



MOSES ORGANIC FACT SHEET

Organic and Sustainable Pest Control

The approach to pest and disease control on organic and sustainable farms is one focused on preventative measures and the reduction of off-farm inputs. The standard agricultural view of pest control often focuses on treating a pest problem once it has already occurred, but given that organic growers do not use synthetic pesticidal products this focus is less effective. Therefore, organic growers take a holistic approach to pest management. This approach is concerned with the entire system and the interactions between the components that make up that system. These methods can potentially reduce dependence on off farm inputs and improve the bottom line.

In order to develop a holistic pest management system we can ask ourselves, what factors on the farm affect pest pressure in some way? Climate and crop identity are going to be the most basic factors in determining what pest issues may arise, while crop diversity is also an important factor. The diversity of crops grown within a year will have important implications for how easily insects move among fields, while crop rotation (or diversity over time), also strongly influences pest distribution. Native biodiversity in non-cropped areas is also important in providing habitat for pest predators and slowing the movement of crop pests, while soil fertility is another factor in enhancing crop resistance to pests.

Climate is a key factor in pest control because it determines the species of crops grown in a region, and therefore the associated pests that growers are going to be dealing with. The most important step farmers can take in terms of climate is to know the life cycle of pests specific to his/her area. This information can help producers to make sound decisions when designing rotations and when monitoring pest pressure throughout the growing season.

Species and variety of the crop will also determine what pests are present. A producer's first consideration is to identify varieties of each crop with genetic resistance to problem pests. Planting resistant varieties can make the rest of your pest management planning much easier because it can effectively prevent pests from becoming a problem.

Another strategy in preventative pest control is managing for diversity. Natural ecosystems contain a community of organisms, and through their interactions, these organ-

isms to work to regulate each other and create a balance in regards to the resources that are available, such as light, water and food. This regulation is the reason that severe pest outbreaks are rare in the natural world. The balance maintained in natural ecosystems is interrupted in an agricultural monoculture, and the response of the ecosystem is to send in insects and weeds to try to restore that balance. This is inevitable and it's the reason farmers have to rely on management to grow a crop. However, if we manage in a way that works to enhance naturally-occurring processes, such as encouraging pest predation by including strips of natural vegetation between fields, we can let the ecosystem do some of the pest control work. Besides providing habitat for pest predators, keeping field sizes from getting too large, growing a number of crops and intercropping when possible can help increase diversity across the farm. Expanding crop rotations and including cover crops not only provide fertility, but diversify the cropping system. In general, a more complex landscape increases habitat for pest predators and can confuse pests, which are unable to travel easily between and within fields. Smaller field sizes (even 50 acres versus 100) have also been shown to increase the mobility of pest predators within the crop, while disease pressure is often reduced by increasing diversity as well.

The organic producers best in-crop defense against pest outbreaks is to ensure crops are healthy and not under stress. Research has shown over and over again that soil fertility and nutrient composition in the plant are related to pest and disease occurrence. Insects and diseases are nature's clean-up crew; they most readily attack plants that are weakened or stressed. So stressed plants are more susceptible to pests and disease, and furthermore, weakened defenses that can occur when a plant becomes diseased can encourage feeding by insects, and feeding by insects can encourage disease! This fact is important in understanding the root causes of pest outbreaks, because outbreaks are often just symptoms of an underlying problem. If, rather than treating the cause of the outbreak, which may be crop stress, we instead address only the symptoms, no ground is gained and we simply continue chasing the pest or disease with new and different "-cides".

