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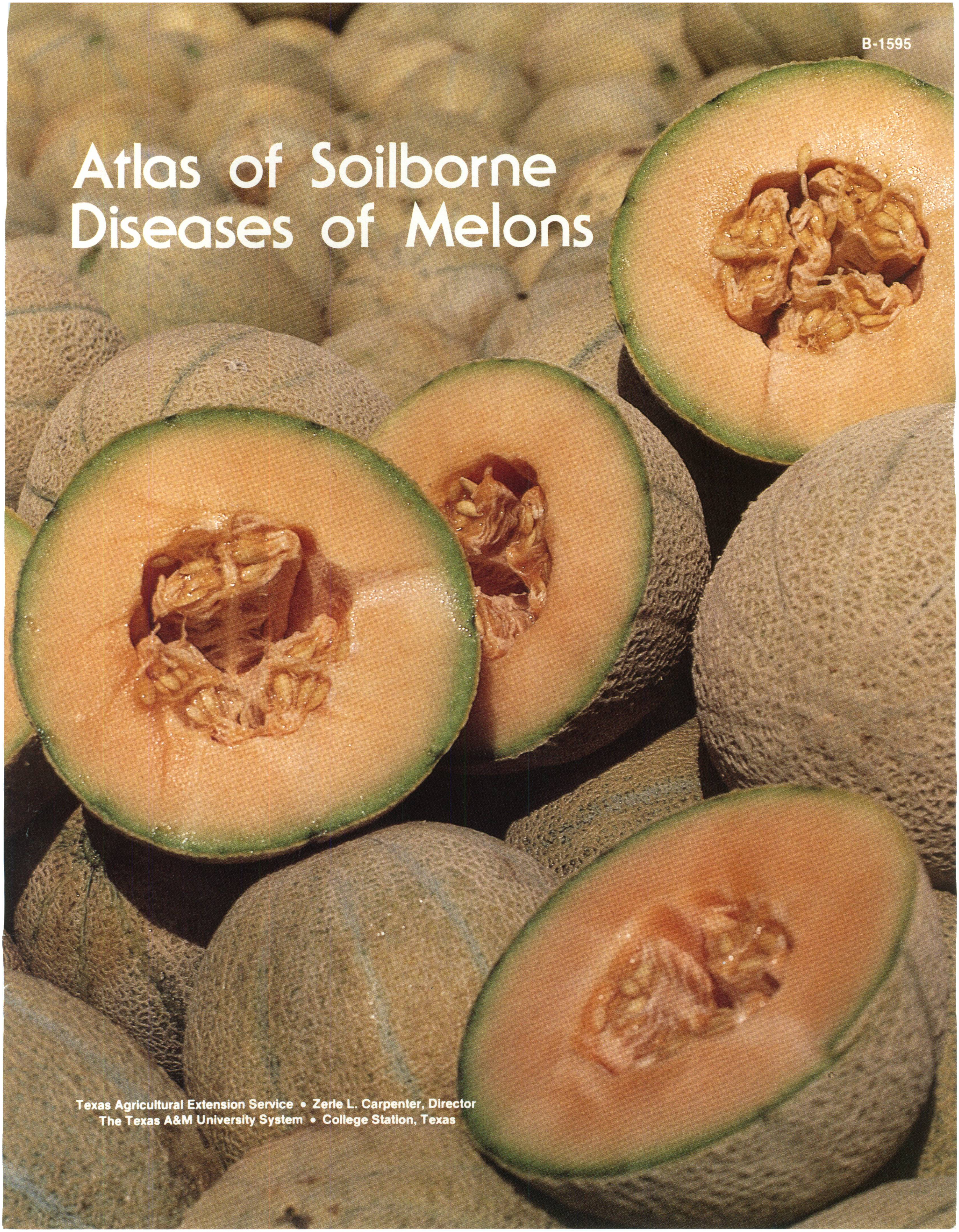
Atlas of Soilborne Diseases of Melons



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Young melons on their way to becoming outstanding marketable fruit. *(Courtesy Greg McCollum)*

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ATLAS OF SOILBORNE DISEASES OF MELONS

Benny Bruton, Jose Amador and Marvin E. Miller*

INTRODUCTION

Cantaloupe and honeydew melons are an important source of agricultural income in Texas. However, the continuous and intensive cultivation of these crops has resulted in an increase in both the number and severity of diseases, which in turn has accounted for significant economic losses. Soilborne diseases responsible for several of the vine declines have become prevalent and economically significant in areas of Texas such as the Lower Rio Grande Valley and Presidio. The organisms associated with these diseases can be perpetuated in the soil as long as cucurbits or other suitable host plants are grown in the same fields. The organisms can be moved from field to field with soil on farm implements, and sometimes can be introduced into clean fields by contaminated seed.

