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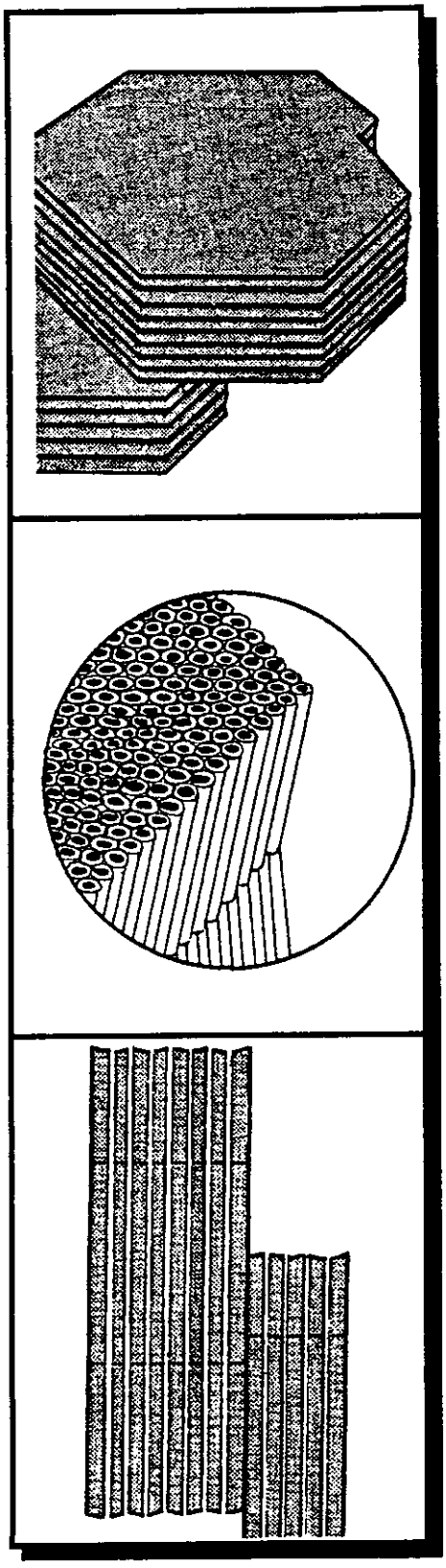

PLANT DIAGNOSTICS QUARTERLY

Features

On the cover: Tobamovirus hexagonial cytoplasmic inclusion

View 1 - Hexagonal virus crystal aggregate in face view

View 2 - Virus particles within the layers of the hexagonal stacked-plate inclusion

View 3 - Stacked-plate hexagonal inclusions are rectangular in side view

Courtesy of Richard Christie

Plant Diagnostics Quarterly (PDQ) is a nonprofit publication which serves plant pathologists in extension, regulatory and industrial clinical laboratories, private consultants, and other interested persons. PDQ is published four times a year. Yearly subscription fees are:

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Volume XVII, Number
September, 1996

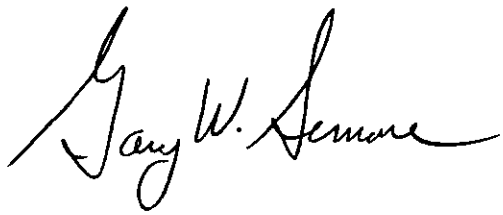
PLANT DIAGNOSTICS QUARTERLY

FROM THE EDITOR

I don't believe this! There are actually subscribers of PDQ who read the issue in a timely manner. The last issue has produced phone calls and electronic mail from many parts of the country concerning the Editorial and Letter to the Editor.

The issue of the Plant Diagnostic Sheets (product of the Diagnostics Committee and the focused labor of Chuck Semer and Jack McRitchie) is obviously a sensitive one. The issue of whether and how to make these diagnostic sheets available has certainly touched some sensitive spots for APS and Diagnostic Committee members. In fairness to this issue, a response prepared by Dr. Kurt J. Leonard (Editor-in-Chief for APS Press) follows to better complete this saga.

Regardless of the outcome, I feel revitalized concerning the utility of PDQ by the response the last editorial has had. Thanks for reading the issue and expressing your opinion back to me and Chuck Semer.



Gary W. Simone, Editor

LETTER TO THE EDITOR

Submitted by Kurt J. Leonard
Editor-in-Chief, APS Press

Clarification of APS Press plans for the "Diagnostics Manual"

In his recent letter to the editor of Plant Diagnostics Quarterly, which appeared in the June, 1996 issue, Mr. Charles Semer IV questioned the wisdom of continuing with the publication agreement that he and Dr. John McRitchie established with APS Press to publish Methods of Plant Disease Diagnosis, which has also been known as the "Disease Diagnostics Sheets" project. As Editor-in-Chief of APS Press, I find that several of the points made in Mr. Semer's letter to the editor and in the commentary written by PDQ Editor Gary Simone differ from my understanding of the history of this project and its current status in APS Press. Therefore, I take this opportunity to present the APS Press perspective.

As Charles Semer stated, the Disease Diagnostics Sheets project arose in the Diagnostics Committee of APS. There were early discussions between Paul Bachi, Mary Ann Hansen, and then Editor-in-Chief of Plant Disease, Wayne Sinclair, about publishing the disease diagnostics sheets in Plant Disease. Wayne Sinclair felt that it would be better to publish the diagnostics sheets as a group in book form with APS Press rather than one at a time in issues of Plant Disease. Consequently, the Diagnostics Committee explored a plan for an expandable collection of diagnostics sheets in a loose leaf book. A formal proposal for such a book, to be titled Methods of Plant Disease Diagnosis, was developed by Charles Semer and John McRitchie and submitted to APS Press on December 19, 1991.

The APS Press Editorial Board and then Editor-in-Chief, Steven Slack, accepted the proposal, and a publication agreement was drawn up in May, 1992, specifying June 1, 1995, as the date for delivery of a camera-ready book manuscript by Charles Semer and John McRitchie to APS Press. From the beginning, Steve Slack cautioned that: 1) it would not be logistically feasible to supply buyers of the book with new individual diagnostics sheets continually to be added to loose leaf binders, and 2) that it would be prohibitively expensive to include color illustrations throughout the book. Therefore, the publication agreement signed by Slack, Semer, and McRitchie specified that there would be no color illustrations in the book and that new editions with additional diagnostics sheets would not be issued at intervals more frequent than five years. This, of course, was not ideal with respect to timely distribution of new diagnostic sheets, but it was deemed necessary to keep the price of the book at a reasonable level.

At the time when the APS Press Editorial Board reviewed the Disease Diagnostics Sheets project, Steve Slack suggested to Charles Semer that he consider an electronic medium for publication of the diagnostics sheets. At that time APSnet did not exist, and the electronic medium option was dropped. However, continuing requests from Charles Semer for inclusion of color illustrations and for a loose leaf format to allow frequent updates caused the APS Press Editorial Board to reconsider the electronic medium option. During their meeting in February,

1996, the APS Press Editorial Board endorsed electronic publication for the diagnostic sheets on APSnet. Gail Schumann, the APS Press Senior Editor assigned to the project, proposed this to Charles Semer who concurred enthusiastically.

I will now attend to specific points in Charles Semer's letter to the editor and Gary Simone's commentary on the letter. First, consider the comment "APS is planning to mount the information on a subscription-access only level of the APSnet. . . . this subscription cost will be ~ $30." You should be aware that APSnet, with support of APS Council and guidance from the APS Electronic Technology Advisory Committee, is still in the process of setting up the subscription-based Plant Pathology Resource Center. The access fee for the Resource Center has not been established, but the accepted policy is that the access fee should be based on costs of putting material on APSnet and commensurate with the value of resources available in the Resource Center. APS Press never expected the Disease Diagnostics Sheets collection to be the only item on the Resource Center or even to be the main attraction for members to subscribe to the Resource Center. Already there are other items available, such as APS journal abstracts and the archival on-line Karnal Bunt Symposium. Note that during 1997, access to the Resource Center will be free of charge for all APS members. Note also, that no final decision has been made to put the diagnostics sheets in the Resource Center of APSnet or to leave them there after 1997.

APS Press wants to have the diagnostics sheets on APSnet and is looking for a feasible way to get them there. The Resource Center of APSnet is an attractive option, but it is not the only outlet being considered. This is new territory for APS Press, and we are exploring other options. One possibility would be a separate subscription at a lower fee for just the diagnostics sheets. In either case, subscribers would be able to print out diagnostics sheets free of charge for their personal use.

In addition, APS Press is sensitive to the need to provide access to the diagnostic sheets by potential users who are not members of APS. One possibility being discussed is to offer a CD-ROM version with updated revised editions produced periodically. In this connection, you should be aware also that the option of publishing a book with diagnostic sheets minus the color illustrations has not been abandoned. The book option, however, cannot be given a high priority until we have a sufficient number of diagnostic sheets to stand as a viable unit for about a 5-year life span to justify printing such a book. As of now, we have just over 60 unedited diagnostics sheets. We still need to establish model formats for diseases caused by various pathogen groups. We have one diagnostic sheet that will serve as an excellent model for diseases caused by fungi, and we eagerly await similar examples that we can use as models for diseases caused by bacteria, viruses, phytoplasmas, and nematodes.

Second, consider the comment "The access cost should be a minimum cost something on the order of $1.00 to $5.00 per year, if a cost is needed to defray operating expenses." You should understand that if you do not expect this project to be paid for by APS membership dues, some kind of fee definitely is essential to defray not just the cost of operating the part of APSnet where the diagnostic sheets will reside, but also the production costs of getting the diagnostics

sheets on APSnet.

Why do we have production costs? APS Press views the Disease Diagnostics Sheet project as a very important and worthwhile endeavor deserving first class presentation on a par with the Disease Compendium Series. We have insisted that the diagnostics sheets receive two comprehensive reviews just as all APS Press books do. As the diagnostics sheets project developed, we also decided that it is highly desirable to have the sheets formatted at the APS Editorial Office to ensure consistent high quality. This entails obvious production costs, probably beyond what APS Press can hope to recover in the first five years of existence of the diagnostic sheets on APSnet. We feel that the project is important enough to pursue in spite of the uncertainty that APS Press will recover the costs of producing and delivering the diagnostics sheets.

One might argue that production costs can be reduced to zero if Charles Semer and John McRitchie bypass APS Press, do all the production work themselves, and make the diagnostics sheets available on a personal home page on the world wide web. My response would be that the diagnostics sheets started as an APS project and it should remain an APS project with an institutional life span beyond that of any single member. Furthermore, I believe that the diagnostics sheets need to carry the scientific authority that comes with peer review. APS Press can provide that. Also, I believe that for long term continuity, there is a strong argument for technical editing and formatting, so that current diagnostics sheets and future additions will have the same consistent format and style. APS Press has well established review and editing procedures, and the APS Headquarters staff will provide first rate, professional formatting as evidenced by the outstanding job that they do with APS journals and APS Press books.

Third, consider the comment ". . . they have alternately asked that we prepare the diagnostic sheets in HTML and then (most recently) they have requested camera-ready text (book or journal style documents) that they would prepare in an HTML format." APS Press never intended for Charles Semer and John McRitchie to prepare the diagnostics sheets in HTML format except in the initial test of how a few representative sheets would look on the net. In that test, APS Editorial Office staff edited and formatted one of the diagnostics sheets and placed it on APSnet for comparison with the examples prepared by Charles Semer. Based on the comparison and comments of three former members of the Diagnostics Committee, APS Press decided on a format designed by staff to combine the best features of the two presentations. From then on, we have asked for text to be prepared in a standard word processing format just as manuscripts for Plant Disease or Phytopathology are submitted. Charles Semer's comments to the contrary, it is much easier to edit text in WordPerfect or MS Word than in HTML. Also contrary to Charles Semer's comments, a word processing document can be converted directly to an HTML document that retains the formatting of the original. With the modern conversion packages in word processing software, there is no longer any reason to save documents in an ASCII format before taking them into HTML. The point is that APS Press wants to avoid the extra effort of editing and reformatting documents submitted in HTML, and APS Press wants to free the authors from the responsibility for HTML coding, so that they can devote more of their time to processing more drafts of diagnostics sheets.

Fourth, I need to specifically address Charles Semer's and Gary Simone's suggestions that APS Press is treating the Disease Diagnostics Sheets project crassly as a vehicle to pad APS Press profits. You must recognize that APS Press was not created to lose money and cause APS membership dues to be raised. By and large, the books and other APS Press products are expected to pay their own way. You should know also that pricing books is not an exact science. All authors want the widest possible distribution of their books. This means the lowest feasible selling price and the best promotional and advertising efforts. APS Press does a better job of promoting books on plant pathology to plant pathologists than any other publisher, but of course, the promotional efforts cost money, too. We do a pretty good job of estimating production and distribution costs based on costs of materials and staff time required, but no one can tell us very precisely how many individual books or slide sets we will sell. So we give it our best estimate and set the price to recover costs with some margin on the positive side. If we err, we want it to on the plus rather than the negative side. But this, of course, does not mean, and never has meant, that every APS Press product will return a profit. Some will lose money and some will make money, and we are never sure which will do which. In the case of an electronic on-line book, such as we envision for the Disease Diagnostics Sheets, it is even more difficult to estimate how much of the production costs we may recover within a reasonable time span.

To be fair, I must add that APS Council has charged APS Press with returning a surplus to help support membership services and other activities of the Society. APS Press is not alone in returning a surplus. The journals do that, too. Long before APS Press was born, Phytopathology was helping to support member services by returning a surplus to the Society. Is it such a bad thing that non-member subscribers to our journals and non-member buyers of our books should help support the services and goals of APS? We support the premise that deserving individuals in developing countries who cannot afford to pay full prices for our products should not be denied access to them. But that does not mean that we must subsidize those who can afford to pay by setting the selling price of our books below costs.

APS Press is not a designated outreach arm of APS. That does not mean that APS Press can never be involved in an outreach project, but it does mean is that when APS Press participates in an outreach project costing a substantial sum of money, a separate source of funds needs to be identified. Such funds might come from the APS Foundation, APS Office of International Programs, or the APS Office of Public Affairs and Education. Generally, we would expect authors to explore these funding avenues if they desire special assistance for certain potential buyers. Another source of funds for APS Press has been the private donations that help subsidize the production costs for some of our books. These donations are used to help keep sales prices as low as practical, and this is how APS Press intends to use the donations solicited by Charles Semer in support of the Disease Diagnostics Sheets project.

Finally, I would like to second Gary Simone's suggestion that the Diagnostics Committee take a more active role in guiding the Disease Diagnostics Sheets project to publication. Where I differ with Gary Simone's suggestion is in my conviction that this project also needs professional input and editorial service, which APS Press can provide. How then should the

Diagnostics Committee become more involved? I see two important roles the Committee should serve.

First, the Disease Diagnostics Sheets project should be an on- going process with continual updates and additions to the total package. As I suggested to Charles Semer, the project should have an institutional basis so that it will outlive the original authors' and editors' current involvement. Once the first installments of the diagnostics sheets are published, I believe that the Diagnostics Committee should be prepared to assume long- term responsibilities for maintaining the timeliness of the diagnostics sheets and for adding new diagnostics sheets to the package as new diseases become important.

