Seed Varieties:
Combine Disease Resistance and Sugar Content
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 sequences and require 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 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 Nembase. This is a huge and comprehensive database for host status of plants to nematodes. Nembase 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 is easily searched, important information buried in the earlier scientific literature is more difficult to access. Nembase 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.

Nembase contains extensive lists of crop 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. Nembase documents information on studies of observations on over 38,000 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 by:

- 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 Nembase, there are many more sources of information on the web on nematodes and their management. An example is NemaXpress, a website developed over many years for classes on plant and soil nematodes taught at UC Davis (http://npxpressweb.ucdavis.edu/nemaxp). The site, described as a virtual...
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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 web site is a useful companion tool to Nematbase as it provides details on the morphological, 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 Nematbase, 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, 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 plant. Hence, rotation may not provide the same benefits as until recently thought. Optimum rotation length is determined by the number of years of growing a non-host between host crops at which average annual returns are 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 Nematbase and include, for example, the use of cover crops that directly reduce survival of the nematode or that enhance the activities of natural enemies of the nematode. Nematodes are not managed economic loss can be estimated.

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 under the absence of a host (Figure 1). The optimum rotation length is determined by the number of years of growing a non-host between host crops at which average annual returns are 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 Nematbase 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.