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Reviewing Decision Thresholds for Pest Insect Control

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Abstract
Three tools need to be understood in order to make decisions regarding the control of insects found on crops: damage boundary, economic injury level, and the economic threshold. The existing values for these three variables are now being questioned with the increase value of Iowa’s row crops and the cost of controlling the pests. This article reviews the use of these tools in regards to soybean aphid control.

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Reviewing Decision Thresholds for Pest Insect Control

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Three tools need to be understood in order to make decisions regarding the control of insects found on crops: damage boundary, economic injury level, and the economic threshold. The existing values for these three variables are now being questioned with the increase value of Iowa's row crops and the cost of controlling the pests. This article reviews the use of these tools in regards to soybean aphid control.

The *damage boundary* is the number of a pest insect that must be present before their injury can be measured as yield loss. There is no reason to spend money and effort to control insects that are present in numbers fewer than the damage boundary because there will not be any observable return in protected yield and there can be detrimental effects on the natural enemies.

The *economic injury level (EIL)* is the number of insects that need to be present for the value of the lost yield to equal the costs of control.

The *economic threshold (ET)* is a decision point. It is the number of pest insects that need to be present for a control to be applied and keep the increasing pest population from reaching the EIL.

*Soybean aphids on a bean leaf, Jon Tollefsen.*

In the case of the soybean aphid attacking soybeans, the economic injury level (EIL) has been an average of 654 plus or minus 95 aphids per plant. This calculation indicates that when there are 654 aphids per plant, the yield loss they cause will equal the insecticide and management costs to control
them. This calculation was based on a $8.65 to $21 range of control costs, with 30 to 60 bushels per acre yield and market values of $5.50 to $6.50 per bushel.

Now that the market value for soybeans has risen, a lowered EIL can be calculated. David Ragsdale, the lead author on the paper describing the existing EIL for soybean aphids, calculated a new EIL for soybeans selling at $15 per bushel, with $8 per acre control cost, and an anticipated yield of 50 bushels per acre. With these values the EIL is lowered to 452 aphids per plant.

**Although a lower EIL has been calculated, we are NOT recommending a lower ET. Here is why:**

- The current 250 ET is below the damage boundary. In the field research from which the original EIL and ET were calculated, there were no yield losses observed for populations that peaked at 250 aphids per plant. Therefore a threshold of 250 aphids per plant is below the damage boundary.

- Lower ETs do not provide greater yield protection. In follow up studies conducted in Iowa, there has not been significant yield protection when insecticides were applied at populations at or below 250 aphids per plant. In 2007 and 2005, soybeans that received an insecticide applied at the 250 ET had higher yields than plots that did not receive an insecticide. Plots that received an insecticide at much lower thresholds, greater than 10 per plant, required multiple applications but where indistinguishable from those that received an insecticide at the 250 ET. In 2006, when aphid populations peaked at less than 250 per plant, we did not see a yield difference between treated and untreated plots; details of the report are available. [www.soynbeanaphid.info](http://www.soynbeanaphid.info).

**Soybean aphid populations do not always exceed the economic threshold (ET).** During 2004 and 2006 on-farm and research farm studies of soybean aphids in Iowa, soybean aphid populations rarely exceeded 250 aphids per plant. When these fields with lower populations were sprayed for research purposes, no consistent yield protection was observed. This is an experience shared by many entomologists and researchers across the Midwest.

Even though we can now find soybean aphids in many of the fields, there is no guarantee that they will reach levels that will cause yield loss. Each grower must determine the risk for their own fields as year to year and location to location variation can occur in soybean aphid populations. For maximizing the value of an insecticide application we continue to recommend scouting and the use of the 250 ET.

**The consequences of preventative insecticide applications can be severe.** If growers apply insecticide as a preventative treatment (i.e. with a tank-mix of herbicide or fungicide) when they are not needed, the risk for insecticide resistance increases. Persistent use of any insecticide can lead to resistance as observed in other crops where aphids have been a pest.

A second consequence of applying an insecticide before it is needed is pest resurgence. All of the insecticides labeled for use in soybeans are “weapons of mass destruction” to insects. They will kill the aphids AND the predators than can be found in soybeans even before the aphid arrives. By using insecticides in a preventative manner, growers can inadvertently make a bad situation worse by removing these beneficial insects and producing greater populations of aphids, and possibly other insect pests, than would have been present had they not have sprayed at all.

In summary, we continue to recommend that growers scout and employ the ET average of 250 aphids per plant. To date we have no evidence that lower thresholds or preventative approaches, where the insecticide is applied regardless of the aphid density, will result in greater yield protection than this recommendation. However, we are constantly re-evaluating this recommendation and will report research findings as they become available.
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