Before control practices can be recommended, the disease or diseases involved must be properly identified. However, some of the symptoms associated with the vine decline complex are common to several of the individual diseases, and frequently, more than one disease may be present on a plant. Consequently, field identification of the disease or diseases is often difficult.

Producers, field inspectors, consultants, researchers and Extension workers have indicated a need for a disease compendium that would facilitate field diagnosis. This publication was developed to help meet that need by describing and illustrating the various symptoms of the vine declines and root diseases.

This publication emphasizes the diagnostic characteristics that are critical in differentiating diseases in the vine decline group. Descriptions of the characteristics are included in the text, in photographs and in a table. Consult all of these parts of the publication, particularly for diseases which have one or more common symptom. The five major disease categories include:

- Vine declines
  - Charcoal rot
  - Gummy stem blight
  - Purple stem
  - Botryodiplodia decline
- Wilt (Fusarium wilt)
- Canker (Myrothecium canker)
- Root rots
  - Damping-off
  - Root rot
- Nematodes (root knot, reniform, others)

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Charcoal Rot *(Macrophomina phaseolina)*

Charcoal rot is responsible for a severe vine decline of cantaloupe just before harvest in the Rio Grande Valley of Texas. Symptoms include yellowing and death of crown leaves and a water-soaked lesion that encompasses the vine at the crown (figure 1). The lesion may extend up the vine 1 to 6 inches. Droplets of amber exudate (gumming) are typically produced in the affected area and eventually dry to a dark brown color. The water-soaked lesions transform to a dry-tan appearance within a few days accompanied by numerous stem cracks (figure 2). Small black microsclerotia are normally seen in mature lesions and occasionally pycnidia are found as well (figure 3). In the early stages of the disease, the vascular bundles appear healthy with no discoloration. As the disease progresses, cross sections of the stem reveal a necrosis of the outer perimeter which extends down between the vascular bundles. Occasionally, the fungus will penetrate a few vascular bundles (three to five) and induce a tan to brown discoloration in the affected area. The discolored vascular bundles can be traced up the stem, and the portion of the leaf which is fed by them dies.

Symptoms of fusarium wilt resemble those of charcoal rot; however, wilting and a general yellowing of *all* the leaves is characteristic primarily of fusarium wilt, while leaf yellowing and necrosis are mainly restricted to the crown leaves in vine decline caused by *M. phaseolina.* Because of the loss of crown leaves, sunburn can occur resulting in unmarketable melons. Vine decline caused by *M. phaseolina* was first reported in the Lower Rio Grande Valley in 1979. Transmission is through soil and seed. No economic control measures are presently known for this disease, although the variety TAM-Uvalde appears to be less affected than Perlita. Charcoal rot is the predominant vine decline in most cantaloupe varieties.

Figure 1. (Top photo) Early symptoms of charcoal rot caused by *Macrophomina phaseolina.*

Figure 2. (Center photo) Advanced symptoms of charcoal rot illustrating numerous stem cracks.

Figure 3. (Bottom photo) Close-up of charcoal rot showing relatively sparse production of microsclerotia as compared to the almost black appearance of gummy stem blight.

Gummy Stem Blight *(Didymella bryoniae)*

This fungus produces vine decline symptoms, and in the early phase of development, it is difficult to distinguish from charcoal rot and botryodiplodia decline (figure 4). Abundant gumming is commonly present. This symptom alone, however, is not a diagnostic characteristic since gumming is also associated with other vine declines (figure 5). The main diagnostic feature that separates this disease from other vine declines is the abundant development of small black fruiting bodies (pycnidia followed by perithecia) giving the mature lesion a dark to almost black appearance (figure 6). Gummy stem blight has become important because of the introduction of susceptible hybrids. The pathogen may be soil- and seedborne. Some control may be achieved by using resistant varieties and applying benomyl directed at the crown before fruit-set.