Second, I feel that the original editorial committee for the Disease Diagnostics Sheets project within the Diagnostics Committee should be reactivated, or a new editorial committee should be activated, to provide immediate assistance to Charles Semer and John McRitchie. That would facilitate the collecting and first round editing of diagnostics sheets and would help put the project on a reasonable schedule. I am sure that everyone concerned can appreciate what an enormous task Charles Semer and John McRitchie took on when they set out to collect and edit the several hundred disease diagnostics sheets that they envision. I sympathize with the frustration that they must feel in not meeting their goals of assembling such a large number of diagnostic sheets from a diverse group of contributors, doing all the necessary detailed editing, and delivering final versions to APS Press within the time frame established for the project. It is just too large a job. Similarly, I hope that all concerned with this project will sympathize with the frustrations that we at APS Press have felt in the delays in receiving material to work with. APS Press would like to work with the Diagnostics Committee and APS Headquarters staff to take over the burden of detailed editing of diagnostics sheets as well as formatting them for APSnet. To do that, we are prepared to coordinate the review and editing needed. As mentioned earlier, we have an excellent model for diseases caused by fungi, so we can proceed immediately with diagnostics sheets for fungal diseases. I believe that the Diagnostics Sheets Editorial Committee could provide invaluable help to Charles Semer and John McRitchie both in preparing model formats for diseases caused by other pathogen groups and also in speeding up the development of review drafts of diagnostics sheets if we can reestablish a Diagnostics Committee role in the project.

If, however, Charles Semer and John McRitchie and the Diagnostics Committee choose not to continue in the publication agreement with APS Press and instead seek another publisher, we will be very sorry to see the project go. We will be sorry not because of any effect the loss would have on APS Press' financial balance sheet, but rather because we believe deeply in this project. We believe that it is important to plant pathology, and we are confident in the ability of APS Press to produce and promote a first rate, professional set of diagnostics sheets that will be a credit to the authors, the Diagnostics Committee, and to APS.

PDQ (1996) 17(2):10

PDQ -- Plant Diagnostics Quarterly

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Submission Format

Articles are preferred submitted on diskette (5.25 or 3.5) -- especially the longer Feature Articles. Electronic submission will allow greater consistency among type fonts and sizes and improve the appearance of the publication. We use Word Perfect 5.1 on IBM hardware, but have the capability of converting most word processing software. Please send a copy of the article on the software you use (be sure to identify the software); please also send an ASCII file to use in case we have problems with the conversion. Label disks with your name and address and job file name. All disks will be returned. Please include a hardcopy printout as well.

Articles will also be accepted in a hardcopy format by surface mail or FAX. Where secretarial time allows, shorter articles will be retyped. Longer articles, however, may be used camera-ready. Please follow the Manuscript Format instructions that follow.

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The top margin will be 1 1/2 inches on the first page and 1 inch for each page thereafter. One inch margins should be used on the remaining sides. Page numbers should be lightly pencilled in at the bottom of each page.

Paragraph or section headings should be in bold print or underlined. Skip the next line and then begin the paragraph; paragraphs are separated by blank lines.

Lines are single-spaced. The article should be printed on a letter quality printer or typewriter; dot printing will not reproduce well and should be avoided.

Latin binomials should be italicized rather than underscored if possible.

Length

Feature articles should be a minimum of 5 pages. Aside from this limitation, articles may be of any length as long as they remain focused on the topic selected.

Illustrations

Our ability to reproduce illustrations is limited; line drawings reproduce most faithfully. Original black and white photographs (prints only) may be used if they are of high quality. Illustrations should be mounted on a separate page, with their captions mounted below.

Fact Sheets

Contributed Fact Sheets from states extension/research units or other agencies for inclusion with PDQ are gratefully accepted. Send two (2) originals to Gary W. Simone (Editor) for appropriate listing in the next issue. If sufficient copies of the publication are available, send 225 copies to Gail Ruhl -- Managing Editor so that they can be compiled with the issue.

References

Use at your discretion. If articles are referred to in the text, please cite them at the end of your article using a standard format such as that used in Plant Disease. If references are not cited, related articles may be listed under the heading "Bibliography".

Plant Diagnostics Quarterly (PDQ)

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DIFFUSION

DIFFUSION
Compiled by Melodie Putnam

Polyethylene plastic wrap for tree wounds: a promoter of wound closure on fresh wounds. D. N. McDougall and R.A. Blanchette (Univ. Minnesota, St. Paul) wounded individual trees in an uneven-aged northern hardwood forest by driving a 5 x 8 cm ellipsoid template cutter into the trees and removing the corresponding section of bark. Into each wound a chisel was pounded 15 mm deep into the wood at three points. Each tree received six wounds and 20 trees of three species were wounded: aspen (*Populus tremuloides*), paper birch (*Betula papyrifera*) and red maple (*Acer rubrum*). The authors looked at the effects on wound closure of: wrapping the wounds in 2 ml polyethylene plastic, time of application and time of removal of the plastic, and the degree of colonization of wounds by decay fungi after wrapping. For aspen and maple, wrapping the wounds the same day they were made resulted in significantly reduced wound size compared to wrapping 1, 2, 3, or 4 weeks after wounding. Birch showed no differences in when the wounds were wrapped. After an initial period of one (aspen) or two (maple) weeks, there was no decrease of wound size with increased time of wrapping. There was no difference in wound colonization by decay fungi for either wrapped or unwrapped wounds. The use of clear polyethylene plastic shows promise for promotion of wound healing on simple wounds in shaded trees. Open grown or street trees may require white or reflective plastic wrap. J. Arboriculture 1996, **22**:206-210.

Canavirgella banfieldii gen. and sp.nov.: a needlecast fungus on pine. W. Merrill, N.G Wenner, and T.A. Dreisbach (Pennsylvania State Univ.) provide a type description of a needlecast pathogen. The disease it causes affects *Pinus strobus* (Eastern white pine) throughout the eastern U.S., from North Carolina to Maine. *Pinus peuce* (Macedonian pine) was also affected in one area. The fungus produces very elongate hysterothecia that extend over much of the length of the needle, and has been mistaken for *Bifusella linearis* and *Virgella*. The fungus infects succulent, elongating current-year needles in late June or early July. Tips of affected needles turn yellowish tan and then reddish brown. By the following spring, the needles curl and fade to a light gray. Not all needles in a fascicle are infected. Infected needles retain green bases and remain attached to the tree until the entire fascicle falls during normal needle shedding. Hysterothecia begin to form in late fall, continue to develop throughout the winter and spring, and mature at about the time of budbreak and shoot elongation. Canadian J. Botany 1996, **74**:1476-1481.

Two leaf pathogens of *Ribes* spp. in North America, *Quasiphloeospora saximontanensis* and *Phloeosporella ribis*. *Q. saximontanensis* comb.nov. is associated with foliar lesions on three species of Ribes: *R. viscossimum* (sticky currant), *R. speciosum* (fuchsia-flowering gooseberry) and *R. sanguineum* (red flowering currant) throughout the western regions of the U.S. and

Canada. The fruiting body is intermediate between the sporodochia formed by hyphomycetes and acervuli made by coelomycetes. Conidia are cylindrical, straight or slightly curved, pale brown to olivaceous, 1-4 septate, and filiform (40-100 x 2.5-3.5 μm.) The lesions formed are light brown to dark red, angular, vein-limited, and up to 5 mm in diameter. They are occasionally associated with chlorosis extending beyond the areas of sporulation. This fungus has been misidentified-identified as *Cylindrosporium ribis*, (= *Cercoseptoria* and *Cercospora*). The lesions formed by *Phloeosporella ribis* are pale to medium brown with a narrow purple-brown raised margin, circular to elliptical or irregular, not vein-limited, and up to 5 mm in diameter. The fungus produces acervuli with filiform, irregularly curved hyaline 1-4 septate conidia with truncate bases. Conidia are 40-85 x 2-2.5 μm and are produced on sympodially proliferating conidiogenous cells. This species has been found in Wisconsin on *R. triste* (swamp red currant) and *R. vulgare* (common or red currant). The fungi were described by B. C. Sutton, S. F. Shamoun, and P.W. Crous. Mycological Research 1996, **100**:979-983.

PDQ (1996) 17(2):14

REGIONAL REPORTS

NORTHEAST REGION REPORT

Richard J. Buckley

It seems that the northeast region can't shake the extreme weather. What a rainy, cloudy summer. The precipitation just kept coming until August, when most of our region began to dry out. Rain, while not conducive to vacations, is great for fungi. What a banner year for diseases we are having!

.... *Turf*

After several of the state reports mentioned early outbreaks of brown patch this spring, the disease became one of the most common problems on turf during the summer. Every state report mentions brown patch as a problem on turf in July and August. Brown patch was diagnosed on virtually every sample of turf from residential clients this year in the New Jersey laboratory. Obviously, *Rhizoctonia solani* is active in cooler weather as long as there is adequate moisture and humidity.

Anthracnose, caused by the fungus *Colletotrichum graminicola*, is becoming an increasingly important disease for golf course superintendents. This disease was the most common problem on golf course turf in our region through the summer. Anthracnose is a disease of stressed turf and the stress often comes from the increasing demands that golfers have of their courses. There has to be a limit to how fast and how far a golf ball will roll! In a recent report to the Tri-State Turf Research Foundation, Noel Jackson (Rhode Island) suggested that combinations of chlorothalonil, mixed or applied in successive applications, with one of several systemic materials will effectively control the disease on golf greens. An unofficial polling of New Jersey golf course superintendents suggests that no fungicides will work very well until the underlying stress factors are eliminated.

Copper spot, absent for some time on the Rutgers bentgrass plots, has reappeared as a problem. Bruce Clarke suspects that the fungus has finally developed resistance to triazole fungicides on our site. The turf symptoms are very similar to dollar spot, but the patches of blighted turf are copper colored rather than a bleach white for dollar spot. The causal fungus, *Gloeocercospora sorghi*, makes brilliant orange sporodochia on the leaves. At certain times this summer the fungus sporulated prolifically and was very easy to identify.

Other turf diseases of note include: red thread; summer patch; necrotic ring spot; dollar spot; rust; Pythium disease complex; Leptosphaerulina leaf blight; gray leaf spot; and leaf spots, caused by *Bipolaris*, *Drechslera*, and *Curvularia*. You name it, it happened somewhere!

.... *Woody Ornamentals*

Leaf spots are everywhere! Anthracnose on the increase, you name the host! Extensive powdery mildew on everything! Septoria leaf spot on birch was reported by Delaware and New Jersey! Tar spot on maple in Connecticut! Scab and rust on every crabapple! Dogwood decline in New Hampshire! A bit melodramatic, but the cool, wet spring and early summer sure makes it nice for leaf spotting fungi. Needlecasts are also on the increase. Phaeocryptopus needlecast was identified on Douglas fir in Maryland, and Rhizosphaeria needlecast was reported to be a problem in Connecticut and New Hampshire. Hormonema needlecast continues to be fairly common on fir in New Hampshire and Rhabdocline needlecast is common all the time!

Phytophthora root and crown rot was abundant this summer. No doubt the wet spring and summer also aided the water molds. Anne Sinderman (Maryland) isolated the pathogen from forsythia, creeping wintergreen, assorted rhododendrons, Frasier fir, butterfly bush, and many others. The butterfly bush also had cucumber mosaic virus. Dianne Karasevicz (New York) diagnōsed the disease in maple, rhododendron, lilac, and boxwood. The New Jersey laboratory had the usual rhododendrons and azaleas, mountain laurel, a couple juniper species, and Canaan fir. Canaan fir is an alternative for Christmas tree production being tested in the state. It is supposed to do well on wet sites.I guess nobody told them about *Phytophthora*!

Tip blights, diebacks, and cankers were very common this summer. Obviously, these diseases are worse after drought stress and winter injury. Juniper tip blight, and Diplodia tip blight were very common. Delphinella tip blight was diagnosed on Frasier fir in New Hampshire. An unusually high incidence of Cytospora canker was found in Connecticut Christmas trees. *Cytospora* was identified on the trunks of *Prunus* in a New Jersey Nursery. From the location of the canker on the trunks of these potted specimens, it appears as if a little rough handling predisposed the trees to attack. Leyland cypress had lots of Monochaetia canker in Maryland. *Stegonosporium* was very common on maple in New Hampshire.

In New York, Armillaria root rot was very common. Dianne Karasevicz's lab (New York) saw the disease in rhododendron, arborvitae, holly, and maples in landscapes, as well as, on several trees in a Christmas tree plantation. Last summers drought likely led to the establishment of the *Armillaria*.

Beautiful examples of Verticillium wilt were found in Maryland affecting smokebush and redbud. This disease continues to be a problem in Connecticut, especially in red maple. Bacterial leaf spot was diagnosed in English walnut in Delaware. New York's Central Park had less Dutch elm disease than usual. Downy mildew was detected in viburnum by the Pennsylvania laboratory.

Many deciduous trees had premature leaf drop in the New Jersey/Connecticut urban environments. Presumably this is a result of the last several years of drought and severe winters. It is interesting to note; however, that what we are calling premature leaf drop may have been called sudden death if summer-like weather appeared when it should have. Many needled evergreens are also showing signs of stress. Yellowing, needledrop, and dieback are very common.

.... *Herbaceous Ornamentals*

Margery Daughtry (New York) reports that poinsettia scab, a disease which belongs in Florida, has been detected in a few Northern greenhouses this year. The causal fungus, *Sphaceloma poinsettiae*, causes small round lesions that buckle out from the leaf surface. Elongated oval lesions appear at the base of the stem and along the midvein and petioles. In advanced cases, a white mycelium with sporulation can be seen on the stems and in the leaf lesions. Strangely enough, in her visits with a grower, the grower only seemed to notice how tall the scab-infected plants were. Margery suggests that the plants she saw did have amazingly long internodes. This phenomenon was previously noted by Art Engelhard on branches of outdoor-grown points with scab in Florida. Other diseases of note on poinsettia were Rhizopus stem canker in New York and Massachusetts; Botrytis stem canker in New Hampshire; and the usual *Rhizoctonia* and *Pythium* everywhere.

In this rainy summer, sunflowers grown as potted plants developed a leaf spot due to *Septoria* in Delaware, New York, and New Jersey. David Farr at the Beltsville Mycology Laboratory identified the New York isolates as *S. aegopodina* and *S. helianthi*. The New Jersey sunflowers also had rust. In New York, landscapers were complaining about Alternaria leaf spot on impatiens instead of the usual *Rhizoctonia* problems. Rob Wick (Massachusetts) and Dianne Karasevicz (New York) also mention *Alternaria* on impatiens in their reports. Cheryl Smith (New Hampshire) reports Pseudomonas leaf spots on impatiens. Sharon Douglas has the usual problems with powdery mildew on phlox, aster, and zinnia in the Connecticut clinic.

Despite significant educational efforts by many individuals, tospoviruses continue to be a problem. INSV was reported on impatiens, New Guinea impatiens, snapdragons, and cyclamen in New York; on New Guinea impatiens in Connecticut; and in a wall of stephanotis in a New Jersey greenhouse (wow!). TSWV was reported on cineraria in New York.

Other diseases reported on herbaceous ornamentals this quarter include: *Fusarium* and *Thielaviopsis* from the roots of European ginger in New Hampshire; pansy in New York with Cercospora leaf spot, *Phytophthora*, and *Thielaviopsis*; Verticillium wilt in field grown snapdragon, and white smut in cosmos, also from New York; Septoria and bacterial leaf spots on mums in Delaware, as well as, Fusarium wilt on mums in New Hampshire; foliar nematodes in fern and aster yellows in fragrant heliotrope in Delaware; Botrytis leaf spot causing defoliation of lily in Connecticut; anthracnose on peony and bergenia in New Hampshire; Sclerotinia root rot on Chinese bellflower, and Rhizoctonia root rot of day lily in New Hampshire; and several cases of *Phoma* on cyclamen in Massachusetts.

