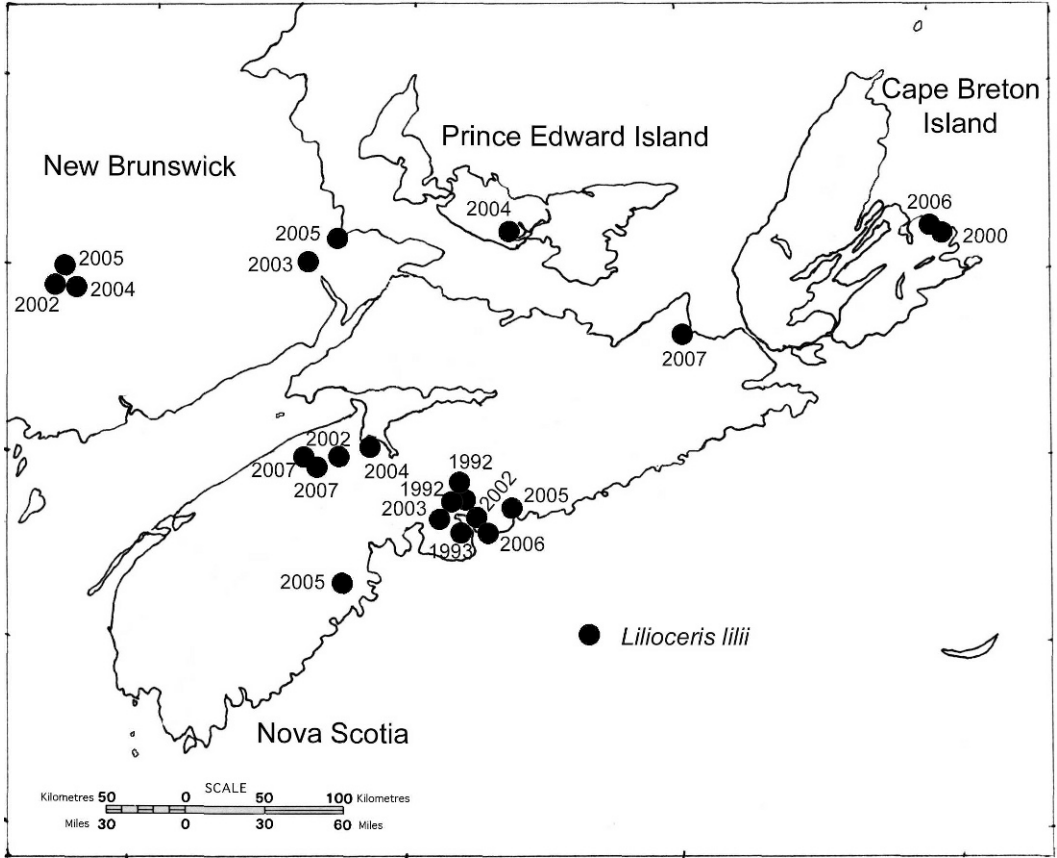


Fig. 2. Distribution of *Lilioceris lilli* in the Maritime Provinces of Canada. Dates indicate the first record of the species at that location.

Noteworthy among the reports are D. Sabine's recent (2007) discovery of *L. lilli* on the native Canada lily, *Lilium canadense* L., in the Marysville area of New Brunswick. Searching floodplain areas he found three adults on two plants, leaf damage apparently attributable to the beetles, and several clusters of both newly deposited, bright orange eggs, and older slightly darker eggs. This is the first report of *L. lilli* both feeding and reproducing on *L. canadense*.

In order to study the dispersal phenology of the species in this region, in 2006 the first author (CGM) carefully monitored recruitment of *L. lilli* into his garden which had a small bed of

Fritillaria and *Lilium*. Plants were checked daily and all beetles that had arrived were removed. Figure 3 presents the results of these investigations. No beetles were allowed to breed in the garden; hence the numbers plotted (compiled on a weekly basis) represented only recruitment by aerially dispersing individuals. They showed a very rapid increase in numbers in the second and third weeks of April continuing through the first week of May. Thereupon numbers begin to decline over the next three weeks, although there was still some on-going dispersal as late as early July. Until May 17 all the beetles were found on *Fritillaria*; thereafter, when