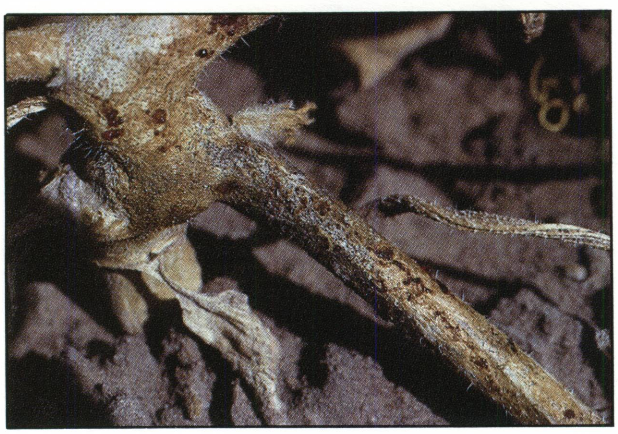


Figure 4. (Top photo) Early symptoms of gummy stem blight caused by *Didymella bryoniae.*

Figure 5. (Center photo) Close-up of gummy stem blight demonstrating the almost blackened appearance caused by numerous pycnidia and perithecia.

Figure 6. (Bottom photo) Advanced symptoms of gummy stem blight.

Purple Stem *(Diaporthe melonis)*

Symptom development of purple stem normally occurs near harvest. Early symptoms in cantaloupe are characterized by a water-soaked lesion with purple pigmentation in the crown (figure 7). Amber-colored, gummy exudations may accompany infections. When exposed to sunlight, the pigmentation fades within a few days leaving a shiny white lesion without cracks in the affected area (figure 8). Small, dark fruiting bodies (pycnidia = *Phomopsis* sp.) typically are embedded in the diseased tissue. Lesions normally extend from the soil interface up the crown for 1 to 3 inches. Occasionally, the infection extends from the crown to the fruit peduncles and into the fruit. Infections at the nodes and tendrils are common. Extensive damage does not occur with tendril and petiole infection unless the lesion remains active and girdles the stem.

Disease onset near harvest has little effect since the melons are fully developed. However, earlier disease development results in yellow crown leaves, general decline of vines and small melons. In addition, melons are more likely to sunburn and full-slip maturity is hastened; the fruit are generally softer, reducing quality and post-harvest shelf-life. Purple stem was first observed in the Lower Rio Grande Valley in 1981. Disease frequency ranges between 2 and 25 percent but is generally less than 5 percent. Transmission is through soil and seed.

Figure 7. (Top photo) Early symptoms of purple stem caused by *Diaporthe melonis*.

Figure 8. (Bottom photo) Advanced stage of purple stem showing an absence of stem cracking and bleached white appearance.

Figure 9. Early symptoms of botryodiplodia decline caused by *Botryodiplodia theobromae.*

Botryodiplodia Decline *(Botryodiplodia theobromae)*

Symptoms of botryodiplodia decline are similar to those of charcoal rot and gummy stem blight which make field diagnosis difficult (figure 9). Microscopic identification of the fungus is necessary for diagnosis. Gumming and stem cracking are characteristic of this disease. The main diagnostic character is the presence of pycnidia only, as opposed to charcoal rot where both microsclerotia and pycnidia are present and gummy stem blight where perithecia and pycnidia give the crown the characteristic dark appearance. The disease was first reported in Texas in 1976. Disease incidence is usually low, ranging from 2 to 5 percent. Transmission is through the soil. No control practices have been developed.

WILT

Fusarium Wilt *(Fusarium oxysporum* f. sp. *melonis)*

Infection of seedlings causes a damping-off and classical wilt symptom on older plants. Dark streaks originating at the crown may run the entire length of the vine (figure 10), seldom girdling the vine but generally restricted to one side (figure 11). The streaks, which are normally restricted to three to five vascular bundles, become necrotic and later develop a pinkish appearance from fungal sporulation. A brownish discoloration of the affected vascular bundles can be seen in a cross section of the vine (figure 12). Affected areas may have

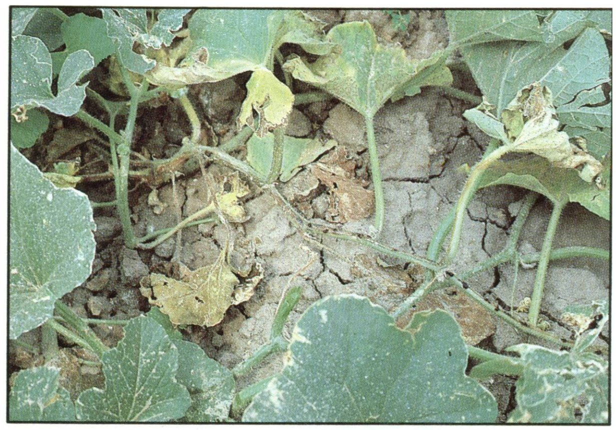


Figure 13. (Top photo) Early symptoms of black canker caused by *Myrothecium roridum*.

