

Introduction:

The fir coneworm, *Dioryctria abietivorella* Groté, (Lepidoptera: Pyralidae) is an important North American seed orchard pest but despite this fact its life history is not fully understood nor well documented across its range. *Dioryctria abietivorella* larvae are especially damaging because they are polyphagous and target the reproductive organs of the host tree. Unfortunately, populations of *D. abietivorella* can become established in seed orchards and their presence can translate into large economic losses. In 2004, *D. abietivorella* damage resulted in a \$1 million loss in seed cone production in southern, interior British Columbia seed orchards.

Tools for managing *D. abietivorella* are limited and this is, in part, due to their cryptic, internal feeding habits. Currently dimethoate, an organophosphate insecticide, is used to control *D. abietivorella* populations. It is a broad spectrum insecticide which can directly and indirectly affect non-target animals which may act as pest population regulators. In addition to reducing natural enemy populations there is the risk that *D. abietivorella* populations will develop dimethoate resistance. This is a possibility as resistance to dimethoate has evolved in another Pyralid moth, the legume pod-borer, *Maruca vitrata* Fabricius.

Sex pheromones are currently being investigated as a control method for *D. abietivorella*. Recent work has addressed the use of sex pheromones for population monitoring, phenology and timing of control applications. Although a very useful tool, sex pheromone-based monitoring targets only the male population. Information regarding female biology is essential for the development of efficient and effective management programs. At this time, little research has focused on the female phenology and behaviour of *D. abietivorella*.

Research goals:

The purpose of this study is to explore *D. abietivorella* general biology, mating and oviposition behaviour in the western region of its range. The research will be primarily focused on female biology. Results from this work will contribute to general biological knowledge of *D. abietivorella* while providing the basis for management programs in seed orchards and specifically in Douglas-fir stands. In summer 2007, preliminary fieldwork in Vernon, British Columbia was conducted. There were two primary goals proposed for this first field season: (1) assess male and female reproductive behaviour; and (2) establish a laboratory colony. A thorough literature review was another important activity completed in 2007.

1. Reproductive behaviour:

a) Light trapping:

As proposed, we attempted to assess female reproductive status using light traps. Black light traps were run one night weekly from May 3rd to August 22nd at five seed orchards and three sites in natural Douglas-fir stands. Live trapping using a mercury vapour light was conducted at different sites at least every two weeks between July 5th and August 16th. Although no *D. abietivorella* were caught in these collections, many other *Dioryctria* species were captured. The fact that *D. abietivorella* was not caught is in contrast with other research in which a number of specimens were caught using light traps.

b) Female attractiveness:

We proposed to determine when female moths attract males and if female attractiveness varied with female age and mating status. Unfortunately, due to difficulties with the colony (see

below) and with live trapping we were unable to obtain adults with which to conduct the proposed field and laboratory experiments.

c) Male attractiveness:

We proposed to examine factors influencing male response to pheromone. We aimed to determine when (within day and season) males were actively searching for and following pheromone plumes. We were also interested in the effect of age and mating status on male response to pheromone. Again, due to the difficulty in obtaining and rearing adults we were unable to perform these experiments.

2. Laboratory colony

A laboratory colony was initiated during the summer of 2007 using larvae collected from Kalamalka Research Orchard (KRO), Vernon, British Columbia. Larvae extracted from Rocky mountain Douglas-fir, *Pseudotsuga menziesii* subsp. *glauca*, cones were placed on a casein and wheat germ-based diet.

We have reared three generations in the laboratory colony but the colony has now collapsed. With each subsequent generation after collection reproduction decreased while egg and larval mortality increased. We modified the rearing protocol in an attempt to resolve the mortality and fecundity issues. We added macerated Douglas-fir cones to the diet to increase palatability. We also found that the presence of cones stimulated reproductive behaviours in the lab. Unfortunately, our efforts did not increase reproduction and survivability so that a colony could be maintained. This result is similar to the results of other researchers who have attempted to establish a laboratory colony of this species. As a result of the colony collapse it will be necessary to conduct the majority of our research in the field.

In the laboratory, the time from neonate to adult emergence was on average 78 days. Adults lived an average of 25 days throughout which time females continuously oviposited. Eggs were laid singly on many surfaces including cheesecloth, and paper towel but most importantly on Douglas-fir and white pine needles and cones. On cones, eggs were laid in niches between cone scales. The oval-shaped eggs are initially cream coloured and become speckled with red as development progresses.

Future directions

In spring 2008 we will attempt to identify if *D. abietivorella* overwinters in cones, duff or under bark scales. Cones with feeding damage were collected from KRO in March 2008. Cone dissections (n=40) suggest that larvae are not overwintering in cones, a finding which is in agreement with the literature. We will also assess adult longevity which is important to consider when timing pest management activities. Additionally, we will identify if there is a trade-off between reproduction and longevity. In light of our lack of success using light traps to assess female flight and reproductive phenology, we will begin host volatile trials. We will use host volatiles in an attempt to trap female moths and monitor female reproductive status and flight throughout the season. We will also determine the effect of day, season and age on calling on female calling behaviour. Furthermore we will investigate where *D. abietivorella* chooses to oviposit in the field and if this behaviour is changes throughout the season.