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Sugarbeet Cyst Nematode — Biology and Management

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SUGARBEET CYST NEMATODE — Biology and Management

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Sugar beet cyst nematode has been recognized as a plant pathogen since 1859 when it was associated with stunted and declining sugar beets in Germany. Since then it has been found worldwide wherever beets are grown. It is assumed that cyst nematodes were introduced to the Central Coast valleys of California during the era when sugar beet production was a primary crop in these areas.

Two cyst nematode species are now recognized as plant pathogens on the Central Coast, *Heterodera schachtii,* the sugar beet cyst nematode, and *H. cruciferae,* the cabbage cyst nematode. The host range for these two nematodes is similar. *H. schachtii* can complete its life cycle on sugar beets, garden beets, broccoli, Brussels sprouts, cabbage, cauliflower, curly dock, garden cress, garden orache (French spinach), horseradish, kohlrabi, mangel, kale, mustard, New Zealand spinach, radish, rape, rhubarb, spinach, swede, some varieties of tomato and turnip. It can also survive on weeds related to the above crop groups. *H. cruciferae* appears to be confined to the cruciferae attacking only broccoli, Brussels sprouts, cabbage, cauliflower, kale, garden cress, kohlrabi, rape, radish, rutabaga, wallflower, white mustard, and turnip.

Sugar beets were cultivated on much of the agricultural land on the Central Coast at one time or another. It can be assumed that most of this land was infested during the sugar beet era or has been infested since that time by the movement of sprinkler pipe, transplanting, and cultivation or harvesting equipment.

Host symptom expression of cyst nematode injury varies somewhat by host, age of the host, time of year, and soil temperature. In general, however, symptoms of malnutrition or poor growth are evident. Infested plants are usually stunted, and overall growth in the field is very uneven. Plants often wilt at midday, even when the field has just been irrigated and soil moisture is at field capacity. Some plants may show nutrient deficiency symptoms. Under high populations seedling wilt and death can occur.

When affected plants are carefully dug and the roots examined, tiny white to cream-colored "lemon-shaped" bodies will be found attached to the roots (Fig. 1). These spherical bodies are female nematodes. As these females mature, some eggs are laid in a gelatinous mass outside her body. At this time the body shell also becomes tough and leathery and turns tan to brown in color. This structure becomes the "cyst" or egg sack in which 50 to 600 or more eggs are retained and will survive through fallow periods, non-host periods, or adverse soil conditions. The cyst and eggs can survive several years. Research has shown that slightly more than half the eggs in each cyst hatch or die each year after cyst formation. Therefore, if a cyst is produced with 200 eggs at time 0, in year one, 100+ of those eggs will hatch, in year two, 50+ more will hatch, in year three, 25+, and so on. This hatching sequence, along with some natural egg mortality, will allow an infested field to be returned to susceptible crop production in 3-5 years, depending on the initial severity of the cyst nematode infestation. The rotation must be host-free or fallow and also weed host-free to be successful in reducing cyst nematode numbers below economic levels.

Soil temperatures are critical to egg hatching and nematode development. Twenty-five degrees C

(77°F) are necessary for eggs to hatch. After hatching, movement in the soil can occur down to 15°C (59°F). The optimum temperatures for growth and reproduction are 21-27°C (70-81°F). On the Central Coast, with the practice of multiple crops being produced year-round, research has shown that several cyst generations per year are possible (see Table 1).

Table 1. Generations and day degrees needed for sugar beet cyst nematode development.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
DD	12	43	42	133	212	260	332	323	299	256	114	30
Cyst Generations					1st		2nd	3rd	4th		5th	
Accumul. DD	12	55	97	230	442	702	1034	1357	1656	1912	2026	2056

As soil temperatures increase, generation time is reduced. Therefore, a host crop planted in January may only allow a partial or one generation of cyst nematodes to mature, while that same crop planted in June or July may allow 2 to 3 generations to mature. A January or February planted crop, which showed no injury from cyst nematode when harvested in April or May, may be severely injured when planted in June or July for a September harvest.

When soil temperature and moisture are favorable, some eggs hatch. Egg hatching is also stimulated by root exudates. The newly hatched larva find roots by sensing these root exudates. They burrow into the root between the cells. The female nematode becomes sedentary and begins to develop into the lemon-shaped structure described above. The males feed for a time and then leave the root and move about the root surface to find females with which to mate (see Fig. 1). After being fertilized and producing a body full of eggs plus laying some, the female dies becoming the cyst described above. When conditions are favorable, eggs laid outside the cyst hatch. If no host is present, they die. Eggs within the cyst may hatch, and the first stage larva emerge from the cyst to seek host root tissue to invade.

Control strategies for cyst nematode have taken many forms. Over the years a number of soil fumigants have been tested and used to suppress cyst nematode. Ethylene dibromide, Telone®, methyl bromide, aldicarb, metham-sodium, DBCP, dazomat, and Nemacur® are some of the chemicals used successfully. Currently, Telone®, metham-sodium, and Nemacur® are being used, but conditions for application and crop uses are restricted and tightly regulated. Several new nematicides are currently under development and testing. However, their commercial viability and availability are still uncertain.