Figure 14. (Bottom photo) Advanced symptoms of black canker.

CANKER

Myrothecium Canker *(Myrothecium roridum)*

The disease, also referred to as black canker, is characterized by shallow to sunken lesions 1/8 to 1/2 inch in diameter found in the crown area (figure 13). In the affected area, visible, upright fruiting bodies (sporodochia), white at the base and covered with a black mass of spores, aid in diagnosis. Disease occurrence is erratic, being favored by prolonged periods of frequent rainfall and high temperatures. The crown area is often girdled (figure 14), killing the plant in a few days as opposed to the vine declines which take longer. The pathogen also causes a seedling disease and root rot, both being of minor importance.

ROOT ROTS

Damping-Off *(Rhizoctonia solani* AG-4)
(Phytophthora spp.)
(Pythium spp.)

Rhizoctonia solani causes a dark discolored lesion on the stem at or below the soil line resulting in collapse of the seedling (figure 15). The lesion may completely surround the stem girdling the plant, resulting in death of the young seedling (figure 16). Infection of the lower portion of the root causes dark lesions in localized areas. Susceptibility to *R. solani* declines significantly as the plant begins to vine. Damping-off can also be caused by species of *Phytophthora* and *Pythium,* particularly during periods of prolonged cool temperatures and rains. Plants wilt, have a dull green color and eventually die. Infection by these fungi can result in darkening of the roots, similar to damage caused by *R. solani.* The occurrence of damping-off in cantaloupe is erratic.

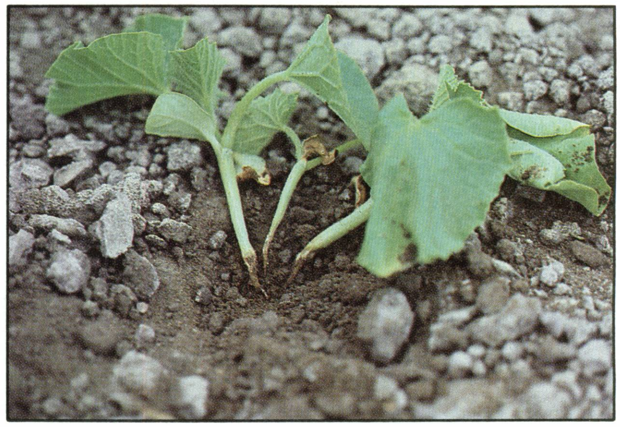


Figure 15. (Top photo) Typical symptom of post-emergence damping-off caused by *Rhizoctonia solani.*

Figure 16. (Bottom photo) Erratic infection typical of damping-off

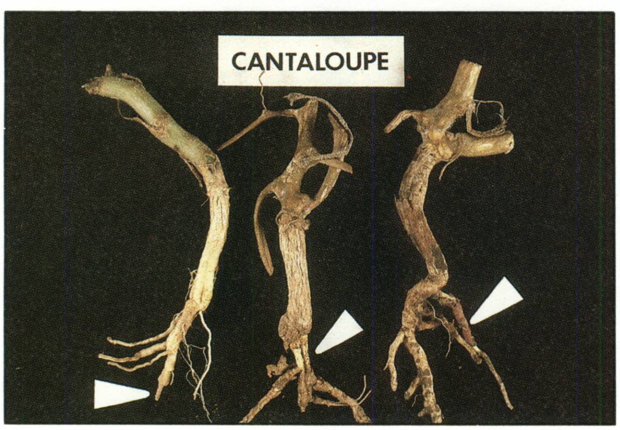


Figure 17. (Top photo) Symptoms of root rot illustrating leaf death, absence of crown lesion and yellowing of vine.

Figure 18. (Center photo) Close-up of cantaloupe root illustrating healthy root on the bottom and one exhibiting root rot on the top. Note numerous discolored areas and cortical sloughing.