.... *Vegetables*

Rob Wick (Massachusetts) reports that pumpkin and spaghetti squash had lots of problems with Rhizopus rot. Bacterial (*Pseudomonas*) leaf spot was also troublesome to Massachusetts and Pennsylvania cucurbit growers. In New Jersey pumpkins, *Phytophthora* is a primary concern.

The disease causes wilt and dieback in the early season and a terrific fruit rot late. Sharon Douglas (Connecticut) reported early heavy powdery mildew infections in many cucurbit fields. She also mentions that ozone injury was quite damaging this summer. Downy mildew and angular leaf spot devastated several commercial pumpkin fields in Connecticut, Delaware, and New Hampshire. In Delaware, late season virus problems continue to plague cucurbit growers. Papaya ringspot virus (watermelon mosaic virus 1) and WMV2 are the predominant viruses and were identified on cucumber, yellow zucchini, pumpkin, and summer squash. Tomato ring spot virus was a problem for cucurbit growers in New Hampshire. Bob Mulroony (Delaware) also mentions a case of bacterial fruit rot of watermelon, gummy stem blight on melons, and lots of foliar diseases in fields that had erratic fungicide treatments due to poor weather conditions.

Tomato and pepper were plagued with bacterial problems, caused by *Xanthomonas* and *Pseudomonas*, in most states. Bacterial stem rot was a problem for several New Hampshire growers. In each case, the plants were pruned when the suckers were too large and the plants were wet. A batch of bell peppers in Delaware was diagnosed with INSV. This was the first INSV in Delaware pepper. Several times Delaware peppers have had problems with TSWV. The INSV transplants came out of Florida. Fulvia leaf mold was identified in Massachusetts tomato. In New Jersey several growers had powdery mildew in field grown tomato late in the season. Apparently, this is somewhat of an oddity for outdoor production and may be a first for New Jersey. The symptoms included an atypical target-like leaf lesion that was very much like an early blight lesion. The fungus was clearly evident growing out of the stomates. Speaking of early blight, *Alternaria* and *Septoria* defoliated tomato plantings in several states. Buckeye rot of tomato caused significant losses on a few New York farms. In Connecticut, growers experienced uneven ripening and excessive internal white tissue on the tomato fruit.

Late blight of potato and tomato became very evident in New York mid to late season. As in previous years the US-8 biotype was most prevalent, but two cases of US-1 were also identified. Some "odd" US-8 biotypes were found in a couple fields in New York and one in New Jersey. One of the cases on tomato was found in a New York greenhouse. John Peplinski (Pennsylvania) reported that beginning in September, his laboratory had many samples of late blight in tomato from both commercial and residential clients. Delaware reported no late blight this summer.

With all the rain, tuber rots were common in potato. Both soft rot and pink rot were diagnosed in Delaware. *Phytophthora nicotianae* caused the pink rot. Potato virus X and potato virus S were confirmed in other Delaware potato crops. The PVS infected plants were slightly smaller, more upright, and slightly less green. Sounds like subtle symptoms, the APS potato compendium suggests that PVS infected plants are nearly symptomless in most cultivars.

Other vegetable diseases of note include: Cercospora leaf spot on carrot and alfalfa in Massachusetts, maybe a first for the state; bacterial stalk rot of sweet corn in Delaware; snap beans had trouble with Rhizoctonia and Phytophthora pod rots in Pennsylvania; snap beans in Connecticut had heavy ozone damage.

.... *Field Crops*

In another life, before turf clouded my vision, I worked for the agronomy specialist on field crops in Delaware, so I always take great pleasure in Bob Mulroony's Delaware field crop report! In the Delaware corn crop, gray leaf spot, anthracnose, southern corn leaf blight, Helminthosporium leaf spot race 3 (*H. carbonum*) were common. Most of these foliar diseases came in too late to affect yield, but they did cause ear and stalk rots that did result in quality drops. Anthracnose, Diplodia, and Fusarium stalk rots were common, as well as, Fusarium, Diplodia, Aspergillus, and Penicillium ear rots. In sorghum, target leaf spot, caused by *Bipolaris sorghicola*, was identified. This may be a first for Delaware. Other field crop diseases of note include: Phomopsis stem canker, downy mildew, Septoria leaf spot, soybean cyst nematode, and soybean severe stunt virus in Delaware soybean crops; *Septoria nodorum* infected New Jersey and Delaware wheat; and net blotch of barley was seen in New Hampshire.

.... *Fruits*

Lots of summer diseases on Delaware apples including Botryosphaeria rot, fly speck, and sooty blotch. Scab, cedar-apple rust, and hawthorn rust showed up in backyard apple plantings in Connecticut. Pennsylvania and Connecticut reported more than the usual number of samples of downy mildew on grape. Connecticut also had a lot of black rot. Pennsylvania had several samples from new strawberry plantings with anthracnose, caused by *Colletotrichum acutatum*. Besides Verticillium wilt of strawberry, the disease of note on fruit in New Hampshire was raspberry bushy dwarf virus on red raspberry. Brown rot appeared in Connecticut stone fruits once the fruit began to ripen. In New Jersey, peach scab was very destructive. In both cases, the diseases were worse because of timing problems with early season fungicide applications.

.... *Odds and Ends*

Sharon Douglas (Connecticut) described an unidentifiable problem on butterfly bush. The symptoms were 1/2 inch long splits in the woody tissue along the stem. They were numerous and sort of looked like insect-injury. A foliar symptom consisting of blotchy necrotic areas with a distinctive black ooze were also evident. A pathogen could not be isolated or a specific factor could not be attributed to the problem. Got any ideas for Sharon?

SOUTHEAST REGION

Jackie Mullen

Summer diseases in the Southeast were abundant as usual. Certain southern sections of the Southeast were on the dry side during early summer weeks, but showers developed by mid July, and crops and diseases did develop. From the state reports, we can see the usual commonly reported summer diseases and the individual unusual state occurrences. In addition, tomato spotted wilt virus was noted as an increased problem in tomato in AR and in peanut in AL. Also, a Cryptomeria blight/dieback/canker was reported in three states. The problem was

reported in GA as a blight and stem necrosis of unknown causal agent. In SC, Cryptomeria with Botryosphaeria canker was noted. And in NC, tip dieback in Japanese Cryptomeria in nurseries was reported.

MISSISSIPPI, M. Patel. Summer was busy with unusual disease occurrences. Field crop problems included soybeans with bacterial blight (*Pseudomonas syringae* pv. *glycinea*) and peanuts with southern blight (*Sclerotium rolfsii*). Signal grass and pasture bahia grass were diagnosed with Helminthosporium leaf spot. Bahia grass also was observed with aerial Rhizoctonia leaf spots.

Tomato diseases seen included bacterial leaf spot *(Xanthomonas campestris* pv. *vesicatoria)*; bacterial speck (*Pseudomonas syringae* pv. *tomato*); and bacterial wilt (*Pseudomonas solanacearum*). Other vegetable diseases were bacterial leaf spot (*Xanthomonas campestris* pv. *vesicatoria*) on Jalapeno pepper; tomato spotted wilt virus on garden tomatoes in one commercial planting; southern stem blight on beans and okra.

Ornamental diseases included orchids with bacterial soft rot *(Pseudomonas* spp.); zinnia with bacterial wilt (*Pseudomonas solanacearum)*; poinsettia with (bacterial soft rot *Erwinia carotovora*). Southern stem blight occurred on daylily, and periwinkle. Paulownia tree seedlings were infected with Pythium damping-off, and three year plantings were infected with root-knot nematode (*Meloidogyne* spp.). A very big leaf or bud gall *(Exobasidium symploci*) was observed on common sweet leaf or horse sugar *(Symplocos tinctoria)*. Chrysanthemum and crape myrtle were infested with dodder (*Cuscuta* spp.). Several greenhouse growers had problems with Phytophthora stem or crown rot disease on their pansy plantings. Some lost about 30 to 40 percent of their trays. Other fungus diseases on various plants were Pythium root rot on periwinkle, ivy; Pythium leaf spot on water lily; Rhizoctonia aerial web blight on fern;Thielaviopsis black root rot on snapdragon; Fusarium leaf spot on bromeliads; and powdery mildews on lilac and dogwood. Turfgrass diseases were Piricularia gray leaf spot on carpet grass, St. Augustinegrass.

ALABAMA, Jackie Mullen. The first half of the summer was relatively dry and diseases were less abundant than usual. About the third week in July, showers arrived and more diseases began to develop. Common rust (*Ustilago sorghi*) of field corn; Phoma and Phomopsis leaf spots of cotton; and Macrophomina charcoal stem rot, Fusarium dry root rot and Phyllosticta leaf spots of field peas were diseases noted on field crops. Incidence and severity of tomato spotted wilt virus on peanut was higher than it has been in the past few years. Fields showed 5-30% disease incidence with some yield loss evident in certain areas. Also, with peanuts, white mold (*Sclerotium rolfsii*) was a problem in the eastern half of the state where dry conditions prevailed after application of the fungicide Folicur. In the absence of rain, the fungicide was not washed off the foliage as was needed for control of this disease. Consequently, white mold was not controlled. (A. Hagan)

Karnal bunt (*Neovossia indica)* analysis of wheat samples (performed in Arizona as part of a national survey) produced three samples which were confirmed as 'regulatory incidents' by a

USDA lab in Washington D.C. using a PCR technique. These three confirmed samples came from Baldwin, Geneva, and Bibb Counties. Samples were taken from grain elevator locations. As a result of meetings with USDA, APHIS, the Alabama State Department of Agriculture and Industries, and the Alabama Cooperative Extension System pathologists and/or representatives, it was agreed that next year extensive field sampling will be done in these three counties. The preliminary screening of samples using microscopy to detect possible teliospores will be done at the Alabama State Department of Agriculture and Industries facility in Montgomery under the direction of Guy Karr, the state plant pathologist. Suspect samples will be forwarded on to another location for more precise identification, which will probably involve DNA PCR techniques.

Fruit diseases generally were light in incidence and severity. Peach bacterial leaf spot *(Xanthomonas campestris* pv. *pruni)* and cedar apple rust were present as usual. Brown rot of peach was of low incidence and severity.

Vegetable diseases were common, especially in late summer. Pumpkin was diagnosed with watermelon mosaic virus II (a common occurrence) and garden beans showed some mosaic virus symptoms. Tomato samples as usual were common in the lab. Most of the common tomato diseases were seen. Bacterial wilt of tomato and pepper was especially common last summer. Southern blight was not a problem in early summer, but it was prevalent in August. Irish potato problems were abundant in June, and we saw bacterial stem soft rot *(Erwinia* spp.); Rhizoctonia lower stem rot; scab *(Streptomyces scabies)*; and southern blight *(Sclerotium rolfsii)*. Rhizoctonia was common as a lower stem rot of several vegetables in June.

With ornamentals, we observed powdery mildew of dogwood; Phyllosticta leaf spot of English ivy; Piricularia leaf spot of Pampas grass; suspect persimmon wilt; Rhizoctonia aerial blight of ajuga. Periwinkle was the most popular ornamental in the lab with *Phytophthora parasitica* aerial blight and Rhizoctonia aerial blight being common diseases. Three interesting bacterial leaf spots were noted on photinia (suspect *Xanthomonas* sp.), Japanese magnolia (*Xanthomonas campestris*), and azalea (unidentified bacteria) from the Mobile area (J. Olive).

Turf samples were frequently received this summer. St. Augustine was the most damaged grass with gray leaf spot, brown patch and take-all causing heavy damage across the state. Brown patch on centipede and St. Augustine was more prevalent in late summer as was dollar spot on zoysia, centipede, and Bermuda. *Pythium* spp. on bentgrass was an occasional problem in golf courses.

FLORIDA, Richard Cullen and Bob McMillan. Richard and Bob sent reports from the Gainesville and Homestead labs, respectively.
From the Tropical Research Station at Homestead (McMillan). Winter freeze damage was evident into the summer months. It was observed on the trunks of small recently planted Longan and mango trees. Also, cold wind damage to many palms was noted. Early summer thunder storms dumped many inches of rain, and lightning strikes were evident on the native trees Gumbo limbo and Geiger in a Homestead Field Nursery, ligustrum hedges in Ft. Lauderdale,

and 20 palms (coconut and royals). Midsummer was extremely dry with heat stress and sun burn on container grown plants in full sun.

Some interesting diseases seen this summer were Panama disease on the plantain banana known as 'Burro'; Phomopsis fruit rot on Thai eggplant. A new disease of the dwarf snowbush, *Breynia* sp., was described as web blight caused by *Rhizoctonia solani*.

From the Gainesville Clinic (Cullen). Richard reported that sample numbers were beginning to recover two years after initiating their charge system. The past summer also contributed to the sample increase as well as an increase in bacterial diagnoses. *Acidovorax* sp. was isolated from water-soaked lesions on Geranium leaves. Bacterial diseases caused by *Pseudomonas* spp. were diagnosed on Philodendron, African lily, strawberry begonia, shrimp plant, Mexican sage, ginger, Japanese magnolia and nephthytis. *Xanthomonas* spp. were associated with lesions on shrimp plant, wax myrtle, Ixora, cocoplum, philodendron, hibiscus, *Prunus* sp., tomato, bell pepper, Dutchman's pipe, Nandina and nephthytis. Soft rot was isolated from Aglaonema. The 'water molds' were also enjoying the wet weather this summer with 32 Phytophthora diagnoses on twenty different ornamental and field crops and 75 Pythium diagnoses on various crops.

Some interesting summer diseases from the Gainesville Clinic were *Corynespora cassiicola* on mandevilla, ligustrum, zebra plant, gerbera daisy, and blue lobelia; *Dichotomophthora* sp. on prickly-pear cactus; Drechslera setariae on prayer plant; *Myrothecium roridum* on dumb cane, zebra plant, and philodendron; *Thielaviopsis* spp. on pansy, date palm, and palmetto palm; and *Ustilago maydis* on corn.

GEORGIA, Wakar Uddin. In field crops, Sclerotinia stem rot (*S. sclerotiorum*) of canola; blank shank *(Phytophthora parasitica)* of tobacco; stubby root nematode *(Trichodorus* sp.) on corn; tomato spotted wilt virus and Cylindrocladium black root rot on peanut; and barley yellow dwarf virus on wheat were prevalent.

In vegetables, sour skin *(Pseudomonas cepacia)* of onion; tomato spotted wilt virus on pepper and tomato; and downy mildew (*Pseudoperonospora cubensis*) and gummy stem blight *(Mycosphaerella melonis*) on several cucurbits were widespread. Macrophoma leaf blight and dieback were prevalent on Ilex, Buxus, and a number of other shrubs during the summer both in commercial and homeowner samples. Other foliar diseases commonly observed on shrubs and herbaceous ornamentals were powdery mildew, Septoria and Cercospora leaf spots. Powdery mildew was also prevalent on several landscape and forest trees, especially on dogwood. Tar spot (*Rhytisma acerinum*) and anthracnose *(Kabatiella apocrpta)* incidence on maples was unusually high this year compared to previous years. Numerous samples of *Cryptomeria* were submitted from GA and out-of-state nurseries with needle blight and stem necrosis symptoms. These samples inconsistently showed an association with *Phyllosticta, Pestalotia, Alternaria,* an occasionally *Macrophoma.* Further work will be necessary to determine the cause for this problem which appears to be increasing. Damage from bark

splitting was seen throughout the summer on several shrubs, especially azalea and Leyland cypress. The bark splits and associated decay are believed to have been caused by the freezing temperatures in February 1996 and subsequent infection by *Botryosphaeria* (causing Bot canker). Dollar spot *(Sclerotinia homeocarpa)* incidence was high on Bermudagrass during the summer, and anthracnose *(Colletotrichum graminicola)* occurrence on bentgrass increased in late summer.