Insects are attracted to plants mainly based on chemical "odor" signals given off by the plant, and unhealthy, stressed or diseased plants produce different odors and signals than their healthy counterparts. These distinct

odors emanating from unhealthy plants are thought to result from the differing nutrient concentrations within the plant. Soluble fertilizers used in conventional agriculture can at times lead to imbalanced nutrition in plants because nutrients in the fertilizers are readily absorbed by the plant in excess, thereby altering the nutrient profile of the plant. These nutrient imbalances can lead to a metabolic bottleneck where excess simple sugars and free amino acids (simple non-protein nitrogen compounds) accumulate in the plant. The accumulated simple compounds (and their associated odors) are highly attractive to many crop pests because they are easily digestible. For example, excess nitrogen fertilization has been shown to be positively correlated with aphid populations, and research has shown that European Corn-Borer prefers to lay its eggs on plants fertilized with readily soluble synthetic nitrogen fertilizers, as opposed to those fertilized with organic materials. Furthermore, nutritional imbalances prevent a process within the plant called induced resistance. Induced resistance is a remarkable response many plants have to insect feeding. It can lead to the production of odors that attract pest predators, as well as stimulate the production of compounds that make plant tissue distasteful or inedible for insect pests.

It should be noted that simple plant sugars are important building blocks of many plant compounds and a high sugar content is only a problem when the plant is unable to further convert the sugars because of a nutrient imbalance. The bottom line here is that good soil fertility management with a diversity of organic inputs will provide the entire spectrum of nutrients necessary for healthy crops. Crops that will be able to maximize photosynthesis and sugar production, while efficiently making all the secondary compounds that are necessary.

Soils with good fertility and high humus contents also have been shown to suppress many soil borne diseases. Most disease-causing pathogens present in the soil are poor competitors, so this suppression is likely due to competition from a healthy microbial population. However, some direct predation may occur as well.

Even if farmers manage for diversity and do everything they can to ensure that crops are healthy, pest and disease problems are inevitable at some point. In the case of pest outbreaks organic farmers are limited to naturally occurring products, or synthetics approved under National Organic Plan regulations. Organic growers should consult the regulations to view the list of approved synthetic substances, while growers can also consult the Organic Materials Review Institute products list to view a list of approved products. This list can be found online at www.omri.org. It should be noted that companies manufacturing the products on the OMRI list submit their products voluntarily, so just because a product is not on the list does not mean it is not approved. Organic growers should always consult their certifier before applying a new product.

There are many materials that can be used by organic grow-

ers to treat pest problems. Some are relatively expensive and therefore are most often used in high value crops. Examples of insecticides include Pyrethrin, a substance naturally occurring in some species of Chrysanthemum, which is effective as a broad-spectrum insecticide (\$20-\$60/ac), Neem oil (extracted from a tree common in Africa and India) (\$20-\$50/acre), Spinosad (derived from bacteria, \$15-\$60/ac) and citrus oils. Diatomaceous earth is inexpensive and can be effective on crawling pests such as insect larva or caterpillars, and applications of the bacterium *Bacillus thuringiensis*, or Bt, are very effective against insect larvae. Sulfur and copper are allowed for use under organic regulations as fungicides, and sulfur is often mixed with lime to increase its effectiveness. It should be noted that NOP regulations state that these and other reactionary products are only used when preventative measures have failed and a documented pest problem is occurring.

Aside from the above mentioned products, biological controls can be effective in reducing or eliminating pest problems. Biological control consists of the release of insects which prey on crop pests. Beneficial predatory insects include aphid midges, which prey on over 60 species of aphids, lacewings, which are voracious consumers of aphids, thrips, leafhoppers and other vegetable pests, and Trichogramma wasps, which are effective against corn borer and earworms. Many other insects are available as well. These insects usually have to be replenished at certain intervals, but do demonstrate good control in many situations.

Ultimately, farmers will never be completely free from pest problems. Even where crops are healthy and there is diversity in the cropping system pests and diseases will find a way in. Still, if farmers use some simple techniques, such as providing natural vegetation for pest predator habitat, using expanded crop rotations and growing a diversity of crops, and providing fertility through organic sources pest problems can be prevented to a great degree. In fact, after the initial transition period, many organic growers report reduced pest control costs while maintaining comparable yields.

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