THE CLOVER ROOT BORER: A BARK BEETLE PEST IN RED CLOVER SEED PRODUCTION IN OREGON

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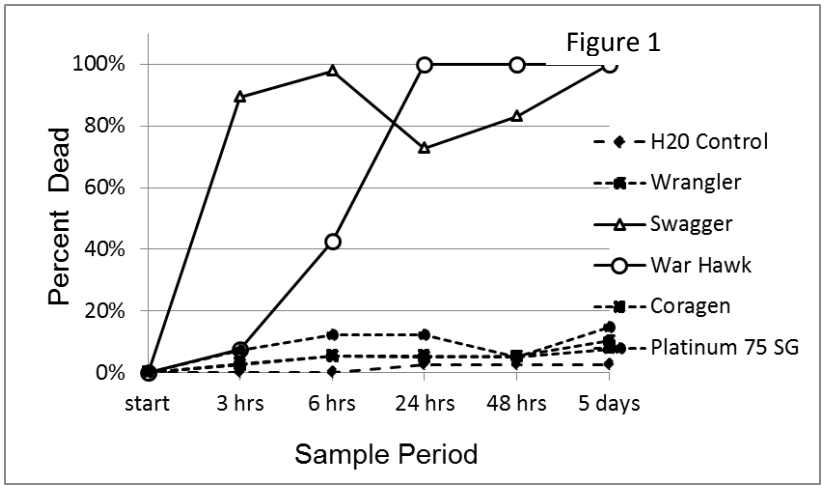
The clover root borer (CRB), *Hylastinus obscurus*, is a major pest of red clover seed production in the Willamette Valley. This bark beetle pest, native to Europe, was inadvertently introduced into the US over 100 years ago. Damage to red clover is caused by adult and larval feeding internally within roots. The presence of five or more larvae per root can result in 43% reduction in above-ground foliage, and mining caused by the pest often becomes a site for infection for pathogens that also contribute to a decline in clover stands. Thus, even though red clover is a perennial plant, the crop can only be grown economically for two years. Keeping a stand productive for only one additional year would be a large economic advantage, and improve a farm's field rotation flexibility. With that goal, we a looking again at improving ways of managing this pest through a variety of options: insecticides, insect pathogens, and attract and kill technologies using either insecticides or insect pathogens.

The clover root borer is a challenge to control due to its subterranean life cycle. In the past, it was managed with organochlorine insecticides which are now banned due to their persistence in the environment. Studies were conducted using insecticides currently registered for red clover production for development of management tactics for the clover root borer. The potential for biological control with nematodes was also evaluated. Data from both studies will be presented.

We tested five insecticides/formulations in two laboratory tests. In the Direct Application test the materials were sprayed with a Potter Tower directly onto 4 replicates of 10-beetles which were immediate transferred to clean Petri-dishes and held for 5 days. In the Indirect Application trial materials were sprayed onto waxed paper and beetles were introduced after the material dried. The insecticides Swagger and War Hawk showed superior control (mortality) in both the direct (Figure 1), and indirect (Figure 2) application trials. The onset of mortality happened faster in the direct application



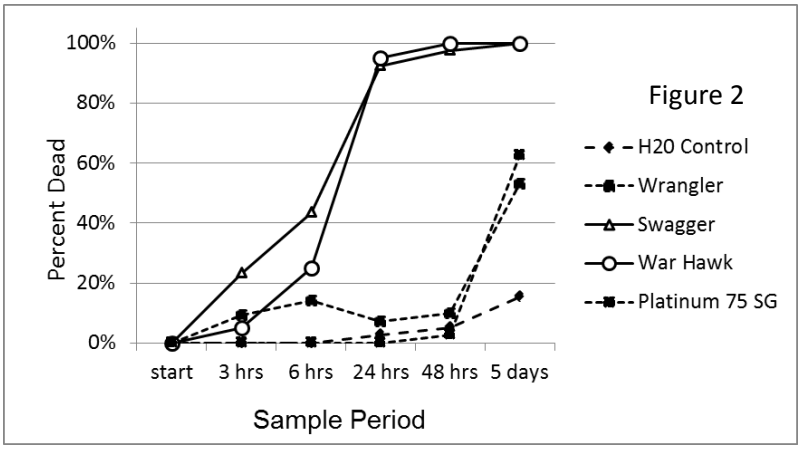


Figure 2

trial, but there was greater mortality after prolonged exposure in the indirect application (continuously exposed to dried material).