SOUTH CAROLINA, James Blake. Besides the usual flood of warm-season turfgrass samples with Rhizoctonia blight and ring nematode, we have received several samples of bentgrass with severe anthracnose *(Colletotrichum graminicola)* causing a crown rot.

Foliar nematode *(Aphelenchoides fragariae)* was identified for the first time in SC on hosta. Also, anthracnose *(Colletotrichum* sp.) was a common problem on hosta.

Some of the more unusual samples received in the SC clinic included ginseng with disappearing root rot caused by *Cylindrocarpon* sp.; hibiscus with charcoal rot *(Macrophomina phaseolina)*; cryptomeria with Botryosphaeria dieback; catalpa with powdery mildew; white blight *(Melanotus phillipsii)* on fescue; *Sclerotium rolfsii* on *Thalictrum* (meadow rue); and Phytophthora root rot on ginkgo.

An endangered plant, *Macbridea alba,* being studied by a graduate student developed a serious problem with Cercospora leaf spot. For the last six years the major leaf spot on birch samples sent to the clinic has been caused by *Cryptocline betularum.* Prior to that time the major leaf spot problem was *Cylindrosporium betulae.* This past summer, we have received several samples of each of these leaf spots. We continue to receive samples of woody ornamentals with cold damage from the early March freeze.

NORTH CAROLINA, Tom Creswell. Hurricane Fran dwarfed most concerns for a few weeks, but the clinic at North Carolina State was only closed one day. Our sample numbers are down by about 10% from last year but we still aren't sitting on our hands!

The following problems were predominant in field crops: Peanut: CBR, Rhizoctonia stem rot, Sclerotinia and Sclerotium rolfsii diseases. Diplodia collar rot was also noted. Soybean: Phytophthora root rot and cyst nematodes. Tobacco: Angular leaf spot *(Pseudomonas),* Black shank and Granville wilt. Only one TSWV sample was diagnosed this quarter. Extension agents appear to be recognizing TSWV more often and submitting it to the clinic less.

With turf grasses, Pythium and Rhizoctonia diseases were seen most often but cold injury from last winter continued to show up in centipede grass. Helminthosporium-like diseases were also present.

Ornamentals. *Rosellinia herpotrichoides* was found on Fraser Fir Christmas trees and on blue spruce. An unexplained tip dieback was seen in several samples of Japanese Cryptomeria in nurseries. *Discula* on dogwood spread to one new county this year. Other problems included:

fire blight and web blight on cotoneaster; bacterial leaf spots on English ivy and Rose-of-Sharon; Phytophthora root rot on numerous hosts and heat/water stress on trees (esp. dogwood) that had earlier suffered from drowning of lower roots. *Xylella* was found twice on pin oak, much less frequently than last year. Tubakia and Marssonina leaf spots were found on several oak species. A cardinal flower specimen had both mushroom root rot and black root rot *(Thielaviopsis)*. Pansy problems included *Colletotrichum, Thielaviopsis, Cercospora, Myrothecium, Phytophthora, Pythium, Ramularia, Rhizoctonia* and *Septoria*. Also, heavy rains leached nutrients from many outdoor-grown pansies leading to nutrient stress symptoms. Fusarium wilt/stem rot was found on chrysanthemum in about equal measure with *Pseudomonas cichorii*. INSV hosts this quarter: schefflera, impatiens, snapdragon and exacum.

Fruits and Vegetables. Bitter rot, black rot, leaf blight, and anthracnose were found on grape and/or muscadine grape. Downy mildew, powdery mildew, and anthracnose were most common on the cucurbits.

KENTUCKY, Julie Beale. A number of disease problems affected the tobacco crop this summer: Infections of black shank and soreshin *(Rhizoctonia)* in combination were severe in burley tobacco in some areas by mid-summer. When black shank resistant varieties became infected, the plants typically had been previously weakened as transplants by systemic blue mold, soreshin and Fusarium wilt. In late July to mid-August, blue mold infection events occurred repeatedly, followed by serious virus problems, especially the aphid-borne virus complex - TVMV, TEV and PVY in late set tobacco.

The legacy of our extremely wet spring continued to affect vegetable crops through harvest. As a result, uneven ripening of tomatoes and bacterial canker, early blight and one diagnosis of charcoal rot (uncommon in this area) were noted. Downy mildew was quite common in cucurbits late in the season.

TENNESSEE, Beth Long. Tobacco problems this summer included most of the usual culprits: black shank, target leaf spot, frogeye leaf spot, sore shin, bacterial hollow stalk, black root rot, and slight levels of tomato spotted wilt virus. Blue mold was found the end of June and became scattered throughout eastern and middle TN. Moderate infections were typical; however, some fields in eastern TN were devastated. A mixed population of metalaxyl susceptible and resistant strains of blue mold were present. With commercial fruit and vegetables, strawberry leaf blight *(Phomopsis obscurans)* is becoming a more important foliar problem in TN strawberry production. Bacterial spot on bell pepper and tomatoes, early blight and Southern blight on tomatoes, stem anthracnose on lima beans, bacterial stripe and Holcus spot on sweet corn, and late summer cucurbit powdery mildew were typical vegetable problems this summer. With ornamentals, mid to late summer problems on trees and shrubs in nurseries and landscapes were mainly related to heat and drought stress induced leaf scorch. Winter injury-related fungal cankers were also still being identified in September. Sphaeropsis tip blight and Kabatina blight on Leyland cypress and Botryosphaeria canker on rhododendron were common. Commonly seen homeowner landscape problems included dogwood powdery mildew (It's everywhere!), Entomosporium leaf spot on photinia; fireblight; Entomosporium leaf spot and leaf scorch on

pear; black canker and Cytospora canker on willow; Dutch elm disease on elm; powdery mildew and bacterial leaf scorch on oak; brown patch on fescue lawns. Beth commented that five new counties in middle TN reported finding rose rosette disease (RRD) on multiflora rose. RRD is slowly moving east towards the Cumberland plateau. Notable diseases in greenhouses included pansies with Cercospora leaf spot, Microdochium stem rot, Rhizoctonia stem rot, and anthracnose; periwinkle and vinca with Phytophthora aerial blight.

ARKANSAS, Stephen Vann. With field crops, Stephen reported a rather high incidence of tomato spotted wilt virus on tomato in the southeastern regions of the state during June and July. Losses up to 50% of the harvested crop were recorded. Diseases of rice included sheath blight, brown, spot, and rice blast. Brown spot was commonly reported on the variety Bengal. Lodging due to nutrient excesses and environmental conditions of wind and rain was reported on Kaybonnet variety. Fusarium sheath rot was observed on Bengal resulting in discoloration of the peduncle and poor grain fill. Despite the disease pressure, the rice crop overall was excellent. With soybean, sudden death syndrome *(Fusarium solani)* and charcoal rot *(Macrophomina)* were among the majority of plant sample diseases submitted to the clinic. Corn acreage was up over last year. Aflatoxin exceeded acceptable levels from several locations where corn was harvested, due in part to dry growing conditions. From over 300 wheat samples processed for karnal bunt at the AR clinic, no positive samples were discovered. The clinic plans to process samples for the 1997 crop. From vegetables, southern blight and bacterial wilt were prevalent on tomatoes and peppers. Turf diseases included brown patch and dollar spot. We do have an unconfirmed report of ergot on Bermuda used for hay.

Central Region
compiled by Karen Rane

Agronomic Crops. Gray leaf spot in corn continues to be the hot topic throughout the region. Diane Merrell in Nebraska reports finding the disease in more counties in the northern and western parts of the state. Gray leaf spot was noted by Judy O'Mara in Kansas, Gail Ruhl in Indiana and Paula Flynn in Iowa as being quite common on corn samples submitted to these clinics. Other late season problems in corn included Diplodia ear rot (Illinois, Indiana, Kansas), and Fusarium ear rot (Kansas). Sclerotinia white mold was common in Iowa and Nebraska soybeans. In Kansas, pod and stem blight was prevalent, but incidence of charcoal rot was reduced, due to the relatively cool summer weather in that state. Soybean cyst nematode continues to spread westward in Kansas. Other soybean problems this autumn include pockets of downy mildew and Phytophthora stem rot in Minnesota (reported by Sandra Gould), and Cercospora blight in Indiana. In wheat, Judy O'Mara reports a higher incidence of leaf rust in Kansas than is normally found at this time of year, although overall the health of the wheat crop is considered to be quite good in the region.

Woody Ornamentals. Sphaeropsis tip blight was mentioned by several Central Region diagnosticians as being particularly severe. Nancy Pataky in Illinois noted several samples with stem cankers caused by the pathogen, and Nancy Taylor in Ohio reports that many producers

of Scots pine Christmas trees confronted this disease for the first time in their plantations this year. Sphaeropsis was also detected on landscape junipers in Ohio, and on Douglas fir and Colorado blue spruce in Indiana. In contrast, Sphaeropsis tip blight was less of a problem in Kansas than in years past. Dothistroma needle blight and brown spot needle blight were more common in Kansas Scots pines, both in windbreaks and Christmas tree plantations. Phytophthora root rot was diagnosed on boxwood and several species of lilac in Ohio. An increase in samples of Phytophthora root rot and Cylindrocladium root rot in several shrubs and perennials in nurseries was noted in Minnesota. A greater-than-normal number of oak samples testing positive for oak wilt were received in the Illinois clinic this year. In Ohio, many cases of iron chlorosis in river birch and pin oak were detected. This was the second year of severe iron chlorosis in combination with Tubakia leaf spot for many pin oaks in central Ohio, and these stressed trees are now being invaded by insect borers.

Herbaceous Ornamentals. Root rots (*Pythium* and *Thielaviopsis)* have been significant problems on impatiens in Kansas. In Ohio, a stem rot caused by a *Colletotrichum* sp. was diagnosed on a sedum sample from the landscape. The normal run of poinsettia problems (Pythium root rot, Botrytis blight, Rhizoctonia root rot) have been received in both Ohio and Indiana clinics. Other greenhouse ornamental problems include Phytophthora root and stem rot on English ivy (Ohio), INSV on cyclamen (Kansas, Indiana) and Myrothecium leaf spot and blight on bigleaf variegated periwinkle (Ohio).

Other Crops. Gray leaf spot, caused by *Pyricularia grisea,* is causing significant damage to ryegrass fairways in Kansas. In Indiana, pink snow mold was active in early October. Dollar spot was quite common in Indiana and Kansas. Tomato spotted wilt virus was diagnosed on greenhouse tomatoes in Kansas this fall. Fusarium wilt was detected in basil in Ohio.

SOUTHWEST REGION
Thomas Isakeit

Arizona: There was not much new activity. The only problems that Mike Matheron reported was Coniophora brown rot and Hendersonula branch wilt of citrus.

California: Ann Gabrik (southern California) reported that an unusually hot and humid summer for California resulted in some increased disease: "Anthracnose was very bad in golf greens. Slime molds were out in force (not pathological, but interesting nonetheless). Large masses of *Fuligo* sporulated on peoples' lawns bringing back reminiscences of "the blob". Also, another slime mold I saw on turf and around trees appears to be some sort of *Ceratiomyxa*. Other problems I saw this summer (more than average) were established shrubs and small trees giving up to Phytophthora root rot. Could be that the hot weather really favored the growth of the fungus while stressing the plant a lot, too. Plus, people tend to water a lot more when the weather is really hot. We have tested field-grown gypsophila (popular in cut flower arrangements) for INSV and TSWV. Many field-grown plants have tested positively for both viruses, without obvious symptoms. Although the gypsophila plants and flowers do not seem

to suffer from the infection, the fact that the fields are a reservoir of virus inoculum is significant. Thrips love this plant."

Gerald Holmes (Imperial Valley): Growers would like to get back into the more lucrative Fall melon market. As a result, there were more melons planted this fall than in previous years. Late-season vine decline was severe in several fields. *Monosporascus cannonballus* was isolated from roots of symptomatic plants and high levels of ascospores were recovered from soil.

Fall planting of winter vegetables started mid-September, bringing with it the usual abundance of abiotic diseases, especially in lettuce. Herbicide injury and over-fertilization was common in lettuce seedlings. We also saw a fair amount of irregularity in stand establishment of carrots and lettuce due to the needle nematode (*Longidorus africanus*). High winds during crop germination and seedling establishment has also caused stand establishment problems.

Steve Koike (Central Coast): There was an unusual occurrence of *Sclerotinia sclerotiorum* causing branch and stem infections of bell and chile pepper crops. This disease is not commonly seen in the coastal region, but in 1996 there were many cases of it. Tomato late blight (*Phytophthora infestans*) continues to be an every-year occurrence on coastal tomato plants. Of interest is the finding that all tested isolates from the Salinas Valley are the old A1 mating type and resistant to metalaxyl. This is in contrast to the rest of California in which the newer A2 mating type is prevalent. Some new host-pathogen relationships have been defined for powdery mildews here. Endive and radicchio crops were infected by *Erysiphe cichoracearum*. Celery seed crops have been infected with *Erysiphe heraclei*. Greenhouse-grown, cut flower lisianthus (*Eustoma* species) have been damaged by a *Fusarium avenaceum* crown rot, which has caused significant damage to some of the commercial lisianthus producers.

New Mexico (Natalie Goldberg): After a near-disastrous 1995 chile season, New Mexico chile growers are experiencing their best season in 10 years. Diseases plagued the chile crop in 1995 from start to finish. This year, only minor problems were associated with diseases such as seedling damping-off and viruses. Phytophthora root rot, a perennial problem in much of New Mexico's chile growing region, was moderate in 1996. Powdery mildew, a once uncommon disease on chile, has now occurred three years in a row, and it is probably safe to say that the organism, *Oidiopsis* (*Leveillula*) *taurica*, has established itself in the area. In 1996, predictive sulfur spray announcements were issued based on weather data. Growers who followed advised sprays delayed the onset of mildew in their fields by approximately 4 weeks, enough time to avoid serious problems associated with premature defoliation and sunburn.

Turfgrass was the most commonly-submitted plant for disease diagnosis. The most prevalent diseases on turf were: leaf spots caused by *Curvularia*, *Bipolaris* and *Fusarium*, brown patch, and Pythium crown and root rot. Other turf diseases identified included: summer patch, leaf smut, pink snow mold, and take-all patch. In New Mexico, Kentucky bluegrass is the most commonly- affected species, followed by fescue and bermudagrass. Native grasses, such as blue gamma and buffalograss, are very rarely submitted for disease diagnosis.

Environmental stresses, such as drought, heat and salt stress, continued to plague ornamentals. Also, powdery mildew was a common problem on many ornamentals, including: Euonymus, Photinia, rose, ash, lilac, verbena, African violet, and Mexican bird-of-paradise.

Other diseases and disorders identified: blossom-end rot on pepper and tomato, powdery mildew on cucurbits, Phytophthora fruit rot on pepper and tomato, beet curly top virus on tomato, Verticillium wilt on peanut, Fusarium wilt on cucurbits, seedling diseases caused by Rhizoctonia on peanut and cotton, Alternaria leaf spot on cotton, Fusarium wilt on mimosa, Phymatotrichopsis root rot on various trees and shrubs, gray mold on greenhouse-grown tomatoes, and alfalfa mosaic virus on chile.

