

## Introduction

This oil applicator will make it possible for you to control corn earworm and other ear-invading caterpillars in your sweet corn with a one-time application using materials that are safe for both you and the environment. The Zea-Later™ II is specially designed for easy and comfortable application of vegetable oil in sweet corn fields—whether you are growing a few rows or many acres of corn!

## Target Pests

The **corn earworm** (scientific name, *Helicoverpa zea*) is one of the most difficult pests to control in sweet corn. Adult moths lay their eggs on the silks of young corn ears. When caterpillars hatch, they crawl down the silk channel into the ear and feed in the tip—making an ugly mess!

In southern areas of the United States, corn earworm overwinters and becomes active early in the growing season. In northern areas, corn is invaded later in the season by migratory flights that may bring large numbers into a region very quickly.

Corn earworm caterpillars may be brown, tan, green, or pink, with light and dark longitudinal stripes. The head capsule is always plain golden brown, and there are small bumps and hairs which give the body a rough texture. Caterpillars reach 1½ to 2 inches when full grown.



**European corn borer** (*Ostrinia nubilalis*) also invades corn ears. During silking, the moths will lay eggs near the developing ear, and the caterpillars will crawl down the silk channel similar to corn earworm. These light-colored caterpillars, with small dark spots on each segment, are also controlled by the Zea-Later™ oil application.

**IMPORTANT NOTE:** Many European corn borer caterpillars, as well as another species, the fall armyworm, also tunnel into the side of the husk. These must be controlled by other means. For further information and recommended controls, see *Integrated system for sweet corn caterpillar pests*.

## Pest Control Strategy

The Zea-Later™ II applicator is designed to deliver to each ear precisely the amount of vegetable oil required, exactly where you need it, time after time. The oil is applied to the tip of the young ear, directly into the silks. The oil barrier protects ears by killing caterpillars as they crawl into the ear, before they inflict damage, and kills small caterpillars that may already be there. A one-time application protects the ear during the crucial kernel growth stage. It only takes a small amount of oil (0.5 ml, equivalent to about 5 drops) to do the job. The barrier remains secure in the tip of each ear—resistant to rain or wind.

Adding *Bacillus thuringiensis* subspecies *kurstaki* (*Bt*), a bacterial pathogen which is toxic only to caterpillars, enhances the effectiveness of the oil barrier. For more on how to mix oil and *Bt*, see the "How To" section.

## Effectiveness

Research at the University of Massachusetts, Hampshire College and on farms throughout New England has shown that, when used correctly, the oil barrier applied by the Zea-Later™ II controls corn earworm and allows growers to sell high quality fresh market sweet corn throughout the season.

## Integrated Pest Control

The oil application method is part of an advanced Integrated Pest Management system for sweet corn. It is the only method currently available for corn earworm control that can be used by **certified organic farmers**. By using this method, you are part of a growing number of farmers and gardeners who are committed to healthy, sustainable, and economical methods for growing food.

## When to Use Zea-Later™ II

*The Zea-Later™ system works best when the corn growth stages and pest conditions are known.*

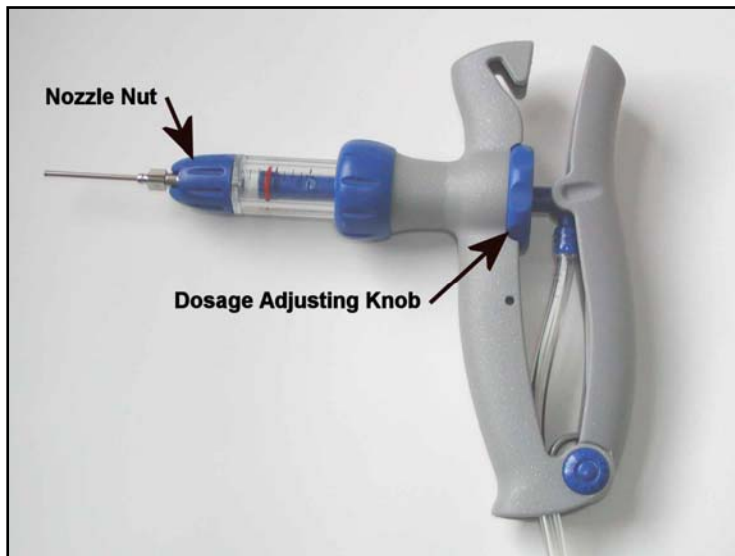
### Monitor for corn earworm

- *Know when earworm is in your area!* Use pheromone traps, field scouting, or your regional Extension pest alert to determine whether corn pests are active in your area. Oil should be applied whenever corn earworm is active and sweet corn is entering the silking stage.

