



Pest Sampling

Pest Sampling and Using Pest Management Tactics

Michael J. Brewer

Pest damage potential is delineated, in large part, by an organism's ability to damage a valued commodity now and in the future. Therefore, in sampling for pests we are interested in estimating a trait of the pest population or commodity that is a good indicator of the damage potential of the pest (such as estimating pest population density or percentage of damaged plants in a cropping system). In all cases, some basic information should be considered before establishing an informal or formal sampling plan. Knowledge of the life history and identification features of the pest is critical. It is not an uncommon mistake to be looking for a wrong stage of the pest: early in the season seedling weeds or immature insects may look very different than mature weeds or adult insects. Proper identification can be crucial in determining whether or what type of management tactic should be implemented. For example, the severity of damage and control strategies differ for two-spotted spider mite and Bank's grass mite infesting corn.

Another crucial aspect of pre-sampling knowledge is an understanding of *pest/plant interaction*. Plant response to pest damage may not only vary by the species of pest, but also by the species or cultivar of the plant, the growth stage of the plant, and the health/vigor of the plant at the time of pest infestation. Certainly plant species vary greatly in susceptibility to a pest. For pests that do damage to a specific plant species, the pest's common name is often associated with its host plant although confusion can arise: beet curly top virus is indeed a sugar beet disease but Russian wheat aphid is a pest of wheat *and* barley. Plant cultivars also can vary greatly in susceptibility to pests. Examples of this plant attribute are small grain and alfalfa cultivars that are resistant to various diseases and some insects. In many cases, these resistant traits are incorporated into commonly used cultivars. Plant susceptibility will also vary, at times greatly, by the growth stage of the plant at the time of infestation. For example, pests may be very harmful when the crop is in the seedling stage but not after the crop becomes established: these are known as "seedling" pests. Crop plants often can out-compete weeds if the weeds are delayed in growth: this is a basic principal of early-season weed control. Aphids are commonly more damaging to seedling plants, but also may do some damage to older plants, particularly if the plants are stressed by lack of water or nutrients. A final aspect of pest/plant interaction to consider is the health/vigor of the plant when it is exposed to a pest infestation. Often, but not always, plants that are nutrient or water stressed are more susceptible to pest injury than if they are vigorously growing. It is worthy to note that both a lack of, and an over-abundance of, water may create an environment such that the plant is more susceptible to pest damage: many small grains tend to be more prone to pathogens during conditions of high moisture/humidity while the same plants grown in dry conditions will be prone to greater damage by Russian wheat aphid. Indeed, it sometimes appears that there is a pest for every environmental condition and plant, making it very important to have as much knowledge about pest-plant interaction as possible.

Sampling programs and protocols have the aim to assess a *sampling trait* in a population by inspecting a portion of the sampling "universe."¹⁴⁸ In sampling pest populations, the sampling trait is usually the pest itself or damage of the commodity. The sampling "universe" relates to the area in which a pest management decision must be applied. Often, the sampling "universe" relates to the value of the commodity to be protected and the potential severity of the pest. We may be interested in protecting a high value crop from a severe, frequently occurring but sporadic, pest; therefore, the sampling "universe" may be an individual field in which an inspection of three or four sites per 30 acre field may be warranted. In contrast, we may be interested in protecting a low value commodity, such as rangeland, from a less severe pest; therefore, the sampling "universe" may be several square miles in which fewer inspections occur because the lessened severity of the pest does not justify a higher frequency of costly inspections. In situations of less severe, and sporadic pests on low valued commodities there is interest in developing region-wide sampling procedures that take advantage of remote-sensing automated technology in order to decrease the cost of sampling in many areas.

In pest ecology, we are usually concerned with *density or frequency of occurrence of sampling traits* (usually the pest but also can be plant damage). Sometimes we are only concerned with detection (some governmental inspection services that aim to detect the entry of pests into a new region). Sampling protocols may provide *direct estimates* of the sampling trait based on the unit of interest (plants, foot of row) or based on "catches" (traps, screens, sweeps, and shakes). Other sampling tools provide *indirect estimates* (such as measuring plant damage in the form of defoliation, root feeding, pierce marks, or other type of damage). These indirect measures are sometimes called indexes of pest severity. Indirect measures must be used with caution because detection of plant damage may or may not be well related with the presence of a pest population. All the sampling programs presented in this guide will involve the estimation of pest densities or frequencies of occurrence of pests (or damage in the case of indirect estimates) that relate to a plant unit, land area unit, or trap unit. Examples of estimates of pest densities include number of leaf spots per plant, number of grasshoppers per square foot, number of weeds per foot of row, number of insects caught per day in a trap, and number of larvae per sweep (using a sweep net). Examples of estimates of frequency of occurrence include the proportion of plants (or animals) that are infested/infected, or are damaged. Issues involving pest-plant interactions, economic value of the commodity, and economic cost of control must

be considered to devise a good sampling protocol, whether it be a formal, well-researched, plan or a more informal plan based on good general knowledge of the following issues:

Issues to consider in developing a sampling protocol

What / where to sample?