Oklahoma (Betsy Hudgins): The following problems were seen on ornamentals: pine wilt, caused by the pinewood nematode (*Bursaphelenchus xylophilus*); Cytospora canker of willow; Phomopsis blight of Juniper; Drechslera stem rot of portulaca; 2,4-D injury of redbud; possible rose rosette; black canker of willow; and crown rot of ajuga and vinca, caused by *Sclerotium rolfsii*. On turf, the take-all fungus, *Gaeumannomyces graminis* var. *graminis*, was suspected of causing a root rot of bermudagrass, while a Curvularia blight of zoysiagrass was seen.

Other diseases seen include: southern blight (*Sclerotium rolfsii*) of chili pepper, pod rot (*Fusarium, Pythium,* and *Rhizoctonia*) of peanut, tomato spotted wilt virus in peanut, charcoal rot of corn, cocklebur rust, root knot nematode on carrot, and Septoria leaf spot of plum.

Texas: Jerral Johnson (College Station) reports: Pierce's disease of grapes has always been a threat to the wine grape industry of Texas but losses have been low except in isolated locations where *Vitis vinifera* were grown. During the summer of 1995, losses began to increase. The bacteria was found in new locations in Central Texas and in the Texas Hill Country. Losses continue to increase in 1996 and the range has spread to an even larger area with the state. One vineyard reported approximately 100 diseased plants in 1995 but the number increased to over a 1,000 in 1996. Some vineyards have been completely destroyed by the bacterium. Some of these were replanted. However, in a few years, losses were reported in the new planting.

Larry Barnes (College Station) reports that Phytophthora crown and root rot is causing problems on pansies. Nurseries are experiencing 25-30% losses.

Harold Kaufman (Lubbock) reported leaf blight of sorghum in Parmer county and Fusarium wilt of pumpkin.

Mark Black in the Winter Garden (Uvalde) reported tomato spotted wilt on tomato in Bexar county. A disease was found on fruit of honeydew, caused by a bacterium that has not yet been identified.

George Philley in east Texas (Overton) reported Cylindrocladium root and crown rot of miniature roses.

Thomas ("Chip") Lee in north-central Texas (Stephenville) reported increased problems with peanut diseases. In Commanche and Eastland counties, tomato spotted wilt virus was severe, resulting in 25-100% plant mortality in fields. Infection was high in July and there was abundant secondary spread. Ozone damage was common, along with *Leptosphaerulina crassiasca* as a secondary pathogen. The source of the ozone was thunderstorms. The root knot nematode was severe. Sclerotinia blight was a problem in Seminole county, while Botrytis was a problem in Gaines and Dawson counties.

Tom Isakeit in the Rio Grande Valley (Weslaco): The squash leaf curl virus, transmitted by whiteflies, has been common on watermelon throughout all growing areas. One instance of a mixed virus infection (squash leaf curl and a potyvirus) was documented.

Foliar diseases caused by fungi have been varied. In the mid-Valley, Alternaria leafspot was seen on cantaloupe. Downy mildew was a problem on honeydew in Starr county. Cercospora leafspot has been the prevalent foliar disease in watermelons in the Falfurrias-Premont area.

Squash bug injury was found to be the cause of wilting watermelons in Duval county. Fruit disorders seen on cucurbits included "measles" on honeydew, evidently a guttation injury, and pimples on watermelon, which is attributed to tobacco necrotic ringspot virus. Bacterial fruit blotch affected 10-20% of watermelon in one field in Duval county. The plants were grown under sprinkler irrigation. The growers had another field a few miles away with the same cultivar growing under drip, with no fruit blotch.

In the Coastal Bend area, high levels of aflatoxin were found in sorghum. Unlike the perennial problems of aflatoxin with corn and cottonseed in this area, the sorghum problem is very uncommon.

Pacific Northwest
Ellen Bentley

Bob Forster (U Idaho-Kimberley) reports he diagnosed his first cases of flag smut of wheat and Cephalosporium stripe of wheat this summer. There is a problem with net necrosis (Leaf Roll Virus) in Idaho potatoes this year. Several fields have been turned down by processors and fresh packers. This followed higher than usual flights of green peach aphid this summer.

The season in North Dakota (Marty Draper, NDSU) started very wet and dried out dramatically by mid-summer. Many small grain and row crop fields showed stress from compaction and shallow root systems that developed from early excess moisture and tillage during wet conditions. The environment had a significant impact on anticipated disease epidemics, although we found that the effects were not as profound as expected. Head blight (scab) of wheat (*Fusarium graminearum*) was less severe than it has been in recent years. However, the center of the epidemic shifted westward into what are typically very arid counties. Due to wet conditions at planting, it was difficult to stagger planting dates and much of the crop was at a susceptible stage during favorable environment. This area of heavy scab was directly

adjacent to the north central "durum triangle" (which produces over 50% of US durum (pasta) wheat), and a large durum acreage was also involved. Similarly, the orange wheat blossom midge (*Sitodiplosis mosellana*) was a major problem in the same area of the state. This insect pest lays eggs in the developing head and the larvae disrupt the normal development of the wheat kernel. Continuing on the insect front (some of us diagnose insects too --eb.), sunflower midge (*Contarinia schulzi)*, was severe in 1996 for the first time in about 15 years. Entire fields were infested early in head development, restricting normal pollination and head/seed set. In some cases, 40-60 acre fields were affected uniformly and yields were near zero. Late blight (*Phytophthora infestans)* on the potato crop was thought to have been arrested by the hot, dry weather of July and August. Little foliar blight was observed, but in current storage samples, late blight is commonly present at levels above the 5% minimum required for Federal Crop Insurance (FCIS). Late blight, because of its affect on the storability of tubers, is one of the few diseases covered under FCIS multi-peril policies. Cereal leaf spots were common early (tan spot and Septoria), as were Monilinia and Taphrina on stone fruits. Perhaps the most common call in the spring was about winter injury on trees and shrubs. Many tree species suffered branch dieback from the extreme winter conditions in 1995-96.

The Plant Pest Diagnostic Lab at NDSU is a multi-disciplinary lab and in 1996, continued a trend toward increased sample numbers. This was the fourth consecutive year with an increase in samples, despite assessing charges for services.

The potato diseases identified in Eastern Oregon (Phil Hamm, OSU-Hermiston) this quarter read like a who's who from the Potato Compendium. Late blight was first identified in the area on July 3rd and continued from there. A number of Norkotah' fields had damage due to IWW (I Wonder What). No pathogen has been Identified. Other potato diseases included black leg, early dying, *Rhizoctonia, Sclerotinia,* phytoplasm (probably BLTVA), Leaf Roll Virus, PVY, pink rot, powdery mildew, fusarium dry rot, deep pitted scab, and powdery scab.

Watermelon growers in the area were dismayed to find that bacterial fruit blotch *(Acidivorax)* had arrived in the area (brought in on seed) (I note no dismay from the pathologist! - eb). They also had to contend with Pythium root rot, and Fusarium and Verticillum wilts. Other cucurbits, (pumpkin and squash) suffered from BCTV. Onion bulbs had Fusarium basal plate rot and a bacterial rot. Garlic was also diagnosed with *Fusarium.* Pepper had bacterial spot, Pythium root rot and BCTV. A bean with *Botrytis* was unique as was root knot nematode on carrot. Apples were sent in with powdery mildew and crown rot. Wheat problems Included physiologic leaf spot.

Melodie Putnam (OSU-Corvallis) adds that this was one of those growing seasons in Western Oregon where nothing came in twice (at least it seemed that way), which makes it difficult to report on. Actually, it was a pretty boring season. Most of the samples had either abiotic problems or Verticillium (maples, mint, potato, photinia, magnolia, cucumber, ash).

The only real exciting disease was finding "black goo" on grape! This is a new disease that is turning up in phylloxera (a homopterous insect) resistant rootstocks of wine grapes. It was

found and first described by Lucie Morton (Viticultural Consultant, Broad Run, VA), who also confirmed the occurrence in Oregon. Diana Fogle, California Department of Food and Agriculture, is working on determining what the causal pathogen is. It appears to be *Cylindrocarpon obtusisporium* - at least that is what is consistently isolated from affected roots. The disease is typified by a dark amber to pitch black material that oozes out of roots or wood when cut in cross section. The goo is the consistency of thick, dark honey. Most of it is found below the graft in the rootstock portion of the vine, including the graft area. In affected rootstock there are black spots or a blackened sector in a partial or full circle within the oldest annual xylem ring surrounding the pith, and sometimes in the pith itself. This blackening is never found in the newest xylem vessels. Whole plant symptoms include vines that grow strongly until mid-summer and then suddenly collapse. Sometimes vines grow apparently normally the first year or two but then fail to increase in size as much as they should after two years. (Disease description information taken from an article by Lucie Morton, Wines & Vines Nov 1995).

The end of the season also became quite mundane to the north in Washington. Columbia Basin potato harvest experienced low prices and too many tubers. As a result many fields sat under irrigation after vine kill and developed pink rot, Pythium leak and bacterial lenticel rot. Skagit Valley red cultivars and seed also suffered from the latter due to wet harvest conditions.

A long mild Indian summer facilitated good powdery mildew conditions on apples, grapes, poplars (a personal first), turf and ornamentals. However, due to the reduced crop (winter vine injury) even mildewed wine grapes got a premium price. Preliminary data indicate that *Uncinula* is surviving overwinter in cleistothecia but not in buds.

Fall weather also encouraged kernel blight (scab) of corn and many foliar leaf spots, Septoria on blackberry was a first. Winter just arrived with wet snow and ice, severely damaging trees and ornamentals.

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A Review of Bud and Leaf Nematodes of the Genus Aphelenchoides And the Diseases Caused by Them.

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Abstract

This paper presents a brief discussion of Genus Aphelenchoides and summarizes species identification of six leaf and bud nematodes with morphological descriptions, distribution and hosts, their artificial rearing, pathogenicity, overwintering, invasion and dissemination. The control of leaf and bud nematode diseases with cultural, physical and chemical measures is discussed.

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Bud and leaf nematodes have not been as troublesome in recent years for growers of ornamental plants because of better sanitation practices and use of effective nematicides. Now, with the loss of registered chemicals for use in greenhouses, many growers are surprised that leaf nematodes are again becoming a problem.

This summary paper was created in 1991-92 while the senior author was visiting scientist at the University of Georgia, Georgia Station. The authors' intention is not to alarm plant growers, but to caution them about the potential increase in bud and leaf nematodes that may occur because of the rapid decrease in use of phosphorous-containing nematicides. Neither is this article meant to replace the very detailed and accurate information issued by the Commonwealth Institute of Helminthology, through their C.I.H. Descriptions of Plant Parasitic Nematodes. The main purpose is to assemble in one document information that may be useful to nematologists and other biologists. [This review preceded the CAB1 publication: Hunt, D. J. 1993. Aphelenchida, Longiduridae, and Trichodoridae, Their Systematics and Bionomics. CAB1. 352pp.]

It is well known that *Aphelenchoides ritzemabosi*, *A. fragariae* and *A. besseyi*. are bud and leaf nematodes, but according to Christie (1959) these are a group of some five or six species that live as parasites in the buds and foliage of various plants. We consider the nematodes of the genus *Aphelenchoides* which principally parasitize either bud, leaf, stem, flower, fruit or bulb of a plant as bud and leaf nematodes. The bulb is included since the bulb itself is also a bud. We consider the following as valid bud and leaf nematode species: *A. ritzemabosi*, *A. fragariae*, *A. besseyi*, *A. blastophthorus*, *A. subtenius* and *A. lilium*. All cause considerable damage to ornamental plants.

1. Genus Aphelenchoides

The Genus Aphelenchoides is the largest genus of Aphelenchoididae, which includes a few important plant pathogens (Franklin, 1978). Baranovskaya (1981) states that Aphelenchoides includes 105 valid species, and males are only present in *A. brevicaudatus* Das 1960 and *A. brevionchus* Das 1960. She considered *A. elongatus* and another 12 species as doubtful species (species inquirendae) and agreed with Sanwal (1961). Her book includes all species of Aphelenchoides published before 1978 and some new species published in 1979. But two new species, *A. jonesi and A. wallacei* (Singh, 1975), were not listed. Nineteen new

species were reported from 1979-1991. They are: *A. vaughani, A. haghaquei, A. helicosoma* (Malslen, 1979), *A. tuzeti* (B'Chir, 1979), *A. sanwal* (Chaturvedi & Khera, 1979), *A. loofi, A. siddiqi* (Kumar, 1982), *A. parasexlineatus* (Kulinich, 1984), *A.suipingensis* (Feng & Li, 1986), *A. brevistylus, A. unisexus* (Jain & Singh, 1984), *A. agarici, A. myceliophagus, A. neocomposticola, A. swarupi, A. minor* (Seth & Sharma, 1986), *A. africanus* (Dassonville & Heyns, 1984), *A. Lichenicola* (Siddiqi & Hawksworth, 1982), *A. bimuceronatus* (Nesterov, 1985). Therefore, Aphelenchoides could include 124 valid species reported in and before 1991. Yet Dropkin (1980) listed 197 species and Esser (1991) listed 236 species including synonyms.

Nematodes in the genus Aphelenchoides are slender, long or short with finely annulated cuticle and with 2, 3, 4, 6 (few) incisures present in the lateral fields and unapparent or no lateral fields in few species (Nickle 1970, Franklin 1978 and Baranovskaya 1981). Heads are off-set slightly. Frameworks are sclerotized lightly. Stylets have bulbs or thickenings. Metacorpuses are strongly developed, with prominent sclerotized valves. -Glands are long, overlapping the intestine dorsally as lobes. Tails of both sexes are cylindrical, tapering, never filiform, but generally with a small mucron of variable shape. Female gonads are short and prodelphic or long and reflexed one or more times, with oocytes in a single row, and a few in double or multiple rows. Postvulvar uterine sacs are well developed, vary in shape, and are with or without sperms. Male tails curve ventrally when relaxed with gentle heat and are without bursa. Three pairs of papillae are present, one adanal and two ventro-submedian between the anus and terminus. Spicules are paired and rosethorn shaped, with or without apex and rostrum. No gubernaculums are present.

To identify the various species of Aphelenchoides, Sanwal (1961) published a key to 35 species, based on the characters of the female, which includes shape of tail, stylet structure, presence or absence of postvulvar uterine sac, position of excretory pore and nerve ring, and number of lateral incisures. Nickle (1970), in discussing the taxonomy of Aphelenchoidea, regards the aphelenchoid spicule and aphelench stylet as stable characters that can be used at the generic and specific level. Drozodvskii (1989) discussed the taxonomic significance of differences in embryological development between species of *Aphelenchoides.*

Species of the genus are heterogeneous in their habitats and feeding habits. It is well known that *Aphelenchoides fragariae* as well as other species are parasites of higher plants, but most species of the genus are soil-inhabiting, feeding on algae, lichens, and mosses (Jenkins & Taylor, 1967) or their feeding habits are unknown (Thorne, 1961). *A. composticola* is a fungivorous nematode that destroys mushroom mycelium (Franklin, 1957). *A. agarici* also infects mushrooms (Seth & Sharma, 1986). Some species of the genus are associated with insects such as bark beetles (Massey, 1974). Both the nematode and the bark beetle inhabit the trunks of pines or other conifers. But the nematodes are not reported as pathogenic to either tree or insect. Timm & Franklin (1961) reported that *A. gynotylurus* and *A. marinus* are marine species.

2. Species Identification

Before 1952 the classification of bud and leaf nematodes was extremely confusing. The

morphological separation of four species of bud and leaf nematodes by Allen (1952), based on a study of more than two thousand specimens collected over a period of nearly 15 years, clarified their identification.