### Know when your corn is silking

- *Timing is important!* For optimal effectiveness, the oil barrier should be applied when silks have reached their full length and begun to wilt and turn brown, approximately 5-6 days after 50% of the corn has begun to show silk.
- Earlier applications will give you good control but can result in ears with reduced kernel fill in the top ½ inch because oil can interfere with the pollination of the silks from the tip.
- Later applications may allow earworms to enter the ear before oil is present, resulting in poorer control.
- If your sweet corn stand is uneven, try to apply oil when most of the corn is at the ideal stage.
- Wind and rain do not disturb the barrier so there is no need to reapply after rainstorms.

## Major Components of Zea-Later™ II



### Applicator

- Comfortable handle.
- Adjustable dosage.
- Replaceable needles.

### Oil pack

- Oil pack consists of a hip belt and a rigid plastic canister, which holds 2 quarts of oil.
- Canister should be removed from belt for mixing, refilling and cleaning. Top closes for mixing and carrying.
- Clear tubing from applicator attaches to a quick-connect fitting at top of canister. Tubing inside of canister extends to bottom of reservoir so intake remains in oil as the canister empties.

## How to Use Zea-Later™ II

Before using the Zea-Later™ II consult “Precautions”.

### Applicator Basics

- The Nozzle Nut should be finger tip tight to hold the needle securely on the applicator (**Warning: Do not over-tighten!**). To remove the needle, loosen the Nozzle Nut one full turn and slide the needle sideways out of the cutout in the end of it. Reinstalling the needle is the reverse.
- The dosage can be adjusted by turning the Dosage Adjusting Knob. The dosage in milliliters is determined by aligning the front edge of the piston with the desired dose printed on the scale on the barrel. The recommended dosage is 0.5 ml. When priming the gun it may be beneficial to increase the amount dispensed to 1 ml or more. After the oil fills the gun, return the setting to 0.5ml.

### Materials

- Use vegetable oil. Corn oil is recommended, but soybean oil can be used. These two vegetable oils are safe and legal for use on food crops and are allowed in most organic certification programs.
- Use a *Bt* product that is labeled for use against caterpillars in sweet corn. Be sure it is the *kurstaki* strain of *Bt*, which is effective against caterpillars. ***If you are a certified organic grower, consult with your certifying agency regarding the organic status of specific brands.***

### Mixing Procedures

- ***Use a dirt free surface when mixing.***
- Mix only what will be used the same day.
- It is important to achieve a relatively stable and fine suspension of the *Bt* in the oil. *Bt* products may be formulated as a liquid or as a dry powder.
- When using a liquid *Bt* product, mix a small test amount to be sure that the liquid *Bt* will form a suspension in the oil. Mix undiluted, full strength *Bt* with oil in a ratio of 1 part *Bt* to 20 parts vegetable oil. For example, Dipel ES can be applied at the  $\frac{3}{4}$  pt/acre rate by using 1.5 fl oz per quart vegetable oil.
- When using a dry *Bt* product, first mix the *Bt* with a small amount of water to form a smooth paste. Then add this to vegetable oil, preferably one which contains an emulsifier. Golden Natural Spray Oil, a soybean oil with emulsifier, is approved for organic production and is readily available at farm suppliers. Use the equivalent of the recommended label rate of *Bt* per acre. For example, Dipel DF can be applied at the  $\frac{1}{2}$  lb/acre rate by using 2 oz dry product (equivalent to approx. 3 Tbls.) in 2 quarts of emulsified oil.
- Shake well when mixing, and agitate periodically during use as needed to keep the suspension mixed.
- Treatment of one acre will require approximately 2 gallons of oil/*Bt* mix.

### Getting Ready

- Once oil and *Bt* are mixed in canister, attach and adjust the hip belt.
- Place canister in belt pack and attach tubing onto oil canister. Hold applicator at waist level.
- To get oil flowing, squeeze the handle repeatedly until the oil is pulled through the tube and through the applicator itself.

***Your Zea-Later™ II is now ready for use!***

### Applying oil solution

- Treat one row at a time. Walk at a comfortable pace with the applicator in one hand.
- Insert the tip of the applicator into the silk at the top of each ear and squeeze the handle. It does not have to be injected down into the tip, but it should land on the silk so that gravity will move it downward into the neck of the ear (the silk channel).
- One squeeze is enough for each ear. More oil does not necessarily give better control, and excessive amounts of oil can result in oily kernels at harvest.
- Use your free hand, as needed, to push flag leaves away from the ears.
- Typical application time is about 2 to 2.5 hours per person per  $\frac{1}{4}$  acre.