Figure 19. (Bottom photo) Various stages of root rot development. *(Courtesy of R. D. Martyn)*

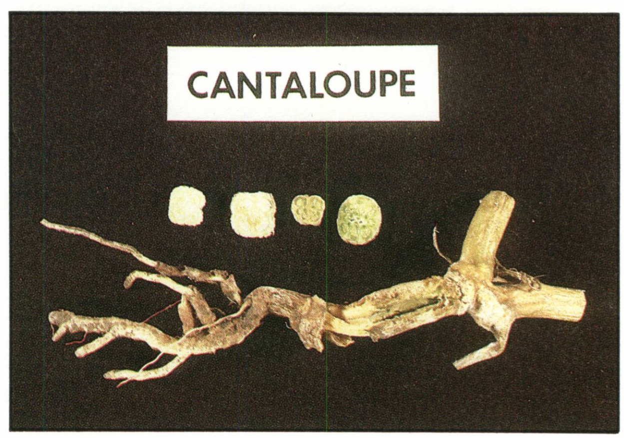
Figure 20. (Right photo) Cross-section of root showing cortical and vascular browning and root with characteristic symptom of root rot. *(Courtesy R. D. Martyn)*

Root Rot (etiology unknown)

Foliar symptoms of root rot are similar to other vine declines except that crown lesions are not produced and vines often remain yellow following leaf necrosis (figure 17). The main diagnostic characteristic of this disease is extensive darkening of the root and sloughing of the cortical tissue of the roots (figure 18). First symptoms appear at distal end of roots and progress upward (figure 19). Root cross sections reveal extensive cortical and vascular discoloration (figure 20) which does not extend to the crown area. Typically, there is complete deterioration of tertiary and many secondary roots. Pink to purplish bands often occur on diseased roots. Leaf yellowing and plant death are generally exhibited following heavy rains or irrigations near harvest.

To date, no pathogenic relationship has been established; however, *Fusarium solani* has been consistently isolated from and associated with diseased roots (R. D. Martyn, personal communication).

Rhizoctonia solani and *Fusarium oxysporum* have also been associated with the root rot. There is some indication that onset and severity of this disease is stress-related, particularly from wet conditions followed by drought. In some years, root rot is the most important limiting factor in cantaloupe production. Root rot has been observed in the Lower Rio Grande Valley for a number of years. Transmission is believed to be through the soil. Control is best achieved by rotating crops and planting in well-drained soils. In addition, there appears to be differences in tolerance between melon varieties.



NEMATODES

Nematodes *(Meloidogyne incognita)*
(Rotylenchulus reniformis)

Root knot and reniform nematodes haved caused damage to cucurbit crops for many years. Both nematodes cause serious damage either by themselves or in a nematode-fungus complex. Several fungi, but particularly *Fusarium* spp., cause more damage to plants when occurring in association with nematodes. Nematode feeding provides wounds through which fungi can penetrate more easily. There is also evidence that nematode infection physiologically predisposes the plant to infection by fungi.

Root knot damage is easily identified. Plants lack vigor and appear unthrifty, stunted and yellowish. The most significant symptom is the swelling (knots) found on roots of affected plants (figure 21). The whole root system can become a mass of galled tissue. Reniform nematode damage, however, usually cannot be ascertained by observing the plants. Damage by the reniform nematode may be suspected when stands are thin in certain localized areas of the field. In these areas, plants also appear stunted, unthrifty and off colored (figure 22); however, examining the root system does not reveal any visible damage caused by the feeding of nematodes. The only positive diagnosis is by careful collection and movement of soil and root samples for analysis in a laboratory. Other nematodes, such as lesion, lance and false root knot have been identified from cucurbit fields. These can be associated in the vine decline complex, although their role is believed to be less significant.

Figure 21. (Top photo) Symptoms of root-knot nematode injury showing galling of cantaloupe root system. *(Courtesy C. M. Heald)*

Figure 22. (Bottom photo) Injury by the reniform nematode is shown on the right half of the photo. Lack of external symptoms on roots makes visual diagnosis difficult, for damage resembles symptoms associated with lack of fertilizers, excess salt, water stress and other soil and nutrient related problems. *(Courtesy C. M. Heald)*

Table 1. Principal diagnostic characteristics.