Although the number of incisures is very important for the species identification of Aphelenchoides, it is of little value in the identification of bud and leaf nematodes because all six species are now known to have four incisures. *A. fragariae* had long been described as having two incisures (Franklin, 1978, Siddigi, 1975, Sanwal, 1961, and Allen, 1952), but Zhang et al. (1988), studying a bud and leaf nematode infecting chulan tree *(Chloranthus spicatus),* discovered that this nematode shared all characters with *A. fragariae* except it had four incisures as observed by SEM. Later D.J. Hooper examined samples of *A. fragariae* isolated from California begonia by SEM and confirmed that four incisures were present on the lateral field of *A. fragariae* (personal communication). The author regarded length of female stylet, position of excretory pore, ovary prodelphic or reflex, number of oocyte rows, length and shape of postvulval uterine sac, with or without sperms, and shape of tails and number of mucrons, and male tail curvation, size of spicules, presence or absence of apex or rostrum as chief characters for identifying bud and leaf nematodes.

A brief morphological description of the six bud and leaf nematodes are as follows:

1) Aphelenchoides ritzemabosi (Schwartz, 1912) Steiner, 1932.

Synonyms (Siddiqi, 1974): *Tylenchus ribes* Taylor, 1917; *Aphelenchus ribes* Goodey, 1923; *Aphelenchoides ribes* Goodey, 1933; *Aphelenchus phyllophahus* Stewart, 1921; *Aphelenchus ritzemabosi* Schwartz, 1911; *Pathoaphelenchus ritzemabosi* (Schwartz, 1911) Steiner, 1932; *Aphelenchoides (Chitinoaphelenchus) ritzemabosi* (Schwartz, 1911) Fuchs, 1937; *Pseudaphelenchoides ritzemabosi* (Schwartz, 1911) Drozdorski, 1967.

Measurements (After Allen, 1952): ♀♀: L=0.77-1.20mm, spear=12μ (neotype) a=40-54, b=10-13, c=18-24, V=66-75. ♂♂: L=0.70-0.93mm, a=31-50, b=10-14, c=16-30, T=35-64.

Female: lateral fields with 4 incisures. Lip region set off. Excretory pore 0.5-2 body-widths posterior to nerve ring. Postvulval uterine sac extending for more than half the vulva-anus distance, often containing sperms. Ovary single, anteriorly outstretched. Oocyte in multiple rows. Tail with a terminal peg which has paint-brush-like 2-4 minute processes.

Male: Common. Posterior end of body curved 180 degrees when relaxed. Testis single, outstretched. Spicules smoothly curved, rosethorn-shaped, without apex or rostrum; dorsal limb 20-22 μ long. Tail peg with 2-4 processes.

2) Aphelenchoides fragariae (Ritzema Bos 1891) Christie 1932

Synonyms (Siddigi, 1975): *Aphelenchus fragariae* Ritzema Bos, 1891; *Aphelenchus olesistus* Ritzema Bos, 1893; *Aphelenchoides olesistus* (Ritzema Bos, 1893) Steiner, 1932; *Aphelenchus olesistus* var. *longicollis* Schwartz, 1911; *Aphelenchoides olesistus* var. *longicollis* (Schwartz, 1911) Goodey, 1933; *Aphelenchus pseudolesistus* Goodey, 1928; *Aphelenchoides*

pseudolesistus (Goodey, 1928) Goodey, 1933; *Aphelenchus ormerodis* of Jegen, 1920 Nec of Ritzema Bos, 1891.

Measurements (After Allen, 1952):♀♀: L=0.45-0.80mm, spear =10 μ (neotype), a=45-60, b=8-15, c=12-20, V=64-71. ♂♂: L=0.48-0.65mm, a=46-63, b=9-11, c=16-19, T=44-61.

Female: Lateral field with 4 incisures (Zhang, 1988). Lip region almost continuous with body contour. Excretory pore level with or close behind nerve ring. Postvulval uterine sac extending for more than half vulva-anus distance, often with sperms. Ovary anteriorly outstretched, with oocyte in a single file. Tail tapering, with single blunt mucro.

Male: Abundant. Tail curved through 45° to 90° upon relaxation. Testis single, outstretched, with spermatocytes in a row. Spicules rosethorn shaped with moderately developed apex and rostrum, dorsal limb 14-17 μ long.

3) *Aphelenchoides besseyi* Christie, 1942.

Synonyms (Franklin & Siddiqi, 1972): *Aphelenchoides oryzae* Yokoo, 1948; *Asteroaphelenchoides besseyi* (Christie, 1942) Drozdovski, 1967.

Measurements (After Allen, 1952):♀♀: L=0.62-0.88mm, spear =10 μ (neotype), a=38-58, b=9-12, c=15-20, V=66-72. ♂♂: L=0.44-0.72mm, a=36-47, b=9-11, c=14-19, T=50-65.

Female: Lateral field with four incisures. Lip region slightly offset. Excretory pore usually near anterior edge of nerve ring. Postvulval uterine sac narrow, inconspicuous, not containing sperms, 2.5-3.5 times anal body width long but less than one third distance from vulva to anus. Ovary relatively short, with oocyte in 2-4 rows. Tail terminus bearing a mucron with 3-4 pointed star-like processes.

Male: About as numerous as females. Posterior end of body curved to about 180° when relaxed. Testis single outstretched. Spicules without apex and with moderately developed rostrum, dorsal limb 18-21 μ in length.

4) *Aphelenchoides blastophthorus* Franklin, 1952.

Synonyms: None.

Measurements (After Franklin, 1952): ♀♀: L=0.83mm (0.68-0.90), spear =17.1 μ (15.0-19.5 male and female together), a=38 (32-47), b=10.2 (9.3-11.0), c=19 (16-21), V=70 (68-74). ♂♂: L=0.82mm (0.67-0.91), a=41 (35-47), b=9.5 (7.2-10.7), c=16 (14-19).

Female: Lateral field with 4 incisures. Lip region offset. Spear about 17 μ long with distinct basal knobs. Excretory pore about opposite the nerve ring. Postvulval sac reaching about halfway from the vulva to the anus, sometimes with sperms. Ovary anterior, with oocyte usually in a single row. Tail ending in a simple mucro.

Male: Common, similar to female except for sexual dimophism. Tail curls ventrally through 90° or more when killed by heat. Testis may reach as far as the oesophageal glands. Spicules rather large, the dorsal limb strong, with ventrally curled distal and giving it a hooked or knobbed appearance, with pronounced apex and rostrum, dorsal limb = 28 μ (24-31), and ventral limb=16 μ (14-19).

5) *Aphelenchoides subtenius* (Cobb, 1926) Steiner and Buhrer 1932.
Synonym: *Aphelenchoides hodson* Goodey, 1935.
Measurements: (After Allen, 1952):♀♀: L=0.87-1.15mm, spear = 11 μ (neotype), a=44-57, b=12-17, c=24-28, V=69-71. ♂♂: L=0.87-0.95mm, a=57-68, b=12-14, c=21-28, T=62-70.

Female: Lateral field with 4 incisures. Head set off. Excretory pore slightly anterior of nerve ring. Posterior uterine branch long, about half of vulvaanus distance (7.6 times body width) with few sperms. Ovary anterior outstretched with oocyte in tandem. Tail tapering gradually to blunt terminus with a ventral sharp mucro.

Male: Tail curls about 180° when relaxed by gentle heat, tapering to a bluntly rounded terminus armed with a single mucronate spine. Spicules with very small rostrum (Allen, 1952), or with no pronounced apex or rostrum (Franklin, 1978).

6) *Aphelenchoides lilium* Yokoo, 1964.
Synonyms: None.

Measurements (After Yokoo, 1964):♀♀: L=0.690 (0.64-0.75)mm, spear 12.5 μ, a=27.6 (25.8-34.5), b=4.0 (3.5-4.2), c=16.5 (15.0-18.0), V=70.5 (68.2-74.6). ♂♂: L=0.657 (0.60-0.80)mm, a=29.9 (23.8-34.5), b=4.9 (4.3-5.6), c=16.4 (15.2-20.0), T=56.4 (55.2-67.7).

Female: Lateral field with 4 incisures. Lip region set off. Nerve ring one body width behind the median bulb. Excretory pore about 2 times bulb-length behind the median bulb. Ovary single, reflexed anteriorly, with oocyte in a single row except terminal part. Postvulval sac extending about half of the vulva-anus distance (4 times body-width). Tail conical, armed with a single ventral truncated mucro.

Male: Tail curves through 90° when killed by heat tapering to a bluntly round terminus with a ventral mucronate spine. Spicules with apex and rostrum; dorsal limb 17.5 μ long.

3. Distribution and Hosts

A. ritzemabosi, the chrysanthemum foliar nematode, is widely distributed in Europe, former U.S.S.R., North America, South Africa, New Zealand and Australia and also was discovered in Brasil, Fiji, Mauritius (Siddiqi, 1974), India, Japan (Kir'yanova and Krall, 1980), China (Li, 1984), Mexico (Szczygiel & Prado-Vera, 1981), and Korea (Choi, 1977).

Although a major pest of chrysanthemum, it has a wide host range. Wallace (1961)

reported that it may occur on 190 plant species, whereas Kir'yanova & Krall (1980) said that the nematode parasitizes more than 165 species of plants comprising 64 different families and they listed about 100 genera of host plants with families. Besides chrysanthemum, another important host is strawberry on which it is usually found in association with the fern nematode, *A. fragariae.* The chrysanthemum nematode clearly prefers plants of the family Compositae which constitute about one third of all its hosts. It has parasitized one fern, *Struthiopteris orientalis* (Kir'yanova & Krall, 1980 and Siddiqi, 1975). It can live successfully on various common weeds (Southey & Bassett, 1982).

A. fragariae is commonly known as the strawberry nematode or spring dwarf nematode, spring crimp nematode, begonia leaf nematode, or fern nematode. This nematode has been recorded in Denmark, Germany, Ireland, Italy, UK, Sweden, Poland, the former USSR, USA, Japan, India, Australia, Hawaii, and Azores, Madieta, and the Canary Islands (Siddiqi, 1975). It was also reported in China (Zhang, 1988) and Mexico (Szczygiel & Prado-Vera, 1981).

A. fragariae infects about 70 species of ferns and has more than 260 host plants in 50 families. Kir'yanova & Krall' (1980) listed approximately 100 plant genera as hosts. Most *A. fragariae* hosts are ferns, or members of Liliaceae, Primulaceae and Ranunculaceae. A nematode infestation was observed in 7 common weeds in Japan (Yamada & Takacura, 1987). Both *A. ritzemabosi and* A. *fragariae* occur sympatrically on about 28 hosts including aster, begonia and strawberry (Siddiqi, 1975).

A. besseyi, the white tip nematode, is distributed in all the countries where rice is grown (Ou, 1985), including, as Franklin & Siddiqi (1972) mentioned, Italy, Hungary, the former USSR, USA, Japan, India, Indonesia, Pakistan, Taiwan, Cuba, El Salvador, most countries of central and West Africa and Madagascar and Comoro Islands. The nematode is well known in China where it is mentioned frequently in text books and used as teaching material for students. Rahim (1988) reported this nematode occurred in Peninsula Malaysia. It was found on some hosts other than rice in Australia, Philippines, Israel and Brazil (Franklin & Siddiqi, 1972). The nematode causes up to 20% of yield loss in southern and eastern states of India (Prasad et al., 1987).

A. besseyi infects, besides rice and strawberry, more than 40 plant species including corn, millet, sugarcane and other crops of Poaceae, soybean, cabbage and sweet potato (Fortuner & Williams, 1975).

The distribution of *A. blastophthorus* is confined to Western Europe (Hooper, 1975), including Britain, Netherlands, Denmark, France, Germany. It was also discovered in Kazakh SSR (Kir'yanova & Krall', 1980). About 12 genera of plants are hosts of *A. blastophthorus* including narcissus and begonia (Hooper, 1975).

A. subtenius is known in Denmark, England, Holland, South Africa, USA, Kazakhstan (Kir'yanova & Krall' 1980) and China (Li, 1984). Narcissus, *Colchicum autumnale, Allium giganteum, Crocus vernus, C. sativus,* Scilla, tulip, iris, phlox and others are hosts for this

species (Decker, 1981; Kir'yanova & Krall', 1980).

A. lilium has only been reported as a parasite of lily bulbs (Yokoo, 1964) and peony (Yokoo & Matsusakim, 1967) in Japan.

4. Artificial Culture

Bud and leaf nematodes are obligate parasites and none of them has been cultured in artificial media to date. But monoxenic or dixenic culture of the nematodes has been successful. *A. ritzemabosi* was cultured in callus tissues of oat (Webster, 1966), tobacco, carrot, periwinkle and marigold (Dolliver et al., 1966). Bud and leaf nematodes are mostly cultured on fungi. *A. fragariae* can be cultured *on Alternaria citri* (Christie & Crossman, 1936), *Fusarium oxysporum* f sp. *melonis* (B'chir, 1977) and *Botrytis cinerea* (Zhang, 1988). *A. besseyi* can be cultured on *Pyricularia oryzae, Cochlibolus miyabeanus, Nakataea sigmoidea (Magnaporthe salvinii), Colletotrichum lagenariam, Phytophthora* sp. (Iyatomi & Nishizawa, 1954), *Nigrospora* sp., *Sclerospora* sp. (Fortuner & Orton, 1975), *Aureobasidium pullulans* (Huang et al, 1979), *Fusarium moniliforme, Alternaria padwickii, Helminthosporium oryzae and Curvularia* sp (Rao, 1985). *A. besseyi* also can be cultured with Alternaria, Curvularia, Helminthosporium (Kondakova & Borovkova, 1970) and Fusarium (Todd & Atkins, 1952) growing on rice seeds. Hooper (1975) cultured *A. blastophthorus* on *Botrytis cinerea* in 1963. Kir'yanova & Krall' (1980) mentioned *A. subtenius* was found on mushrooms in Moscow region and it multiplies on agar with *Fusarium oxysporum, Alternaria tenius* and *Botrytis cinerea*. Unlike other bud and leaf nematodes, *A. ritzemabosi* had not been cultured on fungi (Franklin, 1978) until Hooper (1986) made a series of tests confirming that *A. ritzemabosi* could reproduce on fungi, thus paralleling the behavior of other bud and leaf nematodes. But the rate of reproduction of this nematode on fungi was less than for other species of Aphelenchoides.

Changes have been observed on nematodes reared artificially. *A. fragareae* becomes short and wide on *Alternaria citri* (Zhang, 1988), increasing in length and becoming more slender on balsam callus tissue; *A. besseyi* becomes longer on balsam callus tissue and shorter on *Alternaria citri* (B'chir, 1977). The male and female ratio of *A. besseyi* increases on Aureobasidium, which favours male differentiation and/or lessens the life of female (Huang et al., 1979). Thus traditional biological statistical characters are limited in differentiating closely-related species of Aphelenchoides reared in culture.