## **Cleaning and Storing Applicator**

### ***FLUSH WITH HOT SOAPY WATER AFTER EACH USE.***

The applicator should be flushed clean with hot soapy water after each use. Dish soap or a mild detergent should be used. Squeeze the handle and pump soapy water through the tubing to remove any oil residue.

Whenever possible after use, and before long-term storage, soak the applicator and tubing for an hour or more in hot soapy water. Soapy water penetrates into crevices within the applicator and removes oil. This will extend the life of the applicator and prevent oil from accumulating inside the moving parts of the applicator pumping mechanism. Rinse out the soap with clean water.

When not in use, the Zea-Later™ II and canister should be cleaned and stored under moderate temperatures and out of direct sunlight. The storage area should be dirt- and dust-free.

**Proper cleaning and storage will help ensure a long life for your Zea-Later™.**

## **Troubleshooting Guide**

### **Oil flow problems**

- If oil is not flowing through tube:
- Continue pumping handle until oil is drawn through tubing.
- Check canister for adequate oil supply and to be sure end of tube is in oil.
- Put Zea-later applicator at same height or lower than the supply canister.
- If these steps do not solve the problem inspect for plugged tubing or a disrupted connection that could block and disrupt pumping action. For plugged tubing, flush or soak with soapy water. Fix broken connections by re-attaching linkages. Apply compressed air carefully to both sides of oil tubing to loosen blockage.

If oil drips out of applicator:

- Internal check valves should prevent oil leakage from the tip when applicator is not in use. However, it is best to hold or transport applicator at or above the level of the oil reservoir. If leakage continues, check internal connections. Flush with soapy water to clear check valves of debris that might have blocked them in an open position.

### **Cleaning problems**

If your Zea-Later™II should fall onto the ground or otherwise be contaminated with dust/dirt:

Exterior:

- Rinse with water, preferably warm soapy water.

Interior:

- Immediately disconnect and isolate contaminated tubing. Try to prevent contaminants from reaching the applicator.
- Flush disconnected, isolated pieces with warm soapy water.
- Reassemble once dirt/dust has been washed away.

## **Precautions**

Handling *Bt*:

- Waterproof gloves should be worn when handling *Bt* products and when filling and mixing canister. Always read the label for all instructions, including agricultural use requirements.

Mixing:

- Avoid filling and mixing on dirt surfaces or laying applicator on the ground. Dirt could get pulled into the tubing and clog the internal mechanism.

Oil Barrier Application:

- Avoid applying vegetable oils directly to corn leaves or husks with the applicator or other spray equipment. Vegetable oils may be phytotoxic to green foliage and may result in discoloration if applied directly to leaves. It will not discolor silk or kernels.

- Oil applications may result in some ears with about ½ inch of unfilled kernels at the tip. This effect may be more severe if corn is under stress from environmental or nutritional conditions.
- Point applicator away from face and clothing.

**Keep out of reach of children.**

### **Integrated system for sweet corn caterpillar pests**

Corn can be damaged by **European corn borer** or **fall armyworm** in addition to **corn earworm**. These caterpillars often infest corn before the silking stage, by feeding in the whorl or green, succulent tassels. When ears form, these caterpillars may move down the stalk into the ear. While many of these caterpillars enter the ear through the silk channel and will encounter the oil barrier, others, often a significant number, chew through the side of the ear and are not reached by the oil.

Scout your corn when the green tassels are just emerging, looking for fresh feeding and caterpillars to determine the percent of infested plants. European corn borer caterpillars are light colored, with a pattern of small dark spots on each segment and a black or dark brown head capsule. Full-grown larvae are ¾ to 1 inch long. Fall armyworm caterpillars are also smooth, but with brown or dark green lengthwise stripes, and a distinctive light-colored marking in the form of an inverted Y on the head capsule. Full grown fall armyworms can reach 1½ inches in length.

If you have European corn borer and/or fall armyworm in 15% or more of the plants, **use a foliar spray of *Bt* applied at the point of emerging green tassels**. Spray a second application 5-7 days later if needed for control of these caterpillars. Then, use the Zea-Later™ at the proper silk stage to control caterpillar entry into the tip of the ear.

This integrated system, when implemented correctly, should give you clean corn at harvest, even with a mixed population of caterpillar pests.

### **Product Support**

For questions and product support concerning the Zea-Later™ II, contact: Johnny's Selected Seeds, 955 Benton Ave., Winslow, ME 04901 Phone: (800) 854-2580 Fax: (800) 738-6314  
E-mail: [commercial@johnnyseeds.com](mailto:commercial@johnnyseeds.com)

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