cooperative EXTENSION SERVICE • STATE OF INDIANA

PURDUE UNIVERSITY
and the
U. S. DEPARTMENT of
AGRICULTURE cooperating
West Lafayette, Indiana 47907

Department of Botany & Plant Pathology • Lilly Hall of Life Sciences

P.D.Q.

PLANT DIAGNOSTICIAN'S QUARTERLY

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July 25, 1984

Summer Greetings:

I imagine all of you are in the midst of a busy season and many may not find time to read this until the first freeze. However, there are several timely bits of information which you may want to read BEFORE the meetings in Guelph.

Many thanks to Rick Wukasch and those who contributed information for the Feature on Organic Gardening and the Clinic.

Looking forward to seeing many of you at the "Teach-In" and the Diagnosticians' Supper Meeting on August 12th. The supper meeting is our Diagnosticians committee meeting, so please do try to attend!

Respectfully Yours,

Gail Ruhl

Gail Ruhl
Editor, PDQ

GR/kb

Teach-in: Diagnosis of Abiotic Plant Stresses
1984 Joint APS-CPS Meetings
University of Guelph

Co-sponsored by: APS Plant Diagnositicans and APS Committee on Environmental Quality and Plant Health

When: August 12, 1984

Where: Room 121, Crop Science Bldg., University of Guelph

SCHEDULE

13:30 - 14:00	Herbicide Injury:	Diagnosis and Mode of Action Dr. Jack Dekker - University of Guelph
14:00 - 14:50	Informal Discussion and Injury Identification	
14:50 - 15:10	BREAK	
15:10 - 16:10	Air Pollution:	Diagnosis and Mimicking Symptoms Dr. John Skelly - Penn State
16:10 - 17:00	Informal Discussion - Herbicide Injury	
17:00 - 19:00	SUPPER BREAK	
19:00 - 19:30	Salt Toxicity:	De-Icing and Fertilizer Dr. Gerry Hofstra - University of Guelph
19:30 - 20:00	Informal Discussion and Injury Identification - Salt Toxicity	
20:00 - 20:40	Water Stress:	Diagnosis and Stress Related Diseases Dr. Don Schoeneweiss - University of Illinois
20:40 - 21:00	Informal Discussion:	Water Stress
21:00	ADJOURN to Welcom Mixer, Peter Clark Hall, University Centre.	

***NOTE: The workshop is full. Space will be available only if cancellations occur.

Coordinator: R.T. Wukasch
Pest Diagnostic and Advisory Clinic, Dept. of Environmental Biology
University of Guelph
Guelph, Ontario, Canada N1G 2W1
(519) 824-4120, ext. 2701

Diagnosticians Participating in the "Teach-In" on August 12th at Guelph

LIST

Name	Location
J. Kunickis	Chem Lawn
B. Joyner	Chem Lawn
W. Ellett	Chem Lawn
J. Clayton	MSU Summer Diagnostician
R. Varma	Diagnostician, Alberta Env. Centre
K. Smereka	Diagnostician, New Hampshire
H. Gilbertson	Davey Tree
Bal Rao	Davey Tree
B. Brown	Colorado State
L. Venneman	Nebraska
T. Stasz	Hawaii
J. Carroll	Cornell, Ithaca
P. Bachi	Kentucky
E. Dutky	Maryland
M. Andrews	Oklahoma
L. Sweets	Iowa
S. Thomson	Utah
M. Waindle	Georgia
J. Mullen	Alabama
D. Cooley	U. of Massachusetts
C. Averre	N.C. State
J. Peplinski	Penn State
M. Daughtrey	Cornell, Long Island
G. Ruhl	Indiana
C. Kaiser	Kentucky
C. Ash	N.D. State
R. Wukasch	Univ. of Guelph
W. Attwater	Univ. of Guelph
Harlan Smith	U.S.D.A. (retired)

Organic Gardening and Diagnostic Clinics

Coordinated by R.T. Wukasch
Diagnostician, Univ. of Guelph

Plant Disease Diagnosticians, U.S.A.