5. Parasitism

1). Pathogenicity and Symptoms

Bud and leaf nematodes are endoparasitic and/or ectoparasitic. Endoparasitism and ectoparasitism are determined by the different host species. The different plant organs also influence the type of parasitism, resulting in different disease symptoms. *A. fragariae, A. ritzemabosi* and *A. besseyi*, while infesting strawberry, feed ectoparasitically on buds or young tissues and induce stunted, malformed plants or dead buds. *A. fragariae* is occasionally found

to be an endoparasite of strawberry leaves (Franklin, 1950). Both *A. ritzemabosi*, and *A. fragariae* can infest strawberry pulp (Tacconi, 1972). Their endoparasitism can be observed on other hosts. *A. fragariae* feeds endoparasitically on fern, begonia, peony, causing leaf-spots, and on begonia stems causing stem-rot; *A. ritzembosi* endoparasitizes chrysanthemum, causing leaf-spots. *A. besseyi* is an ectoparasite on rice and strawberry causing well-known rice white-tip and strawberry summer dwarf. It is an endoparasite of hibiscus and *Ficus elastica* (Raabe & Holtzman, 1965; Marlatt, 1966). *A. blastophthorus* is both ecto- and endoparasitic on leaf and bud tissues of scabious *(Scabiosa caucasica)* (Franklin, 1952). It can live in floret buds or the dead leaf bases. The nematode also occurs in stems of aborted inflorescences. Infected plants have dark green aborted inflorescences and distorted or twisted leaves. It was discovered in between testa and embryo of *Callistephus chinensis,* but the embryo was not infected (Burckhardt, 1972). *A. subtenius* infests narcissus bulb, causing brown spots at the base.

Leaf and bud nematodes combined with other organisms can cause serious plant diseases. *A. ritzemabosi* or *A. fragariae* and *Corynebacterium fasciens* together induce the "cauliflower" disease of strawberry (Crosse & Pitcher, 1952; Pitcher & Crosse, 1958). *A ritzemabosi* was associated with *Phytophthora cryptogea* on diseased gloxinia in Florida (Stokes &, Alfieri, 1969). More severe and widespread blight symptoms of Rieger begonia were produced by *Xanthomonas begonia* in the presence of *A. fragariae* than without it (Riedel & Larsen, 1974). *A. fragariae* and *Pseudomonas cichorii* interact causing damage on Phillipine violet *(Barleria cristata)* in Florida (Lehman & Miller, 1988). *A. fragariae* was reported together with *A. ritzemabosi* and *A. blastophthorus* on *Scabiosa caucasica* (Brown, 1955). Weights of a rice cultivar Melrose were reduced significantly by *A. besseyi* alone and *A. besseyi* plus *Sclerotium oryzae*, but not by *S. oryzae* alone (McGawley, et al., 1984).

2). Overwintering

Leaf and bud nematodes overwinter mainly on seeds or vegetative propagation materials. It is well-known that most plant nematodes are soil-borne, but the leaf and bud nematodes seldom live for long periods in soil. *A. besseyi* overwinters beneath the hulls of rice grains. It can survive for 3 years in stored dry grains (Admo, 1977), but will die in 4 months on grain left in the field (Yoshii & Yamamoto, 1950). It does not survive in soil (Franklin & Siddiqi, 1972). A. *ritzemabosi* can overwinter in dormant buds or growing points of chrysanthemum stools. Stools rather than soil serve as the source of infestation (Hesling & Wallace, 1961). French & Barradough (1962) found 33% and 8% of the nematodes of all stages revived from dry leaves kept for 3 years at 4° and 7°C, respectively. *A. fragariae* can survive winter in chulan buds, or in leaves on the ground and leaves buried in the soil (Zhang, et al., 1989). Survival of leaf and bud nematodes in residue of diseased plants is influenced by temperature and humidity. *A. besseyi* became quiescent in 4 days at 30% RH, 6 days at 50-70% RH and 8 days at 90-100 RH, and 17.9-25.l°C was suitable for its multiplication (Rao, et al., 1983). *A. blastophthorus* overwinters in living leaves of the center of scabious crown or in the dead leaf bases (Franklin, 1952). Grass can be the habitat of leaf and bud nematodes, and soil fungi could contribute to their survival in the absence of a host since some of them have grass and fungus hosts.

3). Invasion and spread:

A. fragariae invades leaves through stomata (Klingler, 1970, Zhang, et al., 1989) or by penetrating the epidermis of the under surface (Strumpel, 1967). *A. ritzemabosi* also invades plant leaves through stomata (Hesling & Wallace, 1961 and Wallace, 1959). After invasion, the nematodes reproduce, completing a generation in 10-14 days under suitable temperature (Siddiqi, 1974; Siddiqi, 1975; Franklin & Siddiqi, 1972; Hooper, 1975). Kostyuk (1987) reported that embryogenesis of *A. besseyi* occurs in 10 stages and the larva is formed in the 10th stage. Both *A. fragariae* and *A. ritzemabosi* exit through stomata during rainy days or periods of high humidity (Zhang, 1989; Wallace, 1959) and invade healthy tissue, moving by means of water films. *A. ritzemabosi* is spread by splashing rain and leaf contacts (Wallace, 1959). *A. besseyi* moves from soil to plants to seed heads of a grass, *Sporobolus poiretii,* and thence to *Ficus elastica* 'Decora' where leaves touch the grass inflorescence. This nematode does not migrate from soil to Ficus leaves through the Ficus stem (Marlatt, 1970).

6. Control

Cultural, physical and chemical methods are used to control bud and leaf nematodes among which seed treatment, nematode-free seedlings and resistant varieties are important. Rotation is seldom mentioned. Cultural measures include: destroying all plant remains and symptomatic plants, using nematode-free propagation material, avoiding dense cultivation or overlapping of adjacent plants, over watering, and eliminating grasses. Some rice white tip nematode-resistant varieties have been developed, among which a few are almost immune (Fortuner, 1975). Popova et al (1984) mentioned resistant varieties of rice were available in the former USSR, and Silveira et al (1982) reported testing rice varieties in Brazil. Sivakumar (1988) tested 187 rice cultivars and varieties in India and concluded that none of them was resistant to *A. besseyi* but 7 of them were moderately resistant. Some chrysanthemum varieties are comparatively resistant to *A. ritzemabosi* (Hesling & Wallace, 1961). The most sensitive varieties were those with loose tissue structure and dense foliage (Farkas, et al., 1985). *A. ritzemabosi* produces fewer eggs and the eggs develop more slowly on resistant chrysanthemum varieties than on susceptible ones (Wallace, 1961). Lehman (1989) gives detailed information on resistance of begonia cultivars to *A. fragariae.* Cultivars of Rieger begonia, tuberous begonia and Lorraine elatior begonias are susceptible; many Rex begonias are resistant; fiberous rooted begonias may serve as symptomless carriers of the nematode. Strider (1979) tested 40 African violet varieties and concluded "Allison" and "Suzanne" were most resistant to *A. ritzemabosi.* The resistance of different species or varieties of lily to *A. fragariae* is variable (Yamada & Takahura, 1987).

Hot-water treatment (HWT) is often used to control bud and leaf nematodes on different plants (Siddiqi, 1974; Siddiqi, 1975; Franklin & Siddiqi, 1972; Fortuner, 1975) however the temperature under which nematodes are killed is very close to the temperature at which plants can be injured. Although many farmers think HWT is unsafe (Bryden,1959) the best method to control rice white tip nematode is HWT and generally repeated treatment annually is not needed (Fortuner, 1975); presoaked rice seeds treated at 52°C for 10 min. resulted in control

of the nematode (Nandakumar et al., 1975). Control of *A. ritzemabosi on* chrysanthemum, *A. fragariae* on strawberry and *A. subtenius* on bulbs was obtained at 46°C for 5 min., 47°C for 10-15 min., and 43.5°C for 3 hrs., respectively (Decker, 1981). Hot water plus chemicals has been used with some success. A hot-water-formaldehyde bath (1 pint of 38% formaldehyde in 25 gal. water) at 44°C for 1 hr. is effective to control *A. fragariae* (Jensen & Caveness, 1954). One hundred percent of *A. fragariae* in the leaves of *Asplenium nidus* were killed by Wood light after 7 days (Moussa, 1972). Nematode contaminated rice seeds were gamma-irradiated (60 Co) and good results were obtained at 30 Grey dose (Aleksandrova, 1985).

Tacconi et al (1982) reported that soaking fresh strawberry plants in 0.1, 0.2 and 0.3% of Thionazin 20E for 5 min. ridded *A. fragariae* infection completely without harm to the plants. Szczygil (1980) tested a few pesticides and concluded that granular aldicarb (0.2g/plant) was the best one for controlling bud and leaf nematode on strawberry. Parathion, methyl parathion, systox, thiophos, methomyl, fenamiphos, mevinphos, methomyl and tensulfothion have been successfully used to control bud and leaf nematodes (See Siddiqi, 1974; Siddiqi, 1975; Franklin & Siddiqi, 1972; Fortuner, 1975). Although Temik (aldicarb) is effective, it leaves toxic residues (Strumpel, 1969). Furadan and thiabendazole were effective in rice seed treatment and increased the yield (Silveira, 1978). Isotenphos spray was effective in controlling the nematode and also increasing rice yield (Prasad et al., 1987a). Gill (1980) sprayed *Zinnia elegans* with seven pesticides and concluded that methyl-parathion and puinalphos were the best in lessening the severity of symptoms and *A. ritzemabosi* population. Heungens (1986) reported Temik, Vydate (oxamyl) and Vertimec (abamectin) reduced 95% of leaf nematode population of azaleas. Soil fumigation with methyl bromide ($50g/m^2$) or metam sodium (75 or $100ml/m^2$) provided very good control of narcissus basal plate disease caused by *A. subtenius* (Lavi, et al., 1985).

With the almost certain prospect that nematicides as we know them will not be available, researchers already are devoting more attention to developing biological and cultural techniques to control plant pathogenic nematodes. Plant nematologists may cooperate with plant breeders in creating cultivars resistant to the ubiquitous bud and leaf nematodes. The authors trust that this summary will assist researchers in these endeavors.

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DIAGNOSTICS IN CROP PRODUCTION

A Symposium Held at the University of Warwick, Coventry, UK,
April 1-3, 1996

Notes and Comments by Jackie Mullen, Auburn University, AL

This 3-day international symposium was organized by the British Crop Protection Council in conjunction with the Association of Applied Biologists and the British Society for Plant Pathology. The meeting was attended by approximately 350 international participants who were mostly involved with research on diagnostic procedures and assays.

The program was organized into 8 sessions: (1) an introductory section, The Scientific Basis of Diagnostic Techniques, (2) Diagnostics for Viruses, Phytoplasmas, and GMOs (GMO is an abbreviation for genetic manipulated organisms - I think.), (3) Diagnostics for Fungal Plant Pathogens, (4) Diagnostics for Lower Fungi, Bacteria, and Nematodes, (5) Development of Diagnostic Methods for Agrochemicals, (6) Poster Presentations, (7) Validation, Regulatory Impact and Commercial Development of Diagnostics, (8) Diagnostics in the Future.

The introductory session outlined the present day situation of agriculture in the United Kingdom, the increasing need for more food and the increasing trend away from pesticide use. Along with the above trends, there is an increasing need for quick, reliable field methods of diagnosis for detecting the disease agent at the symptomatic and pre-symptomatic stage of disease development. M.F. Askew (ADAS, Wolverhampton, UK) (I could find no explanation of the acronym ADAS in the program or proceedings) suggested that future diagnostic assays would be less expensive and that the reduced cost would allow for an increase in sampling which would result in smaller (patch) area treatments. The re-occurring environmental pressures on reduced pesticide usage were noted several times in this symposium. Also, in the introduction session, serology as a diagnostic tool was discussed with comments on the advantages and limitations of the technique. I. Barker (Central Science Laboratory, Herts, UK) gave a good review of the use of serology in diagnosis. He concluded with the comment that the limited market for ELISA kits for each particular disease agent and the high cost of kit production will limit the development of this technique. P.R. Mills (Department of Microbial Biotechnology and Plant Pathology, Horticulture Research International, Warwick, UK) presented a good review of the use of molecular DNA-based techniques for identification of particular disease agents.

SESSION 2: DIAGNOSTICS FOR VIRUSES, PHYTOPLASMAS AND GMOs. The presentations involved serology, PCR, and RFLP methods. For me, the most interesting presentation involved data by A. Ziegler, K. Harper,and L. Torrance (Scottish Crop Research Institute, Dundee, Scotland) which described a method for using a phage-display library and DNA recombinant techniques in bacteria to generate virus specific antibodies, bypassing the need for immunization of animals. (This research was also presented as a poster. See comments at the end of the description for Session 6.)

SESSION 3: DIAGNOSTICS FOR FUNGAL PLANT PATHOGENS. Topics included techniques of PCR, monoclonal antibodies production and use, immunomonitoring of fungal airborne pathogens, and PCR integrated with ELISA. E.J.Robb and R.N. Nazer (University of Guelph, Ontario, Canada) presented their work to incorporate PCR-based diagnostics into a government extension program to monitor *Verticillium* species in commercial potato fields. They compared their PCR technique for detection and quantification of Verticillium pathogens in potato with previous biological assays and concluded that the PCR technology was less expensive, faster, more accurate and could be applied cost effectively on large scale.

E.A. Stevens et al. (National Institute of Agricultural Botany, Cambridge, UK) reported on their work to develop a PCR seed health test (called Multiplex PCR) to detect and differentiate three pathogens of barley. At the time of the symposium, two types of primers had been developed to detect *Pyrenophora teres* f.sp. *teres* and *P. teres* f.sp. *maculata*. Still to be accomplished was the development of one more primer type for *P. graminea* and the combining of the three primer types into a multiplex seed health test for *Pyrenophora* species.

J.J.Beck et al. (CIBA Agricultural Biotechnology, Research Triangle Park, NC) summarized their work to incorporate ELISA in a PCR-based assay for a microtiter plate format for quantification of disease pressure. Their attempts were successful, but Beck commented that the amount of processing for this analysis was a disadvantage. They planned further work to reduce the time needed for sample analysis.

SESSION 4: DIAGNOSTICS FOR LOWER FUNGI, BACTERIA AND NEMATODES. T.O.Powers (University of Nebraska, Lincoln, NE) reported on his work using individual nematodes added directly to a PCR reaction mixture. The amplified DNA is assessed by product size and sequence on agarose gels. The size of the ITS region (Internationally Transcribed Spacer Region) of the ribosomal DNA genes is generally consistent for species of each genus, but varies between genera. Digestion of the amplified DNA and analysis often produced species specific gel patterns. The molecular information is being added to a database available through the World Wide Web.

N.F. Lyons et al. (Horticulture Research International, Warwick, UK) developed an indirect ELISA test for *Pseudomonas gladioli* and *Botrytis allii,* two pathogens of stored onions which begin the infection process in the field before harvest. The ELISA testing is done on soluble antigens extracted from bulb neck tissue by a freeze-thaw procedure three weeks before harvest. Results showed good correlation between preharvest test results and the incidence of bulb rot in storage.

R. Black and S. Seal (Natural Resources Institute, Kent, UK) reported on the use of specific rapid methods of bacterial detection/identification in third world countries for detection of *Pseudomonas solanacearum* (*Burkholderia solanacearum*). They compared the BACTID system (which requires pure cultures and is somewhat similar to the BIOLOG system), polyclonal and monoclonal antibodies techniques (ELISA), PCR (where inhibitors may be a problem), and

probes. Each technique had its advantages and disadvantages. They concluded that BACTID is a good choice when the lab has minimal resources and a preliminary identification is needed. BACTID has been adopted in Zanzibar, Mauritius, Malaysia, Zimbabwe. ELISA is suitable for less developed countries. Indirect ELISA is used by many such labs. The 16S rDNA PCR for *P. solanacearum* is being used successfully for screening and diagnosis in a few European research and quarantine labs. Local (UK) research staff have been trained and equipped for use of PCR in *P. solanacearum* identification.

I. Lacourt et al. (Scottish Crop Research Institute, Dundee, UK) reported on PCR-based detection of Phytophthora species in horticultural crop situations. The report described a workable and successful PCR-based detection system based on ribosomal DNA sequence of several (5) important species of Phytophthora. This PCR test was able to detect *Phytophthora* at a presymptomatic stage.

