Organic Transition Series

FACT SHEET

Insect and Disease Management in Organic Grain Production

A major concern among farmers who are transitioning to organic grain production is how to manage insects and diseases. While the tactics used are different from those of conventional systems, organic farmers have several tools at their disposal to prevent pest organisms from causing severe economic damage to their crops.

Insect and disease management in organic grain production relies on multi-tactic strategies that focus on minimizing the negative impacts of pests rather than completely eliminating them. These strategies apply knowledge of the biology, ecology, and behavior of insects and disease-causing organisms. The goal is to develop proactive plans which incorporate decisions regarding crop rotation, variety selection, planting and harvest time, fertility management, and inputs to limit damage that impact crop quality and yield. However, as with many aspects of organic management, a multi-faceted systems-based approach must be adopted. A long-term plan across a diverse crop rotation helps ensure that pest organisms are managed while maintaining desirable populations of beneficial microbes, insects and pollinators. As in conventional grain systems, organic systems management requires regular scouting of the fields and obtaining an accurate id of which pests and microorganisms are present and/or the cause. This knowledge-based approach allows a farmer or crop consultant to develop a plan that is grounded on the pest organism's biological, ecological, and behavioral characteristics.

The pest, weed, and disease management regulations are found in the USDA National Organic Program Regulations, Section 7 CFR 205.206. The regulations require a succession of practices for the management of pests, weeds, and diseases; input-based strategies (those using permissible pesticides or herbicides) are used only after other preventative measures are shown insufficient. Cultural practices of crop rotation, planting date, and variety selection serve as the foundation of the plan. Mechanical and physical methods to pest control (such as mulches and traps) or the development of habitat for natural enemies are additional options. If these practices are found inadequate to hold back crop pests at a manageable level, then a farmer can draw upon input-based practices (biological, botanical, or chemical materials must yet be allowable in organic crop production); in these circumstances, the conditions and reasons for using the material should be documented in the organic system plan.

Biological and ecological basis for pest management decisions

As described above, cultural practices are the foundation of pest management plans in organic agriculture and must be outlined in an Organic System Plan. Both insects and diseases require a specific combination of factors to cause economic damage to a crop, thus knowledge of the ecology and biology of insects and disease organisms is essential. For insects, this includes the presence of the food, habitat, and other resources the pest needs to survive, in combination with an environment that is conducive to growth. For diseases, the presence of both the pathogen and host are needed in a conducive environment. Knowledge of organism biology---such as where it overwinters, how it travels into a field, and temperature/moisture conditions facilitating growth and reproduction---can help determine which management choices will limit pest damage.

A proactive management plan relies on the anticipation of potential threats and an accurate identification of current diseases and insects as well as their underlying biology and ecological foundations. Preventative measures are one of the most powerful tools that organic farmers have to minimize the impacts of pest insects and diseases. The following preventative strategies are similar in that (1) they modify the crop environment to be less conducive to pathogen or pest growth, or (2) they allow the crop to maintain a condition such that it can better withstand pest damage.

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Agronomic decisions for pest and disease management

▪ Crop variety selection

Crop varieties available to organic farmers can have varying levels of disease and insect tolerance, which can be a strong tool in pest management among grain crops. Insect and disease resistance have been priorities of many crop breeding programs, including those using traditional breeding methods allowed under USDA National Organic Program. Specific traits for which plants have bred, including leaf and canopy architecture, leaf pubescence, phytochemicals, can decrease their attractiveness to pest organisms. For example, using traditional breeding methods, organic soybean varieties with Rag 1 & Rag 1/Rag 2 pyramided aphid resistance genetics are available to contribute to the management of soybean aphids in organic fields, suppressing aphid populations to a significant degree providing yield potential under bad aphid stress. Another example of a crop where significant insect tolerance exists is alfalfa, for which organic varieties are available with good leafhopper resistance.

Traditional plant breeding has also varieties to assist with organic disease management. For example, 'Deon' is a variety of oats that exhibits good crown rust resistance. Organic 'Erisman' soft red winter wheat, while at the bottom of the pack for yield in treated, conventional soft red wheat trials, has nearly the best scab tolerance of any variety tested. Organic 'Quest' 6-row spring barley has the best available fusarium head blight tolerance for spring barley. Farmers and advisors can consult local disease screening trials to see where resistance may be present in varieties available for organic production.