G. Ruhl, Purdue Univ., W. Lafayette, IN.
M. Andrews, Oklahoma State Univ., Stillwater, OK.
J. Carroll, Cornell Univ., Ithaca, NY.
C. Bender, South Dak. State Univ., Brookings, S.D.
P. Bachi, Univ. Kentucky, Princeton, KY.
C. Averre, North Carolina State Univ., Raleigh, NC.
R. Wick, Virginia Poly. Inst. & State U., Blacksburg, VA.
E. Dutky, Univ. Maryland, College Park, MD.
L. Venneman (D. Steinegger, L. Finke, B. Besal, and D. Wysong), Univ. of Nebraska, Lincoln, NB.
C. Ash, North Dak. State U., Fargo, N.D.
A. Liese, Univ. of Vermont, Burlington, VT.
W. Mettardy, U. New Hampshire, Durham, NH.
P. Kauffman, Ohio Dept. of Agric., Reynoldsburg, OH.
Anonymous, Univ. of Wisconsin, Madison, Wisconsin.
J. Mullen, Auburn Univ., Auburn, AL.
L. Barnes, Texas A & M Univ., College Station, TX.
T. Tidwell, Calif. Dept. Food & Agric., Sacramento, CA.
J. Hartman, Univ. Kentucky, Lexington, KY.
S. Perry, Michigan State Univ., E. Lansing, MI.
J. Houfek, Kansas State U., Manhattan, KS.

Canada

G. Platford, Manitoba Dept. of Agric., Winnipeg, Manitoba.
K. Lynch, New Brunswick Dept. Agric., Fredericton, N.B.
M. Dykstra, Alberta Hort. Res. Center., Brooks, Alberta
R. Wukasch, Univ. of Guelph, Guelph, Ont.

Special thanks to the following persons whose experiences and input were an important contribution to this article:

Dr. S. Hill, Ecological Agric. Projects, McGill Univ., St. Anne de Bellevue, Quebec.
H. Thistlewood, D. McMullen and John Yorston, Agric. Canada and B.C. Min. Agr. & Food, Summerland, B.C.
D. Matthews and Staff of Rodale Press, Rodale Research Center, Kutztown, PA.
M. O'Connor, Boudreau and A. Pucat, Information Services, Agriculture Canada, Ottawa, Ontario.

Thank you all for considering such a lengthy questionnaire, for your valued input, and for your patience in awaiting the article.

1) Question: What is your definition of "organic" gardening and farming?

Most respondents (66%) defined organic gardening and farming as food and crop production without the use of synthetic pesticides and fertilizers. Phrases such as "completely natural methods", "back to nature approach", "avoiding the use of man-made chemicals" were common in these definitions. This group defined organic growers by what they would not use.

Another group of respondents (34%) also defined organic growers by what methods they would use. Phrases such as "natural or organic control methods", "natural-product fertilizers and pesticides", "cultural practices stressed", appeared in these definitions. Fertilizer and/or soil amendments used include animal and green manures; composted plant matter, rock phosphate and other naturally occurring minerals, blood meal, bone meal, fish meal, and other animal by-products, and rotational crops of legumes. Organic pest control methods included botanical or "natural" pesticides like rotenone, pyrethrin, plant and animal fats (soaps), copper sulphate, sulphur, etc.; biological control; cultural practices such as crop rotation, trap-cropping, time and method of planting, resistant cultivars etc.

Several respondents saw organic gardening and farming as a system. Dr. Stuart Hill, McGill University, defined it broadly, globally as " a rational farming and gardening system, based on all knowledge (particularly incorporating information from ecology, sociology, and psychology), the major goals being nourishment and fulfillment for all the people of the world, the methods employed permitting sustainability, flexibility, and evolution." Another comprehensive definition is found in the USDA Report and Recommendations on Organic Farming, 1980. This report is highly recommended reading.

Some diagnosticians were frustrated by the term "organic", reacting to it as "meaningless" or "inconsistent." One respondent noted that because there is such a wide variety of definitions among the practitioners of organic agriculture, a definition was not possible. There are many other definitions and methods of alternative agriculture, as described in Boeringa, 1980.

2) Question: How many cases do you receive per year from organic gardeners?