Common name	Causal agent	Visual root symptom	Gumming	Lesion characteristics	Color of lesion*	Fruiting structures	Comments
Charcoal rot	*Macrophomina phaseolina*	None	Yes	Profuse gumming; small, sparse fruiting structures	Greenish (water soaked)/tan	Microsclerotia Pycnidia	Most common vine decline in LRGV
Gummy stem blight	*Didymella bryoniae*	None	Yes	Profuse gumming; large, profuse fruiting structures	Greenish (water soaked)/tan with numerous black fruiting bodies	Pycnidia Perithecia	Perlita and TAM-Uvalde are highly resistant. Predominant vine decline of cantaloupe in some hybrids.
Purple stem	*Diaporthe melonis*	None	Yes	Smooth lesion, not cracked; sparse gumming	Purple/white	Pycnidia	Lesion changes color from purple to white with age. Infrequent occurrence
Botryodiplodia decline	*Botryodiplodia theobromae*	None	Yes	Profuse gumming; large, sparse fruiting structure	Greenish (water soaked)/tan	Pycnidia	Least common vine decline in LRGV
Fusarium wilt	*Fusarium oxysporum* f. sp. *melonis*	None	Yes	Elongated; on one side of stem	Dark brown/ dark brown	None	Cross-section of stem shows vascular discoloration on one side
Myrothecium canker	*Myrothecium roridum*	None	No	Sunken canker; abundant visible fruiting structures	Black/black	Sporodochia	Causes quick death of plant if canker girdles stem. Infrequent, primarily following heavy rains
Damping-off	*Rhizoctonia solani* *Phytophthora* spp. *Pythium* spp.	Dark dis-color-ation	No No No	Dry rot Water soaked Water soaked	NA	None	Seedling disease
Root rot	Etiology unknown	Corti-cal slough-ing	No	NA	NA	None	Absence of above ground symptoms other than yellowing and death of plants following heavy rains or irrigation near harvest
Root knot nematode	*Meloidogyne incognita*	Root galls	No	NA	NA	None	Severe stunting sometimes causes plant death
Reniform nematode	*Rotylenchulus reniformis*	None	No	NA	NA	None	Less severe stunting; light colored plants; large areas in field affected

*Color of young lesion/color of old lesion.

GLOSSARY

sunken, necrotic area on a stem or branch
ally sharply defined, sometimes by callous

ompacted series of nodes on the primary which secondary stems arise; includes the es of the primary stem from the soil level
abnormal malfunctioning induced in a host nore causal agents in constant association oms in the host
secretion of gummy substances, usually lark in color; ooze
- process of producing and secreting bstances
otium (pl. microsclerotia) - small sclero- clerotium)
death of tissue, usually accompanied by or discoloration
- stem or stalk that bears either a solitary cluster of flowers
m (pl. perithecia) - a flask-shaped fungus ly having an ostiole (pore) at its apex from al spores are expelled or otherwise released
talk or stem-like structure of a leaf arising ode of a stem
ical Race - a subgroup within a species of hat is physiologically distinct but morpho- distinguishable from other members of the

(pl. pycnidia) - a flask-shaped or globose ng body containing asexual spores (conidia)
n (pl. sclerotia) - a hard, usually darkened, y of the fungus that is resistant to unfavor- ions, which may remain dormant for long d germinate upon the return of favorable

nium (pl. sporodochia) - superficial, cushion- exual fungal fruiting body
on - the process of producing spores
modified leaf; a slender coiling organ of ts
bundles - a distinct group of fluid-conduct- root, stem or leaf, consisting of xylem and

ne - a disease complex characterized by nd death of crown leaves and gradual death ually occurs close to fruit maturity; incited of several fungi
of freshness or drooping leaves from inade- supply or excessive transpiration; vascular t interrupts the normal uptake and distribu- er in plants.

SUGGESTIONS FOR REDUCING CAUSED BY SOILBORNE DISE

1. Properly identify the disease or diseases your fields. Correct identification is a pr a sound disease control program. C county agent, Extension or research pl gist, professional consultant, seed c representative or other qualified resou
2. Some of the organisms responsible (charcoal rot, gummy stem blight, p fusarium wilt) can be seedborne; sele originates in fields relatively free of soilbo Discuss seed origin and quality with purchase.
3. Cultivars differ in their reaction to s diseases in the vine decline complex (fu gummy stem blight, root rot). Review c mation from local sources and select a vars that may have resistance or tole predominant diseases in the area.
4. Analyze the soil for the presence of Avoid heavily infested fields. If necessa soil fumigation before planting.
5. Long rotations (3 to 5 years) may be reduce losses. Be aware of the susceptil tance of even non-related crops; corn a are important hosts of the charcoal ro
6. Consider applying approved fungicide and crown area to control some of the (gummy stem blight, damping-off).
7. Time irrigations properly and avoid hea particularly near harvest. Irrigations rains result in serious damage to both fruit.
8. Maintain a sound control program of fo and insect pests that may otherwise plants, making them more prone to infe of the pathogens in the vine decline c

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A profitable melon harvest in the Lower Rio Grande Valley of Texas is the result of a sound disease control program.

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