



Economic Distance: a Variable Application of the Economic Injury Level

Gary J. Brewer and Kirk Mundal
North Dakota State University
Department of Entomology, Fargo, ND 58105

The banded sunflower moth (BSM), *Cochylis hospes* Walsingham, is found throughout much of the United States and the Canadian Prairie Provinces. In North Dakota, infestations are common and result in significant damage to oilseed sunflower by feeding on seeds and reducing seed set.



Fig. 1. Adult banded sunflower moth and eggs on sunflower bracts.

Edge-Effect

During the daylight period, adult banded sunflower moths often rest in areas of short broad leaf plants adjacent to sunflower fields. The moths move into field margins at dusk to oviposit. The distribution of eggs and larvae in the field exhibits a marked edge-effect.

Because of the edge-effect, yield impacts are typically more severe along field margins than in the field interior.

Survey Methods

Current sampling protocols and the economic injury level (EIL) are based on sampling for moths (Fig. 1). However, sampling moths is often inaccurate and requires a substantial time investment.

As an alternative, we developed a procedure to sample banded sunflower moth eggs. To see and accurately count the small eggs we recommend using a head mounted 3.5 X magnifier (Fig. 2). This leaves both hands free to manipulate the bud being observed. Egg counts should be made when most of the sunflower plants have buds at plant stage R3 (distinct bud, elongated ¼ inch above the nearest leaf, yellow ray petals not visible). When sampling, buds should be randomly selected without regard to plant stage to avoid bias.



Figure 2. Sampling for eggs using a head-mounted magnifier.

Survey Steps:

1. Divide each side of the field to be surveyed into 437 yard (400 m) long spans.
2. Sample the center of each span at 21 feet (6 m) into the field from the field margin.
3. Randomly select five buds at each sample site.
4. From each bud, randomly select six bracts from the outer whorl and count the eggs on each bract (Fig. 3).
5. Average the egg counts from the five buds and then map the average egg counts from each sample site to a diagram of the field.

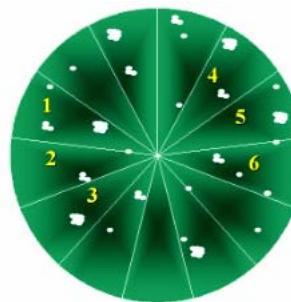


Figure 3. Diagram of sunflower bud showing the arrangement of six bracts to sample for banded sunflower moth eggs.

Economic Injury Level

An economic injury level (formula 1) was developed to replace one based on sampling moths. The new EIL is easier, quicker, and more accurate. The EIL is specified as number of eggs per bud. V is the market value for sunflower seed per lb, PP is the plant population per acre, and TC is treatment cost (\$/acre).

$$EIL = \frac{TC}{V \times PP \times 0.00078} \quad [1]$$

Economic Distance (ED)

ED (formula 2) estimates population size at variable distances into the field (away from the margin and toward the center of the field) when the egg density at a field margin sample site is at or exceeds the EIL. ED is also used to plot the extent of the EIL throughout the field (Fig. 4). Individual ED values are calculated for each survey site and are given as distance from the field margin.

The formula for ED includes the value of the EIL (from formula 1). D is the average egg density at 21 feet and e is the natural logarithm. Instead of manually calculating the EIL and ED values, an ED Calculator is available from the North Dakota State University, Department of Entomology website. The calculator will perform the calculations and provide a field diagram of the ED.

ED Calculator: http://www.ndsu.nodak.edu/entomology/econ_calc.xls

$$ED = e^{\left(\frac{\frac{EIL}{D} - 1.29}{-.194} \right)} \quad [2]$$

Example

Given these conditions, $TC = \$8$, $V = \$0.10$, and $PP = 16,000$, the EIL is 6.4 eggs per six bracts. Table 1 shows example egg counts at eight survey sites and the corresponding ED values.

Table 1. Average total number of BSM eggs per 6 bracts per survey site.

Site	Eggs	ED (ft)
1	7	23
2	10.6	112
3	12.4	176
4	15.2	288
5	16.2	330
6	11.6	147
7	6.6	17
8	4.8	0

In this example, only a portion of the field (about 50%) would need treatment (Fig. 5).

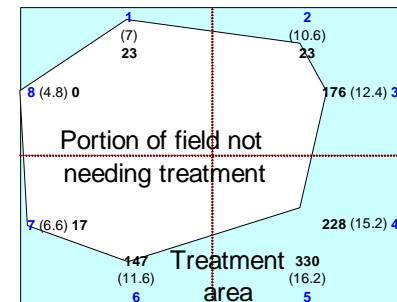


Figure 4. Field diagram showing portions of field needing and not needing treatment. Survey sites (1-8, in blue) centered midway across 437 yard spans along the field margin with egg densities (in parenthesis) and corresponding economic distance values.