# Cases From Organic Agriculture Per Year	# Respondents
unknown	7
0	3
1-10	13
11-30	4
≥31	3
	30

The majority of clinics have very little contact with organic gardeners and farmers. Few clients specify that they request strictly organic control remedies for disease problems, and those which do are very direct about it. "How can I control this pest without using chemicals or poisons?" On the other side of the coin, Dianne Matthews of Rodale Research Centre reports that "Organic Gardening's Reader Service staff annually receive 35,000 letters, many of which request information on non-chemical pest control." In addition, many inquiries are received at the Research Centre in Kutztown, Pennsylvania.

Not all respondents were so overwhelmed, however, and as Sandy Perry, MSU asked, "Where are all those organic gardeners reported in Organic Farming Magazine?" If there are so many organic gardeners and farmers out there, why so few inquiries reported by clinics?

Several reasons are proposed for this disparity.

1) Many organic gardeners are distrustful of land grant university and government agriculturists, claiming that their research into pest control is largely funded and therefore biased by the agri-chemical industry. Therefore, they are also reluctant to seek advice from representatives of that "conventional" system of extension and research.

2) Many gardeners have been turned-off by insensitive encounters with "conventional" agricultural advisors. They resent being written-off by conventional agriculturists as fanatical, irrational, etc. They refuse to believe the all-chemical-fix or nothing approach which is often the only advice offered in crop protection recommendations, and thus seek the information from other than conventional sources, some of which are questionably accurate.

3) Many organic gardeners are conscientious and innovative in seeking information on alternatives to conventional methods of pest control. They ask for more than just a calendar spray-type recommendation, inquiring into the biology and history of the pest in question. From that information, they often develop their own control strategy - in effect, integrated pest management with minimal or no use of acceptable pesticides. Often conventional agricultural advisors are too busy to spend the time required for the above, being occupied with larger acreages rather than the interests of a vocal minority.

4) Some organic gardeners just claim to have fewer pest problems than conventional agriculturalists and therefore don't need as much control advice.

5) Because of the above, and likely other reasons, organic agriculture has an alternative parallel system of extension, usually through publications and organizations. Some of these organizations are: IFOAM, COG, National Organic Farmers Federation, Biodynamic Method Practitioners, and are listed in question 13.

In addition, publishers such as Rodale Press, Garden Way, Harrowsmith, Acres, etc., have articles and reader service columns which cater to the needs of organic gardeners.

Unfortunately, some proponents of organic agriculture have villified conventional agriculture to the extent that the backlash is significant, especially among conventional advisors. It is important that both streams of agriculture dialogue, not diatribe, about farming and seek common ground on which to build more sustainable systems for the future.

3) Question: Have you noticed an increase in requests for information on non-chemical control alternatives in the past?

4) Question: If yes, since when?

5) Question: If yes, how are these requests expressed?

Twenty-seven percent of respondents indicated an increase of requests for information on non-chemical control alternatives, especially since the mid to late 1970s. All others could not detect increase. Why? Greater public and student awareness of pesticide hazards, scandals such as the IBT situation, principles of pest management, and access to extension information were thought to have contributed to the increase in requests.

Requests for alternatives were often stated clearly and decisively, such as "How can I control it without using chemicals, poisons, etc?" Respondents noted more information requests in the last few years about disease resistant crops and ornamentals, companion plants, crop rotation and other cultural controls than in previous years.

6) Question: Are these requests primarily urban or rural? Size of acreage concerned?

The main source of "organic" requests were urban, home gardeners of <1 acre. A significant portion, however, were rural, small acreage gardens, with few actual organic farms of any size being reported. There are, in fact, substantial acreages of organic farms throughout the U.S. and Canada. (USDA, 1980, Hiron, 1981, Kessler, 1983.)

7) Question: How do you accommodate these types of requests?

Most respondents were comfortable with and sympathetic to requests for non-chemical alternatives. Inquiries were handled in normal fashion, providing particular advice on cultural practices and extension literature from government, university, or popular sources. Some respondents such as Rodale Press & Dr. Stuart Hill, keep extensive files of relevant reference material from which to design responses.

