Proposed Management Plan for Corn Earworm in Hemp

Background. Corn earworm (*Helicoverpa zea*) is a key pest of hemp grown in Colorado. Damage is caused by the larva (caterpillar) that tunnels through and destroys maturing buds. This insect is present every growing season in Colorado, where it may be found on a wide variety of crops and weed hosts. However, population size, and associated damage, can vary greatly from season to season and by location.

Traps (light, pheromone) can be used to capture the adult stage of this insect, a night flying moth. When used over a period of time these traps can provide information on in changes in abundance of the insect, with high trap captures being associated periods of peak egg laying on plants.

The insecticides that have the most potential to control corn earworm - and are allowable by the Colorado Department of Agriculture for use on cannabis crops – are two microbial insecticides. One of these is the bacterium *Bacillus thuringiensis* (Bt). Two strains of this bacterium (*kurstaki*, *aizawi*) have been commercialized that can be used to control certain caterpillars; the *aizawi* strain, which tends to be more effective against "cutworm" family caterpillars, such as corn earworm, is recommended. Also allowed for use is a virus (*Helicoverpa armigera* nucleopolyhedrovirus) that infects corn earworm and related insects. Both of these microbial insecticides would be best applied at times when one has determined large numbers of the adult corn earworm moths are present and plants are in sa susceptible stage for injury (e.g., development of flower buds).

Use of Traps for Monitoring Corn Earworm

Two types of traps can be used to capture the night flying moths of the corn earworm, light traps or pheromone traps.

Basic design of a **light trap** uses a light, preferably UV, to attract insects that fly at night. The insects then hit a vane and are funneled into a collecting container below. Usually a killing agent (often a dichlorvos Pest-Strip) is placed in the collecting container to minimize damage to the collected insects, particularly damage to the delicate wings of moths, which may be torn by "June bugs" and other other active insects that come to these traps.

Light traps will capture a wide variety of insects, mostly various kinds of moths and beetles. Traps should be emptied daily and capture sorted to count the number of insects that are of interest, in this case corn earworm moths. The corn earworm moths are fairly easily sorted from the other collected insects, but a bit of training is needed in identification since a few other moths are rather similar in appearance.

A simpler system uses a trap with an attractant lure for monitoring flights of corn earworm moths, a **pheromone trap**. In the case with corn earworm the attractant is a *sex pheromone*, the chemical used by the female moth to attract a mate. A pheromone trap for corn earworm will only capture male moths.

Corn earworm moths are quite strong fliers and a specific type of trap has been developed to capture this insect, known as a *Heliothis Trap*. This is a fairly large trap that is attached to a pole. The pheromone lure is placed at the bottom, where there is a large opening. Moths flying into the trap are funneled into a collecting container at the top.

The pheromone lure is usually supplied as either a small strip or rubber septa, from which the pheromone is emitted over time. Typically the lures for corn earworm will last 2 weeks, then need to be replaced.

Instructions for use of these traps are described well at: http://www.greatlakesipm.com/instrschelio.pdf

For effective use in helping manage corn earworm, traps must be maintained for at least several weeks during the growing season and trap captures regularly recorded. It is suggested that traps be first placed in fields by late July/early August, and maintained through harvest.

Traps should be inspected twice a week during this period, preferably on the same two days each week (e.g., every Tuesday and Friday). The traps should be emptied of moths each time and the numbers of corn earworm moths recorded. Every two weeks the lures need to be changed.

If the pheromone traps are used over time and the captures recorded these traps can detect changes in abundance of the corn earworm moths. Periods when high numbers of moths are captured indicate periods when spray applications are optimally made.

Microbial Insecticide Applications for Corn Earworm Control

There are two microbial insecticides that should have value in manageAmong the insecticides that are presently (2/20/2018) allowed for use on hemp in Colorado, there are two microbial insecticides that should have value in managing corn earworm in hemp. One is a virus, known as *Helicoverpa armigera* nucleopolyhedrovirus or HearNPV, which is sold under the trade name Helicovex. The other products are certain strains of the bacterium *Bacillus thuringiensis* (Bt).can cause infection in corn earworm and a few closely related species of caterpillars.

HearNPV is a type of virus that can cause infection of caterpillars of corn earworm and a few closely related caterpillars. (Tobacco budworm is another important caterpillar in North America that is also susceptible to this virus.) Preparations of the virus are made of infective particles (occlusion bodies) of the virus and these are then sprayed on the crop. Corn earworm caterpillars can become infected after they consume particles of the virus. Within the digestive tract of a corn earworm, the virus is released from the occlusion bodies and initially causes infection of the cells of the midgut. The virus particles replicate rapidly in these cells and these new viruses infect other cells.

The first evidence of infection by HearNPV will be a cessation of feeding. As the infection progresses throughout the body the caterpillar is killed and its body dramatically softens. At end stages the body seems to melt or wilt and the body ultimately ruptures, spilling large numbers of virus particles that can cause new infections.