▪ Crop rotation

Crop rotation (or crop sequence) can be an important element of the organic system plan to help reduce the risk of insects and diseases causing economic damage to a crop. By breaking up pest life cycles by limiting multiple years of a host crop, crop rotation is an effective tool for managing diseases that are at least in part maintained in the soil (such as white mold and fusarium) and ground-dwelling insects with limited host ranges (such as corn root worm). Crop rotation has limited or no effectiveness against highly mobile insects or diseases, such as those that are moved by airborne spores.

▪ Planting date

Since synthetic chemical seed protectants and GMO technology are prohibited in organic agriculture, the quick emergence and early, vigorous growth of crops are very important for avoiding insect and disease damage. Cold soils result in delayed emergence and slow root development and thus the stand is more susceptible to root rot pathogens such as *Phytophthora, Pythium, Rhizoctonia,* or *Fusarium,* as well as insect damage. Often, organic farmers plant their crops quite a bit later than their conventional neighbors. Farmers transitioning to organic systems may be concerned with a loss of yield potential with this later planting, but uniform stands which result from quick seed germination and emergence not only have a positive impact through achieving the targeted plant population, but also greatly promote weed management through competition.

Strategizing planting dates also contributes to the successful management of insect pests and the diseases they vector. For example, Barley Yellow Dwarf Virus in winter wheat can be managed through timely planting in the fall to avoid prolonged periods of aphid feeding for viral transmission. Degree-day models that estimate the peak flight times of seed corn maggot can inform when to plant corn to reduce risk of damage on the untreated, non-GMO seed.

▪ Plant population and row spacing

Crop population density and row spacing also affect crop susceptibility to disease and insect pests. Although cultivation equipment typically necessitates that corn and soybean planting be standardized on a wider 30-inch row, there are some situations where precision guidance can allow for narrower rows. Certain fungal diseases, such as white mold in soybean, thrive under humid microclimates, and these conditions can be mitigated through wider row spacing that improves air flow. Increasing plant populations may be advised when pest pressure is anticipated to be high as this reduces the risk of lower plant populations due to feeding damage.

Natural enemies

Encouraging natural enemies for biological control involves managing crops and the surrounding vegetation to offer and maintain their preferred habitat and food sources. This can be done by managing habitat areas adjacent to crop fields, demonstrated by the Science-based Trials of Rowcrops Integrated with Prairie Strips (STRIPS project) led by Iowa State University. Diverse cover crops (particularly flowering species) help support natural enemies and beneficial insects, particularly when cover crops are managed by mowing prior to being tilled under. While further research is needed to determine optimal species and management combinations, intercropping is one strategy to maintain beneficial plants and insects, particularly when flowering species such as buckwheat and clovers are sown within the cash crop.

Inputs

Synthetic insecticides and fungicides are prohibited for use in certified organic systems. However, an increasing number of products are available which are based on active ingredients that come from natural sources. One example is the insecticide Spinosad, of which the active ingredient is a fermentation product of the soil-dwelling actinomycete Saccharopolyspora spinosa. Other natural insecticides that have proven highly effective include products with active ingredients based on *Bacillus thruringiensis* and Pyrethrum. The availability of these new products brings the challenge of identifying the efficacy, reliability, and return of investment of these inputs under a wide range of environments. Of particular interest are organically approved fungicides, biostimulants, and other biological amendments in grain crops.

Take-home message:

The tools in the organic toolbox may differ, but through a systems-approach based on biology and ecology, organic grain farmers can successful manage insects and diseases to maintain crop quality, productivity, and profitability. As with many aspects of organic production, successful pest management requires careful planning and a long-term outlook. Applied inputs in organic pest management of grain crops are seldom used due to their high costs and variable efficacy; however, even beyond these issues, their use is de-emphasized in organic management because the focus of the transition is to establish a proactive, systems-based approach. The foundational cultural and agronomic tools outlined above can support a system that allows a crop to sustain minimal damage with manageable pest pressure, especially if these tools are used in combination with weed management and soil health practices to support a healthy, vigorous crop.

References and Further Resources:

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