

**PARASITOIDS OF *Delia radicum* (Diptera: Anthomyiidae) IN
CANOLA: ASSESSMENT OF POTENTIAL AGENTS FOR
CLASSICAL BIOLOGICAL CONTROL**

A thesis

Submitted to the

Faculty of Graduate Studies

of

The University of Manitoba

by

Kennantudawage Siril Hemachandra

In Partial Fulfillment of the Requirements

for the Degree of

DOCTOR OF PHILOSOPHY

Department of Entomology

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Winnipeg, Manitoba, Canada.

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ABSTRACT

Kennantudawage Siril Hemachandra. University of Manitoba, 2004. **Parasitoids of *Delia radicum* (Diptera: Anthomyiidae) in canola: assessment of potential agents for classical biological control.**

Major supervisor: Dr. N.J. Holliday

Delia radicum L. is an important insect in canola on the Canadian Prairies and there is no single effective method of control. Hence, classical biological control has been proposed. The main objective of this study was to assess the parasitoid community of *D. radicum* in canola on the Canadian Prairies and Europe. Immature stages of *D. radicum* were sampled in six canola fields on the Canadian Prairie Provinces and in 11 canola fields and one brassica vegetable field in Switzerland and Germany. Immatures were individually reared in the laboratory until emergence of parasitoids and adult *D. radicum*. Parasitoid species found in canola on the Canadian Prairies and in canola and brassica vegetables in Europe included *Trybliographa rapae* (Westwood) (Hymenoptera: Eucoilidae) and *Aleochara bilineata* Gyllenhal (Coleoptera: Staphylinidae). *Aleochara verna* Say (Coleoptera: Staphylinidae) was found only in Canadian canola while *A. bipustulata* L. (Coleoptera: Staphylinidae) was found only in European canola and brassica vegetables. Minor parasitoids found in canola included *Phygadeuon trichops* (Thomson) (Hymenoptera: Ichneumonidae), three undescribed *Phygadeuon* species, *Aphaereta minuta* (Nees) (Hymenoptera: Braconidae), *Aleochara brevipennis* Gravenhörst (Coleoptera: Staphylinidae) and *Trichopria* sp. (Hymenoptera: Proctotrupidae). Specimens collected by other workers in North America and labeled as *A. bipustulata* were examined and found to be *A. verna*. The previous reports of

occurrence of *A. bipustulata* in North America were erroneous. Hence, *A. bipustulata* is the most promising candidate for introduction to canola on the Canadian Prairies. In addition, some aspects of the biology of *D. radicum*, *A. bilineata*, and *T. rapae* were studied.

Dedication

To my wife Sandhya and daughter Shashika

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CHAPTER 1

Introduction

Delia radicum (L.) (Anthomyiidae: Diptera) is an introduced insect now present in many regions of North America (Griffiths, 1991). The insect is of European origin (Biron *et al.*, 2000) and it is assumed that it was introduced to North America in the mid 19th century (Schoene, 1916; Griffiths, 1991). The presence of *D. radicum* in North America, with a positive identification, was confirmed with the report of an outbreak of *D. radicum* in New York State in 1856 (Riley, 1885). The species was reported to be in Canada at about the same time and it had been reported from Nova Scotia to Ontario by 1885 (Fletcher, 1886). In Manitoba, *D. radicum* was probably present in the valleys of the Red and Assiniboine Rivers by the 1930s (Turnock *et al.*, 1995), but its presence with definite identification was not confirmed until 1958 (Allen, 1964). Moreover, it was present in Saskatchewan by 1949 (Brooks, 1949) and in British Columbia by 1913 (Wilson, 1913). *Delia radicum* now occupies the Nearctic and Palaearctic regions from 35 to 60°N and is associated with agriculture and horticulture (Griffiths, 1991).