What is the destructive stage of pest (and virulence of different stages)?

What is the susceptible stage of plant?

What pest stage is most susceptible to management tactics?

What are the most efficient ways to sample while maintaining good estimates of pest densities or plant damage?

When to sample (how often)?

What is the severity of plant response to pest attack?

What is the epidemiology of the pest population (how quick does it increase)?

What is the lag time necessary between sampling and implementing a management tactic?

What is the lag time necessary for a management tactic to be effective?

Ultimately, the economic value of a sampling protocol and implementation of a management tactic relates to the prevention of commodity loss because the management tactic was implemented at the appropriate time based on good estimates of pest damage potential. Of course, the savings associated with preventing commodity loss should be greater than the cost of using the sampling protocol and management tactic. Whenever available, this guide will present information on such economic thresholds: the level (usually pest density) at which the cost of sampling and implementing management tactics is equal to the cost of the expected commodity loss if a management tactic is not implemented. If the economic threshold is exceeded, it becomes economically viable to implement a management tactic. Economic thresholds are typically and most appropriately used for implementing short-term management tactics, such as chemical control and to a lesser degree regulatory and cultural controls. Chemical control is the use of chemical compounds to kill and/or reduce pest densities. Cultural control is deliberate modification of the crop environment or pest habitat to decrease pest populations. Regulatory control is the regulation of an area or commodity in order to eradicate, prevent, or manage pests and their injury to a valued commodity.

Based on the factors affecting pest-plant interaction, as well as variability in commodity price, economic thresholds should not be considered stagnant levels. Usually, economic thresholds cited in this guide will be pertinent to a particular pest stage or crop growth stage occurring under normal environmental conditions. As available, information will be presented so that the reader can modify or “build” his own threshold based on specific conditions. If a single economic threshold is given, pay special attention to the situation (pest and plant conditions) in which it is applicable. Thus, it is very important to consider that economic thresholds should be used as suggested guides that will aid you in determining whether to implement a management tactic. Keep in mind that most economic thresholds are constructed from information on commodity and control economics and an understanding of pest-plant interactions. Other factors, such as presence of beneficial organisms (wildlife, honey bees, natural enemies of pests), potential contamination of soil and water sheds, and potential human exposure to pesticides, should be considered prior to implementing a pesticide control strategy.

Other pest management strategies may be available that typically involve long-term sustainable approaches to pest control (such as biological control and cultural control). Biological control is the action of natural enemies (such as some plant-feeding species that are weed feeders, and parasitoids and predators of pests) that result in the death or suppression of pests. Cultural control is the reduction of pest populations or their effects through standard agricultural practices (such as crop rotation and use of pest resistant cultivars).

If successful, these strategies usually do not require active season-to-season manipulation by a grower (such as pest control by established exotic natural enemies of an introduced pest) or are part of the normal production practices of a grower (such as growing cultivars that are resistant to a pest). Because of the nature of these control strategies, they are not implemented by standard use of economic thresholds. These sustainable approaches to pest control are admirable because they usually are very much in keeping with the goal of good pest management: use of control strategies to reduce pest populations to levels that do not cause economic injury to the commodity, without exposing humans to harmful control agents, without disrupting nontarget organism(s), and without causing other forms of harm to the environment. When available, sustainable pest management strategies will be listed in this guide. We recommend that growers consider such options for use in their operation (i.e. using a resistant cultivar) and be aware of the many beneficial organisms that contribute to a productive agriculture and healthy environment.

Categories: Pest Sampling, Tactics

Date: 08/14/2001

Supported in part by:

Western Region IPM Center, EPA Region VIII, National Plant Diagnostic Network, Great Plains Diagnostic Network, USDA CSREES, Colorado State University, Montana State University, and the Universities of Nebraska, Wyoming and Queensland CBIT.