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POTATO

CUTS THAT HEAL:

Seed Cutting, Treating

Insect Focus

By Howard Ferris

UC Davis Provides Resources

Innovative tools are available on the web

New approaches to pest management are information-intensive and require greater understanding of the biology and economics of the pest. There are new tools that aid in the design of cropping and rotation sequence requirements and there is a vast amount of helpful and applicable information readily available on the internet.

PEST MANAGEMENT

Economically and environmentally efficient approaches to managing pest populations are enhanced by developments in Integrated Pest Management (IPM). At the University of California, Davis (UC Davis), guidelines for pest management are accessed through the Statewide Integrated Pest Management Program.

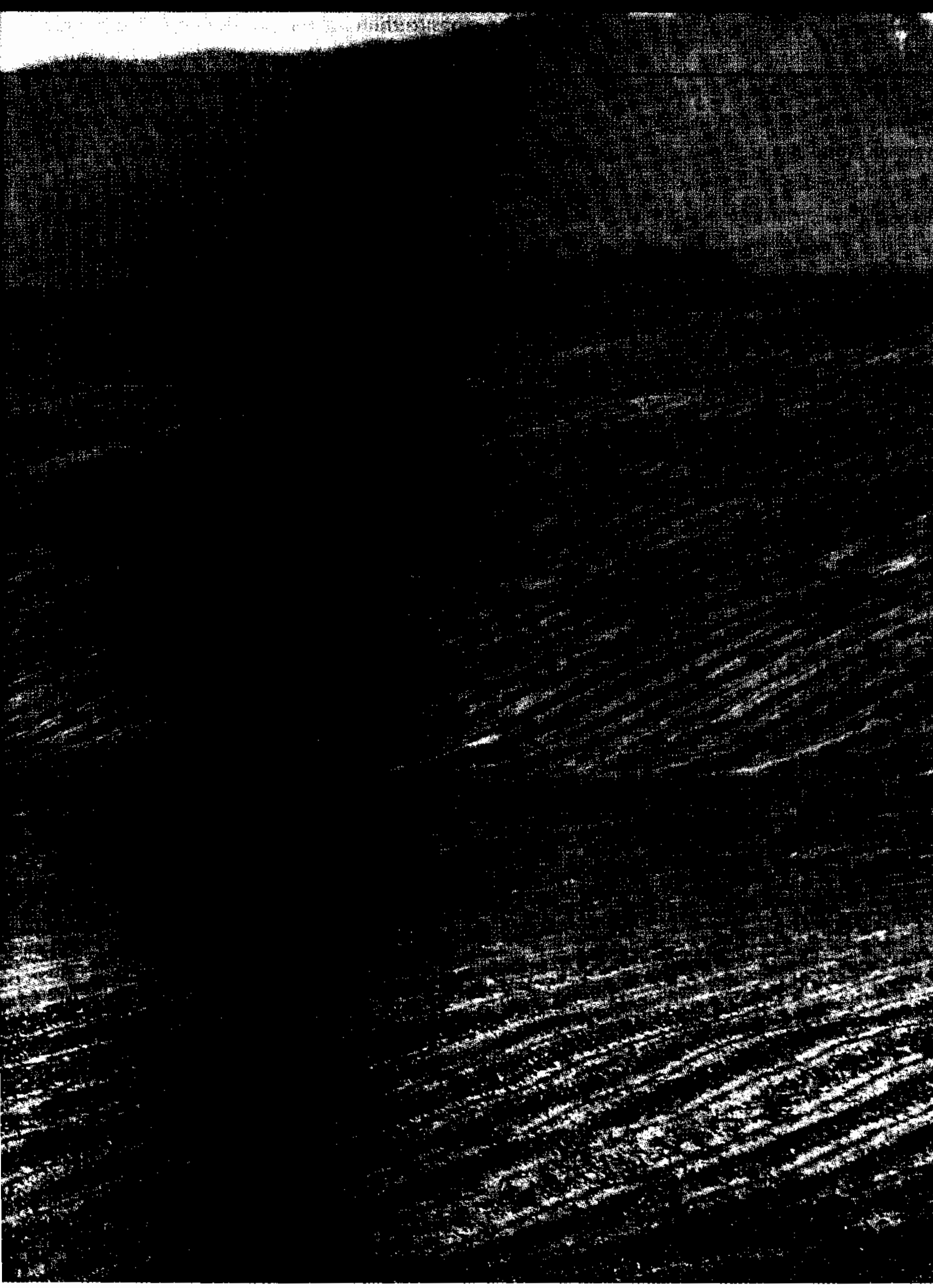
Detailed program information is posted on the website at www.ipm.ucdavis.edu.

Viewers can access complete IPM programs for specific crops, including strategies for managing diseases, insects and mites, nematodes, weeds and more. In addition, the guidelines list monitoring techniques, pesticides and non-pesticide alternatives.

The website also provides an interactive tool called Nemabase. This is a huge and comprehensive database for host status of plants to nematodes.