SESSION 5: DEVELOPMENT OF DIAGNOSTIC METHODS FOR AGROCHEMICALS. ELISA and chemiluminescence research was reported. B.S. Ferguson and H.N. Nigg (Millipore Corp., Scarborough, Maine; University of Florida, Lake Alfred, respectively) reported on the use of ELISA and related serological tests to detect chlorpyrifos and parathion methyl in fortified saliva. When saliva samples were fortified with 1.0 ppb of pesticide, the average recovery was 91%. The authors planned to test saliva from Florida pesticide applicators before and after spraying the spring of 1996. Results will be compared with hplc (high performance liquid chromatography) and glc (gas liquid chromatography) analyses.

C.R. Lowe (University of Cambridge, UK) and L.J. Cox et al. (Environmental Sensors Ltd, Cambridge, UK) reported on a new chemiluminisce immunoassay method (Lumina TM) for pesticide detection that is now being used for regulatory pesticide analysis by UK water authorities. The method was described as rapid, low cost, accurate and highly automated and with sensitivities higher than or equal to gc-ms (gas chromatography- mass spectrometry). Work was being conducted at the time of the meeting to develop a hand held dip stick for field use.

SESSION 6: POSTER PRESENTATIONS. Diagnostic techniques included ligase chain reactions, PCR (polymerase chain reactions) based assays, RFLP (restriction fragment length polymorphism) analysis, RAPDS (random amplification of polymorphic DNA), monoclonal antibodies, and polyclonal antibodies. These analyses were being used for a variety of detections of plant pathogen genera, species, strains; pesticides, and plant species. Some of the pathogens, pesticides, and plant species detected by these techniques included potato virus Y, beet necrotic yellow vein virus, *Pythium violae, Colletotrichum acutatum, Trichoderma harzianum,* zucchini yellow mosaic virus, beet luteoviruses, potato cyst nematode, aster yellows phytoplasmas. *Spongospora subterranea* f.sp. *subterranea, Pseudomonas gladioli* pv. *allicola*, *Mycosphaerella* species, triazole fungicides, pirimiphosmethyl, organophosphorus pesticides, oxamyl, and hexazinone, oil seed rape and barley, and genetic characterization of heather. Also, there was poster by Torrance et al. (a European Union funded project with input from Scotland, Austria, Germany, and The Netherlands) which described work to produce antibody-like proteins from bacterial cultures (also described in the comments in Session 2). The antibody-like proteins

were used in ELISA to detect beet necrotic yellow vein virus and potato leaf roll virus. Results were comparable to polyclonal antibody-based ELISAs. The antibody-like protein producing bacteria had been modified by recombinant DNA methods which involved the use of hybridomas and synthetic antibody gene libraries.

SESSION 7: VALIDATION, REGULATORY IMPACT AND COMMERCIAL DEVELOPMENT OF DIAGNOSTICS.

W. Telliard from the U.S. EPA (Washington, D.C.) spoke on the operation and organization of EPA, analysis procedures used, and the current and future use of immunoassays. EPA program offices are (1) Air and Radiation, (2) Prevention, Pesticides, and Toxic Substances, (3) Solid Waste and Emergency Response, (4) Water. At the time of the symposium, many of the analyses were based on gas or liquid chromatography or other chemical reaction procedures. Immunoassays were being used to some extent with pesticide and solid waste programs. Immunoassays constituted a very small component of the analysis methods used for air, drinking water, waste water programs, and hazardous waste clean-up programs. Telliard suggested that future analyses would probably involve more serology.

S.J Holmes (ADGEN Diagnostic Systems, Ayr, Scotland) spoke on the validation and commercial development of serological tests for non-medical uses. He cited Neogen's products of Alert and Reveal and Agriscreen, which can be used on-site. He cautioned that these tests should not be stand-alone tests, but should be used to complement other lab diagnostic procedures and input from specialist advisors.

K.D. Lockley et al.(ADAS, Bridgets Research Centre, Hants, UK) reported on work with ELISA for detection of *Septoria tritici* in winter wheat. The assay was able to detect the pathogen in tissue 3-4 weeks before symptom development. ELISA was also able to detect the pathogen inoculum on the wheat leaves. Application of fungicide at this early stage of disease would help control disease development. But, tests showed that the presence of inoculum did not always result in disease development. Lockley noted that weather usually determined whether disease developed after the inoculation event or not.

SESSION 8: THE FUTURE. This final group of presenters described diagnostics as it may be in the future. Badley (Unilever Research, Colworth Laboratory, Bedford, UK) described the potential future for immunodiagnostics. He predicted more use of this technique within 5 years. C.R. Lowe (Institute of Biotechnology, University of Cambridge, UK) described the future use and application of biosensor technology for health care, food processing industries, and agriculture and horticulture industries. Gray and Strachan (Central Science Laboratory, Food Science Laboratory, Aberdeen, Scotland) spoke on the need for development of easier verification of PCR products. He described new developments in biosensor and thermal cyclers which will allow for a more user-friendly procedure to identify PCR products. de Lacy Costello et al. (Faculty of Applied Sciences, University of West England, Bristol, UK) described a sensor system that could be used to detect volatiles released from potato tubers infected by *E. carotovora*. They proposed the application of this sensor technique for early

detection of soft rot in stored potato tubers. The last paper, presented by R.C. Righelato Innovation Centre, University of Reading, UK) addressed the role of the consumer in determining standards for food safety and quality and analytical methods used to guarantee these standards. He predicted that retailers and processors will seek to find technologies that can be used economically to provide a means to satisfy consumer requirements. Future research must address these needs for more user friendly analytical techniques.

Exhibitors are listed below. I have included copies of some of the handouts provided. I found the most interesting and applicable product for a diagnostic clinic to be the slide agglutination serology kit for detection of several bacterial plant pathogens being marketed by ADGEN Diagnostic Systems. See information sheets to follow for more information. I did purchase the kit for detection of *Xanthomonas campestris* pv. *vesicatoria* for diagnostic and teaching purposes and found it to perform satisfactorily. The cost of $182.99 (as of 10/17/96) (120 L, British currency) for a 100 test kit is not an unreasonable cost per sample test ($4-8, including controls), but the kit size and the hard-to-plan-for needs in a clinic citation makes the product too costly for many diagnostic situations.

EXHIBITORS

ADAS, Plant Diagnostics Laboratory, Woodthorne, Wergs Road, Wolverhampton, WV6 8TQ

ADGEN Diagnostic Systems, SAC, Watson Peat Building, Auchincruive, Ayr KA6 5HW

Blackwell Science Ltd, Osney Mead, Oxford OX2 OEL

Bond Biotech, 11 Station Road, Holme, Peterborough PE7 3PH

British Crop Protection Council, BCPC Publications Sales, Bear Farm, Binfield, Bracknell, Berks RG42 5QE

Ciba Agriculture, Whittlesford, Cambridge, CB2 4QT

DSM, c/o Biologische Bundesanstalt, Messeweg 11/12 D-38104 Braunschweig, Germany

Environmental Sensors Ltd, Downhams House, Downhams Lane, Cambridge CB4 1XT

Europa Bioproducts, Pond Green, Wicken, Ely, CB7 5XX

Horticulture Research International, Wellesbourne, Warwick CV35 9EF

Perkin Elmer, Applied Biosystems Division, Kelvin Close, Birchwood Science Park North, Warrington, Cheshire WA3 7PB

Potato Marketing Board, PMB Experimental Station, Sutton Bridge, Spalding, Lincs PE2 9YB

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Scotlab Bioscience, Kirkshaws Road, Coatbridge, Lanarkshire ML5 8AD

Tepnel Life Sciences plc, Toft Hall, Knutsford, Cheshire WA16 9PD

OFF THE SHELF

Brunt, A.A., K. Crabtree, M.J. Dallwitz, A.J. Gibbs and L. Watson
Viruses of Plants
1996. CAB International c/o Oxford Univ. Press. Cary, NC. 148400.
ISBN: 0-85198-794-X $185.00 (800-451-7556)

This book is the product of the Virus Identification Data Exchange project (VIDE) and is also available on Internet from the BioWeb Server (URL http://biology.anu.edu.au). For diagnostic facilities that encounter many viruses across commodities, this book is a must as part of the reference collection. This is not a diagnostic tool but rather a concise summary of virus genera and species. You must know the genus or specific virus to use the text. This is not a host-driven index of virus reports.

The generic summaries include the following: definitive species list, natural host range and symptoms, transmission, experimental host range, properties of particles in sap, particle morphology, physical morphology, physical properties, biochemical properties, replication and cytopathology. Numerical fractions are used to reflect the number of specific viruses that confirm to a characteristic of the number of viruses in a virus genus. The summaries of specific viruses include the aforementioned data plus the collaborator(s), first report, ecology and control, geographical distribution, purification, taxonomy and relationships and key references. All viruses are entered with the latest, approved nomenclature set by the International Committee for the Taxonomy of Viruses.

The content of this text is more current and comprehensive than the existing set of Descriptions of Plant Viruses by CAB and AAB. It is indexed by virus common name and synonyms for convenient use. As a bibliophile, I prefer the book to the Internet access but the web site does offer a cost-free access to new information and new viruses as the database is updated.

Gogo, Masao
Fundamentals of Bacterial Plant Pathology
1990. Academic Press, Inc. 342 pp.
ISBN: 0-12-293465-2 $59.00

This is an older title that is still available from Academic Press. There are not many titles in the area of bacterial plant pathology. This one offers a very broad coverage of bacterial plant pathogens in a format suitable to support a teaching curriculum. The book is well written and organized, covering such topics as bacterial morphology/structure, taxonomy, physiology, lysis, genetics, serology, pathogenesis, life cycles and dispersal, disease infection, environmental interactions, diagnosis and control and 18 specific bacterial disease scenarios. Illustrations and black & white photographs are well placed. This title does not compete with Fahy and Persley (1983) as it is not strongly diagnostic with highly detailed methodology, media recipes, etc. It does however, provide a very sound core reference to diseases incited by bacterial pathogens.

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THE OHIO STATE UNIVERSITY EXTENSION

Extension FactSheet

Plant Pathology, 2021 Coffey Road, Columbus, OH 43210-1087

Black Root Rot of Strawberry

Michael A. Ellis
Department of Plant Pathology

Black root rot is a serious and common problem of strawberries. The term "Black root rot" is the general name for several root disorders that produce similar symptoms. The disorders are not clearly understood and are generally referred to as a root–rot complex. For this reason, it is difficult to discuss black root rot as we do other diseases which usually have a specific cause. Black root rot has been found in every strawberry growing area of the United States, and a considerable incidence of black root rot has been observed in recent years in Ohio.

Symptoms

Black root rot is most common in fields with a long history of strawberry production. Symptoms begin with some plants in a field showing reduced vigor, often in low or wet spots or in portions of the field where the soil has become compacted. This decline in vigor usually begins during the first fruiting year. The symptoms are most apparent the last couple of weeks before harvest. Although severely affected plants may die before harvest, it is more common for diseased plants to continue living but become stunted and produce a reduced crop of small berries. The percentage of plants affected in any individual field usually increases significantly the year following the first appearance of symptoms.

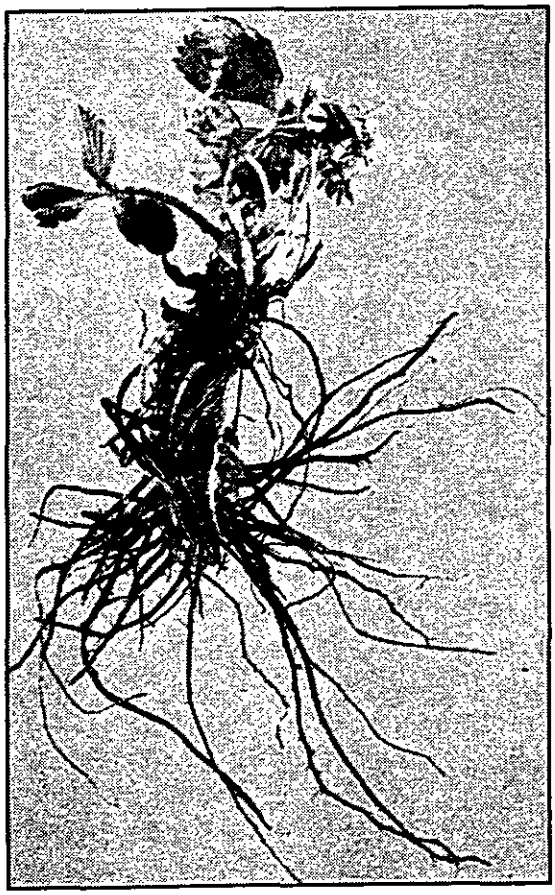

Figure 1. Note the discolored (black) roots on this plant affected with black root rot.

Diagnosis is made by digging up declining plants and examining their root systems, about the time that fruit begin to color. Abundant fleshy white roots and fine lateral roots will be seen on healthy plants, and the interior of the older woody roots is yellowish–white. With black root rot, there is usually a loss of many fine lateral roots, and irregular black patches occur along the length of the fleshy white roots. In severely affected plants, these black patches grow together so that no white roots are visible. The interior of infected older woody roots turns black.

Potential Causes

Several different fungi have been implicated as causes of black root rot, as have certain environmental stresses such as cold injury, soil compaction, and excessive water in the root zone. In some soils, black root rot has been associated with an interaction between a particular soilborne fungus and the lesion nematode *Pratylenchus penetrans*. It is likely that black root rot symptoms result from one or more of the following: (a) gradual buildup in the soil of disease–causing microorganisms and nematodes when strawberries are grown with inadequate rotation; (b) interaction of these organisms with environmental or other stress factors such as herbicide injury, winter or cold injury, and excessive soil moisture that might make plants more susceptible to attack; and (c) certain soil conditions such as heavy (clay) or poorly

drained soils that might favor the activity of disease–causing fungi and/or inhibit the ability of the strawberry plant to produce new roots to compensate for their damage. Additional factors may also be involved.

Control

Because several factors appear to be involved in the black root–rot complex, no general control measure is totally effective. The following may help to reduce its incidence:

- Always start plantings with healthy white–rooted plants from a reputable nursery.
- Rotate out of strawberries for at least 2–3 years before replanting.
- Minimize soil compaction and increase tilth by incorporating organic matter, such as straw from a rotational grain crop.
- Avoid heavy, wet soils and improve drainage in marginal soils by tiling or planting on raised beds.
- Preplant fumigation of the soil is sometimes helpful, but not always.

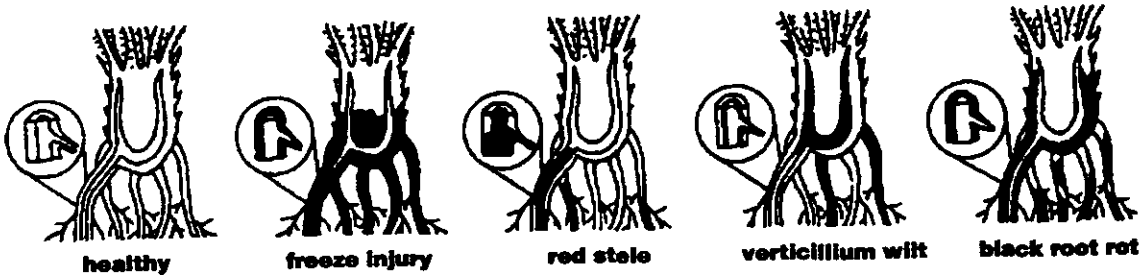

Figure 2. Some common strawberry root problems and typical symptoms.

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