Swagger and War Hawk treated plots had the fewest CRB and least damage in field insecticide trials (Crop Protection Services), but their effectiveness in extending the productivity of clover stands has not yet been determined.

Four species of entomopathenogenic (insect killing) nematodes: *Heterorhabditis bacteriophora, H. marelatus, Steinernema carpocapsae, S. kraussei*, were tested in two trials. In the first experiment nematodes were sprayed onto moist filter paper just before the adult beetles were introduced. Rates were 25 and 75 infective juveniles (IJ) per cm^2. In the second experiment the test arenas were small Petri dishes containing 20 g of moist soil. The nematodes were sprayed on the soil surface and the beetles introduced the following day. In the first trial after approximately three weeks mortality from nematode infections ranged from 0 to 25%. *Steinernema* spp. at the higher rate were more infective (Figure 3). In the more realistic trial in soil *Heterorhabditis* spp. were more effective, with mean mortality after two weeks ranging from 0 to 20% (Figure 4). This difference may be related to the way these two genera of nematode find their hosts. Nematodes used as effective biocontrol agents generally kill their host much quicker, and at higher rates, than we found in these studies.

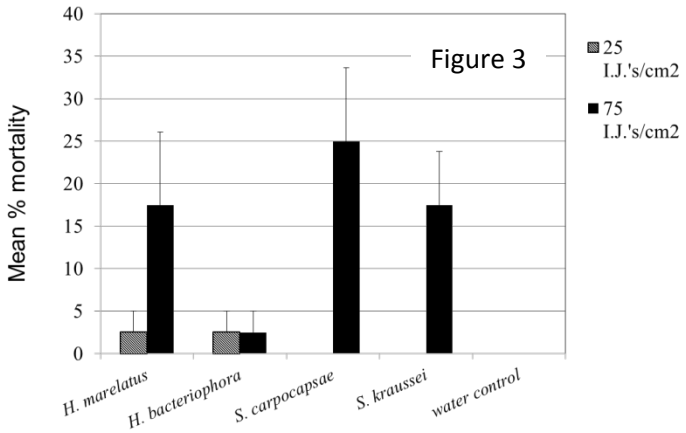


Figure 3

Additional work in the Rao lab will examine fungal and bacterial pathogens which have proved effective against other pest insects.

Recent work in the Rao lab with field collected CRB have found a naturally occurring nematode and a fungal pathogen. Their effectiveness at killing CRB is being assessed.

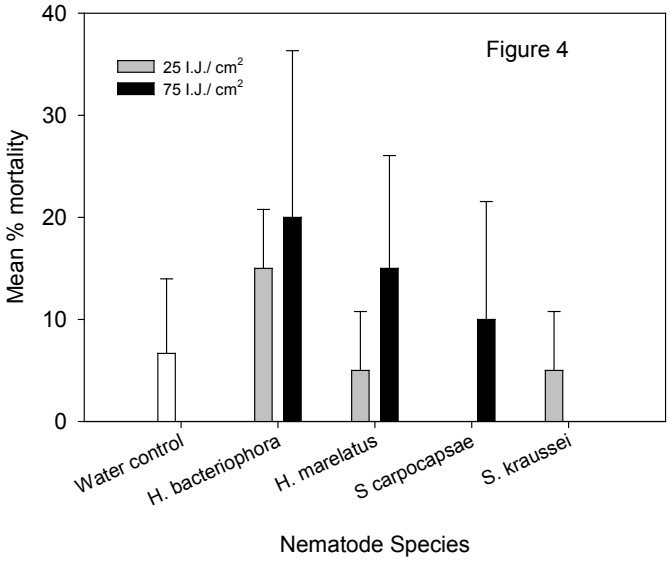


Figure 4