Clinicians generally claimed that they provide the most comprehensive, sound plant disease control advice possible. Several respondents described themselves as giving accurate, realistic information, including all alternatives as well as pesticide recommendations, and letting the client make the appropriate choices.

Other interesting comments regarding control practices were as follows: Because both the organic grower and the markets for organic produce will generally tolerate more blemishes or lower yield, the economic and aesthetic thresholds are different than for conventional agriculture. Organic growers often pay more detailed attention to cultural practices than those who strictly rely on pesticides, and hence, have to spray less frequently. When the crop is threatened, however, most will use an acceptable pesticide. Furthermore, they are usually more conscientious about when and what to spray, using materials which are less hazardous to normal biocontrol processes as well as themselves.

8) Question: To what extent do you rely on varietal or host resistance to diseases as a recommendation? Too often a vague recommendation is made in extension literature "use resistant varieties" without details to back up that recommendation. (Specifically, list the sources you would use for this information on resistant varieties.)

Despite the fact that almost all respondents cited this as a major component of recommendations, only some were specific as requested. (Perhaps this could be a feature article topic in itself - any takers?) Over half of the clinicians gave out disease resistance information regardless of the orientation of the client. In decreasing order of importance, the following sources were cited for such information:

1) Seed catalogues
2) Government extension literature
3) Literature reviews, reports, research trials in region
4) Popular articles

In the author's experience, garden centres and nurserymen do not often have this information, nor do they make it available to the public. Along with the recommendation, I often ask the client to request resistant varieties of ornamentals and vegetables (such as scab resistant crabapples) from their suppliers to help create a demand for such varieties in the marketplace.

Specifically, the following were cited as having good information on cultivar resistance:

Vegetables: specific disease factsheets, such as "Potato Scab", "Pest Management on Cucurbits", and "Corn Smut" from Vermont; also contained disease resistance information.

Chupp, C., and A. Sherf. 1960. Vegetable Diseases and Their Control. Ronald's Press Co. Inc., New York.

Felty, Sheryl. 1982. These Seeds. Gardens for All News. February, 1982. pp. 10-11.

Flanagan, T.R., and A.R. Gotlieb. 1982. Vegetable Varieties Recommended for Vermont Gardens. Univ. of Vermont. Plant and Soil Science Dept., Publ. G121, 2pp.

Lambe, R.C., Tolin, S.A., and R.E. Baldwin. 1982. Disease Resistant Home Vegetables. Virginia Coop. Ext. Serv. Publ. 450-171. 5 pp.

Stevenson, W., Harrison, H.C., and M.F. Heimann O.S.F. 1981. Disease Resistant Vegetables for the Home Garden. Univ. Wisconsin Extension Publ. A3110, 30 cents. (Terrific source, often cited, gives varietal name, disease reactions, and seed source).

Topoleski, L.D. 1981. Growing Vegetables Organically. Cornell University Coop. Extn. Serv. Info. Bull. 39. 8 pp. $1.00.

________________________ Disease Resistance in Vegetable Crops. North Carolina State Univ., Plant Pathology Note 188. 2 pp.

Some respondents, such as Tim Tidwell (California), said they collected papers which include varietal screening for disease resistance. e.g. Elstrom and Hopkins. Plant Disease 65:825-27. This is the only paper which was specifically listed, however.

Ornamentals:

APS Compendium of Elm Diseases

APS Compendium of Turfgrass Diseases

Brooklyn Botanical Garden, Sourcebook for Nursery Plants

Dutky, E.M. 1981. Verticillium wilt of Woody Plants. Univ. of Maryland Coop. Ext. Serv. PPM 27.

Nichols, L. 1981. Disease Resistant Crabapples. Penn State Univ. Plant Path. Contribution # 1244. 16 pp. (Annual survey in 11 states, lists resistant and susceptible cultivars and disease reactions.)

Nursery Catalogues - Hilltop, Stark (Perry, MSU).

(S.O.S. - Sandy Perry, Michigan State, requests list of disease resistant ornamentals)

Pirone, P.P. 1978. Diseases and Pests of Ornamental Plants. 5th Edit. J. Wiley & sons, N.Y. 566 pp.

