Management of commercial vegetables in ways to minimize the risk of diseases is important to sustain success over the long term. Commercial vegetable growers should focus on disease prevention rather than curing plants of diseases, because in general the tools are not available to cure plants of diseases. The strategy should be to use cultural practices that keep the pathogen populations low, that slow spread, that improve the plant’s resistance or tolerance to diseases where possible [many production techniques required to achieve desired market standards of quality and acceptable yields actually increase susceptibility to certain diseases], and take steps to minimize disease-favorable environments.

Chemicals should be viewed as only one part of a total disease prevention program, albeit a very important part, of most modern production approaches. A carefully managed vegetable operation combines cultural practices and selected chemical treatments to obtain prevention and achieve maximum disease control, although diseases can be managed with cultural approaches if adequate inputs are used. It is especially important in commercial vegetables to stop epidemics early in the season, because once most infectious diseases are well established and developing rapidly many are nearly impossible to control under ideal weather for the disease.

Consider these cultural practices and principles of disease control when developing management options in your commercial vegetable operation:

**Resistance**

Many vegetable varieties are resistant to specific plant diseases. Use them whenever
possible, however, recognize that often resistant varieties may not have all the other horticultural qualities of the most desired susceptible varieties. But remember, reducing a pesticide use or residue may have environmental and social value and may have significant market appeal.

Exclusion or Avoidance
A near sure way to failure with vegetables is to start the crop with infected transplants or infested seed. Avoid introducing plant pathogens into the crop and field is an essential step, yet many fail at this initial point. Growers often buy the pathogens with their seed or transplants! Kentucky laws do not protect you against this, and even if legal steps were available they would not totally protect. The best approach is to use certified, disease-free seeds then treat the seed to minimize escapes and to grow transplants in small units in environments that prevent infection.

The modern mass-market approaches to transplant production greatly increases the chances of a few infected/infested seed contaminating a large production area. Do not transport soil or tools from diseased areas to disease-free areas. Rotate crops to disease-free fields to avoid planting into areas of the pathogens. Use of barrier or border crops is an important use of this principle with many vegetable diseases.

Eradication
This principle involves destroying the pathogens in place, but does not necessarily mean total destruction of the pathogen. Rather, eradication measures are designed to reduce the pathogen populations to a point low enough that a crop can be economically produced. With diseases, such methods usually involve killing the pathogen during its survival phase, while between disease events, or very early in the epidemic; mainly through treatment of seed, crop rotation long enough to starve-out the pathogen, or by preplant fumigation. Contrary to many growers hopes, most foliar applied fungicides have little eradicative action, killing or burning-out of infection. Those few that do must be used early in the epidemic for best results. Removing badly diseased plants from a field or control of weedy host plants, helps prevent spread of the disease to healthy plants through the use of this principle. Chemical baths or hot water treatment of seed are used to eradicate pathogens from seed prior to seeding.

Sanitation
Removal of old plant parts, weeds and trash is important in discouraging pathogens from growing and the disease from spreading. Prevention of volunteers and prompt destruction of earlier plantings where subsequent plantings are planned involve this principle. Tools and equipment should be disinfested and free of pathogens.

Protection
This principle involves the use of chemical or physical barriers on or around the plant to prevent the pathogens from establishing in the plant. Fungicides are effective in prevention and control of disease only when they are present on the plants. They control the disease mainly by slowing its rate of development during the first incubation period. Most disease organisms reproduce very fast - compared to other pests - so large numbers of additional pathogens occur within days or weeks:

Fungicides are subject to weathering and must be applied early in the disease cycle and reapplied at regular intervals during the period of pathogen activity in order to keep plants adequately covered due to new growth and weathering of the pesticides. Moreover, waiting until large amounts of disease have
developed seldom gives economic control and discontinued applications often results in even more disease than if no sprays were made. Once the disease is active, delaying applications, increasing intervals, or stopping applications should be based on environmental conditions that prevent infection or spore production.

Several predictive models are being developed for commercial vegetables (such as the TOMCAST system for tomatoes) that use this very technique of monitoring leaf wetness and temperature to determine when to start and stop sprays.

Chemicals should be applied only in the prescribed manner as recommended by the manufacturer, which is the law. Read the label carefully and follow directions. Note the number of days required between the harvest date and the last fungicide application, and that the crop being sprayed is covered on the label. When chemical formulations differ from those listed, adjust rates up or down as needed. However, the formulation in question must be labeled for the specific crop and site in question. For example, just because the material is labeled for field use on tomatoes does not mean it can be legally or safely used in the greenhouse.

**Insect and Weed Control**

Certain diseases are spread by insects and survive in weeds or insects. Where this relationship between a plant pathogen and weeds or insects exists, timely weed or insect pest control is of utmost importance. Two classic examples are bacterial wilt of cucurbits and the cucumber beetle control and mosaic virus of corn and johnson grass eradication and control.

**Timely Diagnosis**

Accurate and timely diagnosis of vegetable diseases and disorders is a critical step in disease management. Without a sound diagnosis the controls programs are either missing or not focused. Knowledge of the specific problems that occur in a specific field or on a certain variety allows one to incorporate the appropriate controls into the total plan.

Unfortunately, too many growers do not know what specific diseases are occurring so their control strategies often are “shots in the dark”, costly in losses, and usually lead to irresponsible use of pesticides. County Extension Agents are trained to assist growers in getting accurate and timely diagnosis of diseases and disorders.

**Crop Rotation**

Rotation to non-host crops is a valuable tool in vegetable crop production. The concept is to allow the pathogen population to decline over time by starving the pathogen and depleting its resting stages. This practice slows pathogen buildup in fields routinely used for vegetables and can be used to reduce the level of pathogen in fields after a serious disease outbreak. Unfortunately, it is not effective against all diseases but where it is, it is most valuable and environmentally safe. Crop rotation controls more diseases than any other single cultural step. When rotation is not practiced, expect increases in both the numbers and intensity of diseases.

As a general rule in rotating your vegetable crops, avoid planting the same crop species or closely related species in the same place more than once every three years. Crops grouped together below are subject to the same disease and insect problems.

- Corn, sorghum, small grains
- Chives, garlic, leeks, onions, shallots
- Beets, swiss chard, spinach
• Cabbage, canola, cauliflower, kale, collards, brussels sprouts, broccoli, turnips, kohlrabi, rutabaga, chinese cabbage, mustard

• Peas, snap beans, lima beans, soybeans, clover, alfalfa

• Carrots, parsley, celery, celeriac, parsnips

• Pumpkins, squash, watermelons, cucumbers, muskmelons

• Endive, salsify, lettuce

• Potatoes, eggplant, tomatoes, peppers and tobacco

In addition, root and bulb crops - though often not related botanically - are susceptible to many of the same soil pests, so be sure to avoid other root crops as well as botanically related plants in the rotation. Grasses are often excellent crops to rotate with them. Also, many unrelated vegetable crops share root knot nematodes, so major changes in the rotational patterns are needed where nematodes become a problem.

Some diseases will not be impacted adequately by the short to moderate rotational schemes. This happens because either the pathogen is able to maintain its population on a wide host range (including weed hosts), produces very resilient resting stages, or has very rapid rates of secondary reproduction [so even though the initial population was reduced by rotation, that remaining is more than adequate to start a serious epidemic]. Also, some pathogens have more than one source, so even though the local soilborne or crop residue source is control, new sources arrive with transplants or on the winds, for example.

Realize there is no perfect rotational scheme, all have their strengths and weaknesses, and disease control is just one of many factors that must be considered in making the selection.

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