Nemabase is a compilation of the published data up to the late 1990s. Although much information on the host status of plants to nematodes, and on crop cultivars that are resistant to nematodes, is now available on the web and easily searched, important information buried in the earlier scientific literature is more difficult to access. Nemabase was developed to provide access to that information. It can be used to find resistant cultivars to specific nematodes or to determine whether plants are hosts or non-hosts. It is a powerful tool for designing cropping and rotation sequences.

Nemabase contains extensive lists of



cover crops, native plants, crop cultivars, and their status as host for a wide range of nematodes. The lists are compiled from information extracted from nearly 5,000 articles published over the last 90 years. Nemabase documents information on studies or observations on over 38,000 interactions between nematodes and plants. The UC Statewide Integrated Pest Management website enables growers and consultants to download the entire database or to do simple searches online for:

- Selection of non-host crops, and determination of the availability of resistant cultivars, for species and races of plant-parasitic nematodes.
- Selection of cover crops that are non-hosts to resident plant-parasitic nematode populations.
- Rapid search of the available knowledge base for novel species of crops or cover crops that warrant testing in a cropping system in relation to their effect on resident nematode populations.

MINING DEEPER

Besides Nemabase, there are many more sources of information on the web on nematodes and their management. An example is Nemaplex, a website developed over many years for classes on plant and soil nematodes taught at UC Davis (http://plpnemweb.ucdavis.edu/nemaplex). The site, described as a virtual encyclopedia of plant and soil nematodes, is a work in continuous progress that is updated with new developments in the field and with new nematode management concepts and tools.

Nemaplex includes components on management options, concepts of economic thresholds and optimizing rotation sequences, and evaluating soil health and productivity. The website is a useful companion tool to Nemabase as it provides details on the morphology, distribution, biology, feeding habits and damage potential of important nematode pests of plants.

OPTIMIZING SEQUENCES

Crop rotation is a powerful approach to managing population levels of damaging plant-feeding nematodes. Here is an example of how on-line tools like Nemabase, Nemaplex and other sources can be used to determine cropping sequences that generate maximum returns in relation to a nematode population in a field. The basis of the crop rotation strategy is that plant nematodes feed on the roots of certain plants but not others. In the absence of a food source, population levels of the nematodes decline. When population levels are low enough, a susceptible crop can be grown without appreciable damage from the nematodes. So, for how many years should non-host crops be grown? The answer, "It depends!"

Making optimal cropping sequence decisions for nematodes is easier than for some other pests. The nematode population is already resident in the field and typically completes three to four generations during a cropping season. While they build up to high levels, those levels are measurable and, to some extent, predictable. Population levels of plant-feeding nematodes in the soil can be measured by soil sampling and analysis prior to planting and at the end of the crop season. So we can determine population levels and estimate the likely economic loss if nematodes are not managed.

Optimal cropping sequences have been determined, in most cases, for important crops that are damaged by nematodes with relatively narrow host ranges. In those cases, it is easy to select economically-acceptable non-host crops for the rotation. However, by an interesting quirk of evolutionary fitness, nematodes with narrow host ranges often have extended survival capabilities in the absence of a food source. In extreme cases, they may enter a prolonged dormancy that is only broken by root exudate signals from the next host crop. So, when nematodes are able to survive for a long time in the absence of a host crop, rotation to non-host crops may be necessary for several years.

Recommended cropping sequences for fields with pest nematodes have usually been determined empirically. Sources like Nemabase allow selection of resistant cultivars or crops that are non-host to the resident nematodes. By monitoring their population levels over time, we can determine when it is safe to return to a host crop. But what about optimization of the system? What sequence of crops will provide maximum returns? A few pieces of information are needed beyond the host status of various crops to the resident nematode species:

- the annual decline rate of the nematode species in the absence of a host crop,
- the annual rate of increase of the nematode species when a host crop is grown,
- the expected returns from the host crop in relation to the level of the nematode population and
- the expected returns from growing the non-host crops.

Optimizing calculations based on these four pieces of information have been developed and applied, as an example, to the sugar beet cyst nematode on sugar beet. Similar calculations could easily be applied to other nematode species although some informed estimates of the above measures would be necessary.

As an example, using a cropping sequence optimizer model available in Nemaplex, the optimum non-host rotation length between sugar beet crops when sugar beet cyst nematode is present is strongly affected by the annual survival rate of the nematode in the absence of a host. The optimum rotation length is influenced, of course, by the production economics and values of the host and non-host crops. In this example, we used arbitrary data for the crop values and have altered only the survival characteristics of the nematode population in the absence of a host crop. The optimum rotation length is determined as the number of years of growing a non-host between host crops at which average annual returns are at a maximum.

Clearly, the economics of the production system and the optimum rotation length are strongly influenced by the survival capabilities of the nematode in the absence of a host crop. Although the survival rate is a biological attribute of the nematode population, it can be altered by various management strategies. Those strategies are reviewed in sources like Nemaplex and include, for example, the use of certain cover crops that directly reduce survival of the nematode or that enhance the activities of natural enemies of the nematode.

(EDITOR'S NOTE: Ferris is the professor of Nematology, University of California, Davis.)