Fruits:

APS Compendium of Strawberry Diseases.

Control of Insects on Deciduous Fruits and Nuts in the Home Orchard without Insecticides. 1977. USDA Home and Garden Bulletin # 211. 36 pp.

Field Crops:

APS Compendia, Corn, Wheat, Barley, Soybeans, Alfalfa

Ball, W.S. 1982. North Dakota Grain Variety Descriptions. N. Dak. State Coop. Ext. Serv. Circular A-170. 4 pp.

Corn Pedigrees from registration authorities in USA - Does anyone know where to get pedigree information regarding disease reaction of field crops?

Nematodes:

Sasser, J.N., and M.F. Kirby. 1979. Crop cultivars Resistant to Root Knot Nematodes: Meloidogyne spp.

See also papers and reports followed by (NEMA).

General:

Anonymous. Organic Gardening. Washington State Univ. Bull. EB 648.

Anonymous. Organic Gardening. Ohio State Univ. Coop. Ext. Serv. Bull. 555

Anonymous. Plant Disease Control in the Yard. Ohio State Univ. Coop. Ext. Serv. Bull. 434

Kucharek, T. 1974. Plant Disease Resistance. Univ. of Florida Coop. Ext. Serv. Extn. Plant Pathol. Report #13. 8 pp.

Gail Ruhl (Purdue) and Juliet Carroll (Cornell) mentioned university departmental publications produced with updated varietal resistance information.

9a) Question: In what specific instances is crop rotation of benefit in home gardens for plant disease control?

Crop rotation was cited by many as important in controlling soil-borne diseases but only in proportion to the size of the garden. The larger the garden, greater benefit achieved, whereas futile if small. Effectiveness of rotation was limited by tillage method, length of viability of pathogen in soil, method of irrigation, etc. Sometimes it was felt that establishing a new garden plot was the best solution. The following diseases were cited:

Diseases cited	Length of Rotation with non-host crops
Verticillium albo atrum	2-4 yrs.
Fusarium and other root rots of beans & peas	2-3 yrs. (6 yrs, Chupp & Sherf)
Meloidogyne spp.	2 yrs.+
Gaeumannomyces graminis (take all, cereals)	2-3 yrs.
Plasmodiophora brassicae (clubroot of crucifers)	4 yrs.+
Rhizoctonia solani (wirestem, crucifers, bottom rot of lettuce)	"long"
Sclerotinia sclerotiorum (white mold)	2-3 yrs.
Xanthomonas campestris (Black rot of crucifers)	2 yrs.
Pseudomonas solanacearum (Southern bacterial wilt of tomato)	4-5 yrs.
Soft rot bacteria	1-2 yrs.
Heat smuts e.g., *Urocystis tritici*	2 yrs.

See also Chupp & Sherf, 1960; Lodgson, 1980.

Some rule of thumb notations used were, "never plant same crop in same area if devastated the previous year", or rotate on a 3-year cycle with solanaceous, cole or cruciferous and pluse or leguminous crops. Another sensible alternative is available in the factsheet by Philley & Kaufman (1982) for controlling soil-borne diseases.

Ethel Dutky (Maryland) recommends soil analysis for *Xiphinema* sp., vectors of viruses like tomato ring spot, before planting brambles or other fruit.

9b) Question: Destruction of crop refuse?

Destruction of crop refuse was cited by many as valuable for most diseases (especially for foliar disease to reduce inoculum, for those diseases with resting structures which survive in crop residues, and for obligate pathogens). It is not particularly useful when adjacent contaminated gardens enable dissemination of spores (e.g. powdery and downy mildews), or if leaf size is so small or root system at a size which would make removal impractical.