Bacillus thuringiensis (Bt)-based insecticides involve the use of certain strains a type of bacterium (Bt) that is widely found in soils. Strains used for insect control produce specific toxins, each of which can kill specific kinds of insects. Two of these strains are effective against caterpillars (immature stages of moths/butterflies, Order Lepidoptera), which includes the corn earworm, the **kurstaki strain** and the **aizawi strain**.

Presently there are eight Bt insecticides on the Colorado Department of Agriculture list of allowable pesticides. Two of these are ***Bacillus thuringiensis* var. *aizawi* strain**:

Agree WG*

XenTari Biological Insecticide Wettable Powder*

Six of these are ***Bacillus thuringiensis* var. *kurstaki* strain:**

Crymax
Deliver Biological Insecticide*
Dipel DF Biological Insecticide*
Dipel Pro DF Biological Insecticide
Foray XG Biological Insecticide Flowable Concentrate
Javelin WG Biological Insecticide*

Those marked with an asterisk * have labels indicating they are allowed also for use in Organic Production. (Helicovex is also allowed for use in Organic Production.)

Among the two strains of Bt that can kill caterpillars, the *aizawi* (Agree WG, XenTari Biological Insecticide) strain *is more effective* than *kurstaki* strain products against cutworm/armyworm types of caterpillars, such as corn earworm. Therefore it is recommended that aizawi strain products (Agree WG, XenTari Biological Insecticide) be considered for application

All of these Bt-insecticides are used as sprays that should cover the leaves and buds of the plant where corn earworms feed. When the caterpillar feeds on a part of the plant covered with Bt they ingest the toxins and bacteria. Once within the midgut of the digestive system, the Bt-toxins paralyze the digestive system of the insect. Caterpillars that have ingested enough of the Bt on the treated leaf will usually stop feeding within a few hours. Death of the caterpillar may take much longer, perhaps 2-3 days or more. Unlike HearNPV, caterpillars killed by Bt-insecticides cannot be expected to release new infective forms of the microbe that may infect new caterpillars.

Both of these microbial insecticides have several desirable features. They have extremely low toxicity and hazard to humans and other vertebrates. They are also very selective in their effects on other insects; both microbes are 1) only potentially able to kill caterpillars (immature stages of moths/butterflies, order Lepidoptera), and 2) can only kill caterpillars that chew on parts of a plant that have infective particles of the microbe (virus, bacterium). Insects that are natural enemies of pest insects are not susceptible to these microbes. They will be conserved even after application and can continue to suppress various kinds of insects that feed on hemp, including corn earworm caterpillars.

Pollinating bees, such as the honey bee and various bumble bees, also are not susceptible to either of these microbes. This is a particularly important feature since hemp that produces pollen, which many bees actively collect, is often in flower at the same time it may be useful to control corn earworm.

And, of course, one of the most important features is that, at this point in time, they are one of the very few insecticides presently allowable for use on hemp in Colorado that could kill corn earworm. That most all formulations are also allowed for use in Certified Organic production may also be an important feature for some producers.

Both of these microbial insecticides (HearNPV, Bt aizawi) have limitations. Unlike most insecticides that can kill insects on contact, these microbial insecticides must be ingested – they are a type of stomach poison. Thorough overage of the plant is essential for good control and caterpillars within buds are not likely to be affected until they emerge and feed on parts of the plant covered with the spray. These

microbes also can degrade fairly quickly when exposed to direct sunlight and can be expected to only effectively persist on plants for a short period (days). Repeat applications will be needed, perhaps twice a week, to sustain coverage.

Bottom Line

The suggested pest management plan for corn earworm in hemp is:

1. Establish a way to monitor flights of the corn earworm moths. It is suggested that the Heliothis Trap be used, with the corn earworm sex pheromone as the lure. Place the trap in the near vicinity of the hemp fields. Begin this by late July/early August.
2. Consistently monitor and maintain the trap, recording captures twice a week.
3. When large numbers of moths are caught that will indicate an increased amount of eggs will be laid by corn earworms. If fields are in a susceptible state, with buds present that need protection, sprays of either the HearNPV (Helicovex) or certain Bt-insecticides should be considered.
4. Bt insecticides containing the *aizawi* strain are recommended, although *kurstaki* strain products should also provide some control.
5. Sprays should be applied in a way that provides good coverage of the developing buds. Since microbial insecticides prays applied late in the day Sprays may need to be reapplied every 4-5 days or so during periods when high moth captures occur in traps.
6. Treatments can probably be safely discontinued a week or so before harvest, since very young larvae do very little damage. However, some caterpillars may continue to develop in green, moist buds for some time after harvest. Plants that are harvested in a manner that allows them to dry down rapidly will likely soon become unsuitable for any corn earworm caterpillars that are on the plants.

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