Delia radicum infests brassica vegetables in the Atlantic Provinces causing economic damage (Read, 1960) and it infests canola (*Brassica napus* L., and *Brassica rapa oleifera* (DeCandolle) Metger) on the Canadian Prairies (Griffiths, 1986a, 1986b; Turnock *et al.*, 1992; Soroka *et al.*, 2002). *Delia radicum* larvae feed on canola roots and feeding injuries interfere with nutrient and water uptake (McDonald and Sears, 1991). In addition, root injuries predispose the root to attack by pathogenic microbes (Griffiths, 1986a). *Delia radicum* causes economic damage to canola in the northwestern agricultural region of Alberta (Griffiths, 1986a, 1986b), but its damage on canola in other

parts of the Canadian Prairies has yet to be quantified. In a year when *D. radicum* infestation is high and canola is under poor growing conditions, the estimated yield loss could be high as \$100 million (Soroka *et al.*, 2002). Even though the relationship between yield loss and root damage of canola is yet to be defined, a yield loss of a few dollars per hectare due to root injuries would amount to millions of dollars because canola is grown so extensively. From 1994–2003, on average 4.6 million ha of canola was grown on the Canadian Prairies (Canola Council of Canada, 2004). Therefore, *D. radicum* damage in canola, even though it may not result in economic damage for a farmer, leads to significant losses in foreign income to Canada.

Canola growers on the Canadian Prairies do not apply any particular management practices for *D. radicum* (Canola council of Canada, 2004). However, manipulation of cultural operations such as tillage regime (Dosdall *et al.*, 1996b) and seed density (Dosdall *et al.*, 1996a) can have a significant effect on population suppression of *D. radicum*. Insecticides applied as seed-dressings do not provide effective control of *D. radicum*. This is because *D. radicum* generally infests canola more than a month after seeding, when canola is in the bolting stage (Griffiths, 1986a). Even though management of *D. radicum* in brassica vegetables is well established (Finch, 1987, 1989, 1993; Gehringer and Goldstein, 1988; Finch and Collier, 2000b), those management practices are not technically feasible in canola on the Canadian Prairies (Soroka *et al.*, 2002). Therefore, additional control strategies for *D. radicum* in canola are required and classical biological control has been suggested (Turnock *et al.*, 1995).

Classical biological control of *D. radicum* in brassica vegetables in eastern Canada was attempted in 1949. In that attempt, *Aleochara bilineata* Gyllenhal,

Aleochara verna Say, *Trybliographa rapae* (Westwood), *Phygadeuon trichops* (Thomson), and *Aphaereta* sp. were introduced (McLeod, 1962; Soroka *et al.*, 2002). However, the programme was suspended when it was found that the main parasitoid species that were introduced were already present in Canada (Soroka *et al.*, 2002). Introduction of *A. bilineata* to Canada was partly associated with misidentification of Canadian specimens of *A. bilineata* as *Baryodma ontarionis* Casey (Colhoun, 1953). This signifies the need for precise identifications of parasitoid species, including agreement on parasitoid identities by taxonomists in Europe and North America.

Biological control of *D. radicum* in canola is a viable option and technically feasible. Crops that can tolerate a reasonable level of pest injury with no economic damage are suitable target crops for biological control (Turnbull and Chant, 1961). Canola plants can tolerate a reasonable level of *D. radicum* larval injury (McDonald and Sears, 1991); therefore, it is not necessary to suppress larval populations to a very low level. In addition, *D. radicum* injury does not directly affect market standard of the product or economic value of the crop. Moreover, shortage of hosts for parasitoids is unlikely because canola is grown every year on a large scale (Canola Council of Canada, 2004). *Delia radicum* larvae remain on roots for about 2–3 weeks and then overwinter as pupae in soil until next spring (Brooks, 1949, 1951). Consequently, the immature stages of *D. radicum* are available to parasitoids and predators for an extended period of time.

In developing classical biological control of *D. radicum* in canola on the Canadian Prairies, it is absolutely essential to characterize the parasitoid community of *D. radicum* in canola in Canada to avoid the introduction of parasitoid species that are already present. Comparing the Canadian parasitoid community with the European

parasitoid community facilitates the selection of potential biocontrol agents for introduction to Canada. Here and throughout this thesis, parasitoid community refers to all “parasitoid species that exploit the population of” *D. radicum* “in a given locality” (Mills 1994, p 399). Therefore, the objectives of this study were to assess the parasitoid community of *D. radicum* in canola in Canada and in canola in Europe to choose potential biocontrol agents for introduction, and to study the tritrophic interaction among canola, *D. radicum* and its parasitoids to understand the biological control system in canola.

This thesis is organized in paper style, comprising four chapters. Chapter one is devoted to a general introduction, and is followed by a literature review in chapter two. Chapter three consists of eight sections, each section detailing a facet of the research in the general format of a research paper. Chapter four is a general discussion.