Examples were cited as follows:

Disease cited	Host
Septoria blight	Tomato, soybeans
Alternaria early blight	Tomato, potato
Peronospora sp., downy mildew	Lettuce, onion
Anthracnose	Ornamentals
Phoma black leg	Cruficers
Club root	Crucifers (root system)
Xanthomonas, black rot	Crucifers
Fusarium yellows	Crucifers (root system)
Rusts	many
Fusarium or Verticillium wilt	many
Cankers	woody ornamentals
Botrytis	herbaceous ornamentals and vegetables
Sclerotium, Sclerotinia (other sclerotia producing fungi)	many
Meloidogyne spp.	many (root system)
Powdery mildew	many
Insect vectored diseases	
e.g. Dutch elm disease	Elm
Pine wilt nematode	*Pinus* spp.

A good rule of thumb was plow down or remove crop refuse at the end of the season where pathogen will overwinter in the crop refuse. Bury or destroy cull piles (especially potatoes and onions). Composting, only if adequate temperature is realized in the process to kill disease organisms. A good general "clean up" factsheet to prevent disease is Lamey & Ash, 1981.

9c) Question: Hot water seed treatment (HWST)?.

Only 27% of respondents thought that hot water seed treatment (HWST) was useful. Several deemed HWST as not useful for home gardeners due to necessity for precise temp. and timing, riskiness, and excessive work involved. These thought it useful for those who saved their own seed. Some seedsmen will HWST for the client if requested e.g. (Stokes Seeds). Sometimes problems with reduced germination and seedling vigor are encountered, and is a concern for growers using mechanized speedling-type systems or expensive hybrid seed. HWST was useful for the following:

Host	Disease
Celery	Blights
Bean	Bacterial blight, anthracnose
Crucifers	Blackrot, *Alternaria* leaf spots, black leg, bacterial leafspot
Carrot	Bacterial blight
Tomato	Bacterial canker, spot & speck
Gladiolus	Fusarium corn rot

Consult Chupp & Sherf pp. 9-24, Shurtleff, pp. 429-31, Sutton, 1974 and references in later list which are followed by (HW) for further information.

10) Question: The organic movement claims that if the soil is "balanced" or crops are perfectly grown and nourished, then plant diseases and pests will not be a problem. e.g., "Crops grown on land properly treated with humus resist all pests" (B.T. Hunter, *Gardening without Poisons*). In your opinion, are these statements justified and why?

Most respondents thought that statements like "Crops grown on land properly treated with humus resist all pests" were misleading, naive and oversimplified. True enough, humus improves soil tilth, structure, waterholding capacity, increases the population of micro fauna and flora which are antagonisitc to plant pathogens, and vigorous plants may yield well despite insect and disease losses. Plants growing under minimal stress are less susceptible to facultative parasites. Indeed, those folks who take the time to produce and use humus usually are careful with other cultural practices which also reduce disease.

However, humus holds no magical powers in preventing disease (is not fungicidal). Even if plants are perfectly grown (whatever that means), this does not confer resistance. How can the addition of humus control the environment, host genetic traits, pathogenicity, (the spread of inoculum by wind, water, or transplants, or by insect vectors) other factors which influence disease. Heavy losses have been observed by nematodes and fungi such as *Sclerotium rolfsii* despite plentiful humus amendments. Often, more vigorous growth is more severly attacked by obligate parasites like rusts and powdery mildews.

It is unfortunate that such blanket statements pervade the popular literature which serves as resource material for organic gardeners. More on this later, but there are signs that the scientific credibility of the organic movement is improving continually.

11) Question: What practical methods of biological control of plant pathogens are now available and recommended by you?

Strictly speaking, few practical biocontrol methods for plant pathogens are available and recommended by clinicians. Those listed were:

Agent	Trade Name	Pathogen Controlled	Use
Agrobacterium radiobacter (several respondents)	Galltrol, Dygall	*Agrobacterium tumefaciens*	Ornmanetal and fruit nursery stock dips to control crown gall
Bacillus subtilis (Jackie Mullen, Alabama)	Quantum 400	several soil-borne diseases	Peanut seed treatments

There has been a lot of work with organisms like *Trichoderma viride* in controlling soil-borne fungi, and many other discoveries of potential biocontrol agents. Yet none of these are to the stage of being commercially available for use in agriculture in North America. Entomologists are further ahead in developing such biological tools as *Bacillus thuringiensis*, Viruses, *Verticillium lecanii*, etc.