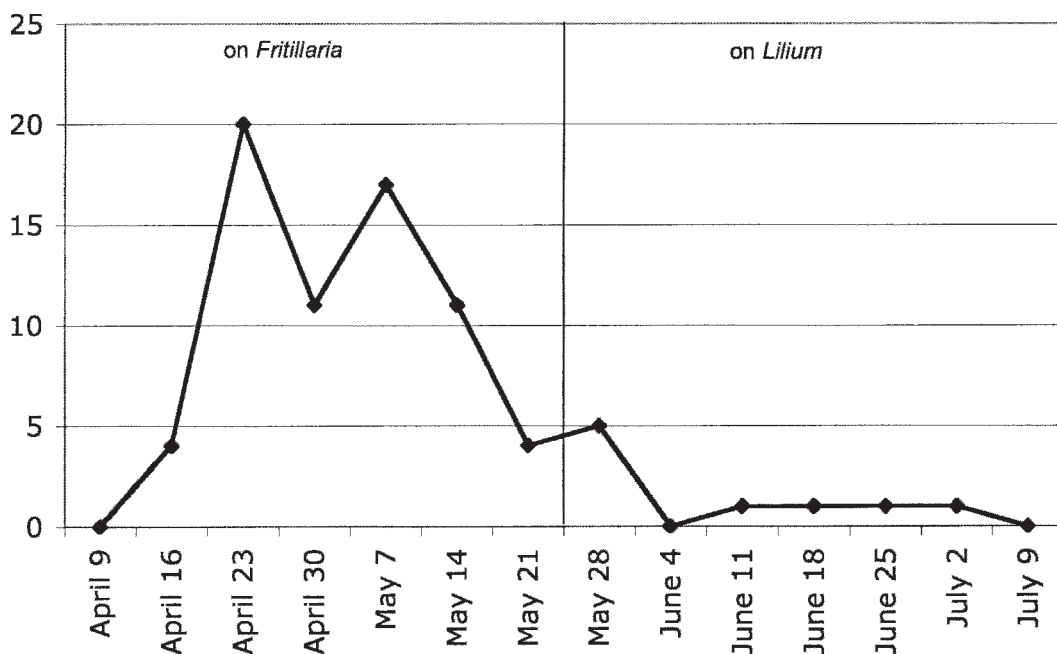


Fig. 3. Dispersal phenology of *Lilioceris lili* in Halifax, NS, in 2006. Numbers along the y-axis indicate the number of specimens collected during each one-week period.

Lilium plants had emerged from the soil and had produced sufficient foliage, and the *Fritillaria* plants had started to senesce, beetles were found on lilies. In Halifax, specimens have been collected during the year as early as April 16 and as late as September 1.

To gain some insight on beetle longevity, an individual *L. lili* beetle collected on July 6 was kept alive in the laboratory and periodically supplied with fresh lily leaves. It remained active and continued to feed until November 1 when fresh lily leaves were no longer available. At that point it was supplied with other foliage, water, and soil but it no longer fed and died on November 16, 133 d after it had been collected in the field.

DISCUSSION

The recent and very rapid radial spread of *Lilioceris lili* in the Maritime Provinces of Canada is cause for consid-

erable concern. In the Halifax area, the impact of *L. lili* on *Fritillaria* and *Lilium* in many gardens has been quite severe. Beetle populations can rapidly increase over the season, can cause severe defoliation, and affected plants eventually languish and die. C.G.M. interviewed one gardener in Waverly, NS who, in 1992 had over 50 species and cultivars of lilies growing in a large garden on his property. Although he took very active measures to curb the numbers of beetles, including hiring neighborhood children to pick them off affected plants, in 2006 only one species of lily survived on his property.

Until 2007, all reports of *L. lili* in the region had been on garden plants; however, a cause of concern is the recent discovery of the species on the native Canada lily, *Lilium canadense*. *Lilium canadense* is present in both the Annapolis Valley of Nova Scotia, and the Fredericton area of New Brunswick

where *L. lili* has recently been found (Roland 1998, Hinds 1986). Roland (1998, pp. 1203) stated that *L. canadense* is, "now becoming rare in most parts of its range." *Lilium canadense* occurs from the Maritime Provinces south to Alabama and Georgia. It is ranked S1 (extremely rare) in Alabama, Kansas, North Carolina, Rhode Island, and Ontario; and S2 (very rare) in Delaware, Indiana, Tennessee, Georgia, and Nova Scotia (Dolan 2004). Given the present decline of *L. canadense* and the impact of *L. lili* on other species of lilies, this transfer of *L. lili* from a horticultural to a native plant would appear to pose a potentially significant threat to this already rare, native lily. Ernst et al. (2007) identified several endangered native lilies including *L. canadense*, *L. philadelphicum* L., *L. michiganense* Farw., and *L. superbum* L. as being at risk of being colonized by *L. lili* and recommended that populations of these lilies be monitored closely.

In the United States a number of researchers (Gold et al. 2001, Gold 2003, Kenis et al. 2003, Casagrande and Kenis 2004, Tewksbury et al. 2005) investigated the potential utility and effectiveness of introducing some of the European parasitoids of *L. lili*. They evaluated *Tetrastichus setifer*, *Lemophagus pulcher*, *L. errabundus*, and *Diaparsis jucunda*, and particular interest has focused on the former species. Tewksbury et al. (2005) began introducing *T. setifer* at selected sites in New England in 2003. It is now established in four states (Maine, New Hampshire, Massachusetts, and Rhode Island) and the authors reported that it is substantially impacting populations of *L. lili* in the latter two states. In one test plot in Massachusetts, peak larval density declined from seven per stem in 2000 to one per stem in 2004 and rates of parasitism of fourth instar larvae varied from 37% to 100% (Tewksbury et al. 2005). Since 2003, *Lemopha-*

gus errabundus also has been released in Massachusetts and is now established there (R. Casagrande, pers. comm.). No such trials have been conducted in Canada and no biocontrol programs are in place. Given the detrimental impact of *L. lili* on lilies and *Fritillaria* in horticultural contexts, and the spread of the beetle to the already threatened native Canada lily, it would appear to be prudent to investigate such biocontrol measures in Canada.

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