Crop rotation remains a standard method of cyst nematode management. Soil populations of cysts and viable eggs should be monitored before susceptible crops are planted.

During the winter months when soil temperatures are below 77°F, most host crops will grow well even with relatively high numbers of cysts and eggs present. However, as soil temperatures increase to above 77°F, egg hatch and subsequent nematode activity can occur, which can cause crop injury. Table 1. shows approximate generation times for the coastal valleys. This table indicates that the months of June through October are the most critical monitoring periods for cyst nematode activity. During this period live egg populations above ten per 1 cc and soil temperatures at 4 inches above 75°F should trigger soil treatment for cyst nematode control.

Research is continuing to refine the treatment thresholds as determined by egg counts, soil temperature fluctuations, and host injury.

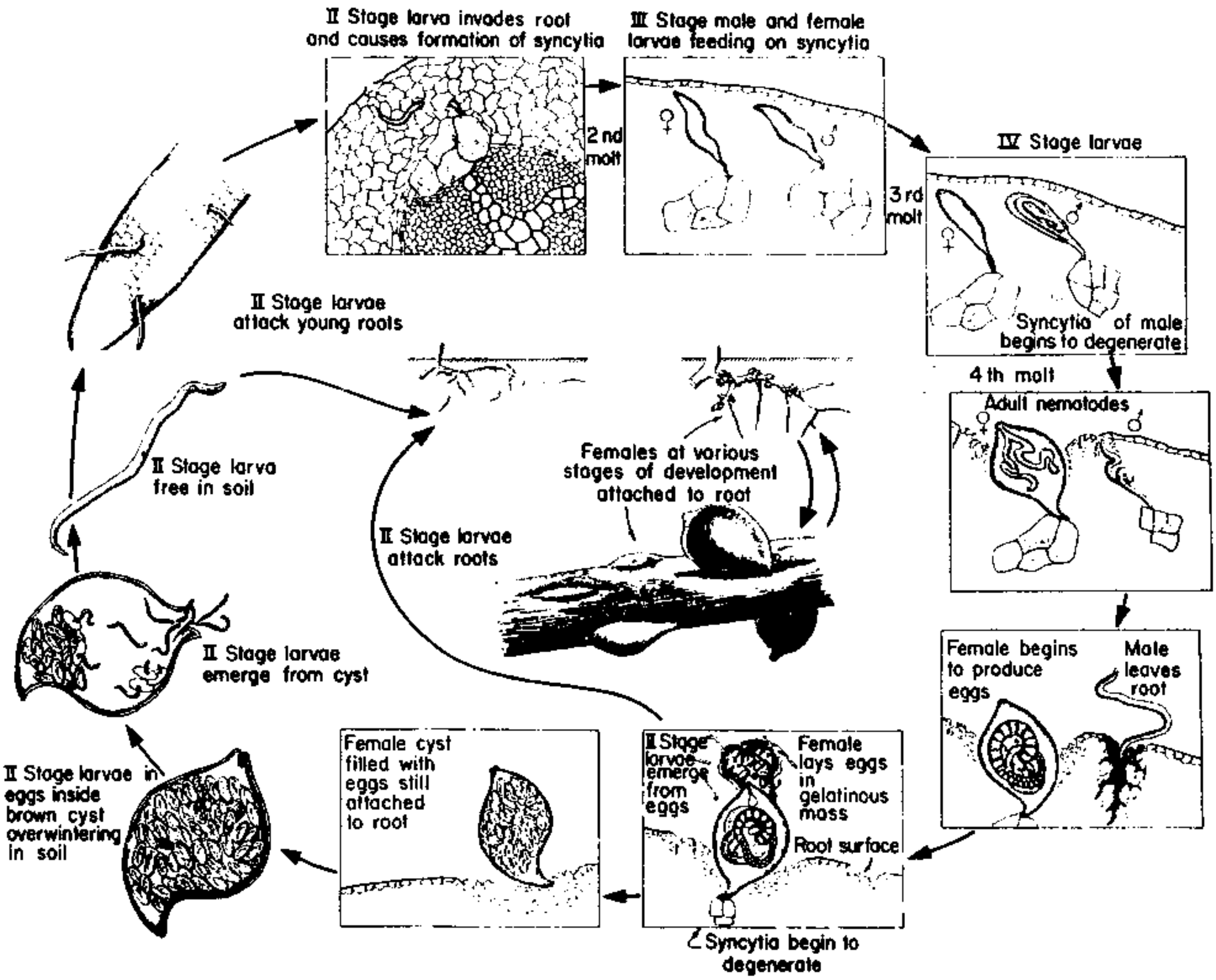

Fig. 1. Disease cycle of cyst nematode *Heterodera* sp.

From Agrios, 1988