More broadly interpreted, there were many suggested methods which would not necessitate the use of chemical control, as listed:

1) Resistant varieties, avoiding problem crops

2) Crop rotation see (9) - use marigolds to reduce population of root knot nematode in crop rotation.

3) Sanitation - reducing inoculum

   - roguing, pruning, hand-picking, crop refuse destruction, soil sterilization, disinfesting tools, removal of alternate hosts or weed reservoirs, clean seed, disease-free planting stock

4) Altering the environment to discourage disease

   - watering practices (e.g., thorough, infrequent) avoiding wetting foliage, watering in the morning only

   - humidity control, especially in greenhouse through ventilation

- raised beds in soil to promote drying, proper plant spacing and row orientation to promote air drainage and drying of crop

- temperature management, especially indoors to minimize stress related disease

5) Cultural practices to improve host vigor

   - adequate fertility and soil organic matter, using amendments of plant, animal, or mineral origin; avoidance of excess fertility or salinity

   - proper seedbed and planting conditions, site selection

   - keep vigorous seedlings, rogue the rest; use certified, new seed

   - maintain water balance required by the crop

   - avoid root injury during tillage

   - maintain soil pH suitable for the crop

   - control competing weeds and injurious insects

6) Use composted bark to suppress soil-borne pathogens like Rhizoctonia, Pythium, Phytophthora, Fusarium, and Theilaviopsis. See Hoitink, Plant Dis. 65: 796-7, 64: 142-7..

7) Disease monitoring to find out what and how severe the problems are and may become.

12) Question: Do you have literature which you distribute especially for organic gardeners? If so, list reference and include one copy if possible. Otherwise, please annotate the list. Which literature would you not recommend?

The majority of respondents did not have literature especially designed for organic gardeners, using the same material for these and conventional growers alike. Much of the recommendations listed in question 11 are the same for both streams of agriculture and clients were presented with all the options and chose those which they were confortable with. The extension literature for many states/provinces details non-chemical methods (as well as chemical).

A partial list of information available is as follows:

Extension Publications

Anonymous. Undated. Organic Gardening. Atlantic Provinces Crop Protection and Vegetable Committees. Publ. #V24-75. Agdex 250. UPP. 1442. 8 pp. (Canadian).

Anonymous. 1983. Bug Off! How to Protect your Plants the Organic Way. Rodale Press Inc. Emmaus PA. 56 pp. (lots on insects, almost nothing on diseases).

Anonymous. 1984. Home vegetable gardening in Kentucky. Univ. of Kentucky Coop. Extn. Serv. 69 pp.

Anonymous. 1984. Publications List. Ecological Agric. Projects. Macdonald College, McGill Univ., Box 225, Ste.-Anne-de-Bellevue, Que. H9X 1C0. - includes 69 general references, practical leaflets, bibliographies, etc. on ecological agriculture.

Courtney, W.D. 1963. Control of nematodes affecting bulbs by hot water treatment. Wash. State Univ. Ag. Expt. Stn., Circular 422. 13 pp. (HW)

Dunn, R.A. 1980. Plant nematodes - what are they and what they do? How to minimize losses to nematodes in the vegetable garden, and soil organic matter, green manures, and cover crops for nematode management. Florida Coop. Ext. Service. Gainesville, FL. 32611. 3 pp. (Good non-chemical control options [NEMA]).

Dunn, R.A. 1983. Soil solarization: practical for nematode control in Florida? Florida Coop. Ext. Service NPPP-17. 2 pp.

Dutky, E., and J.G. Kantzes. 1982. Wilt diseases of tomato - home gardens. Univ. Maryland Coop. Extn. Serv. PPM 28. - includes good section on root-knot nematode.

Erhardt, W.H. and L.E. Littlefield. 1980. Natural gardening. Univ. of Maine-Orono Coop. Ext. Serv. Bull. 567. 28 pp.

Fletcher, R.F., Ferretti, P.A. Hepler, R.W., MacNab, A.A., and S.G. Gesell. 1972. Extension agents guide to organic gardening, culture, and soil management. Penn. State Univ. Coop Ext. Serv. 48 pp. (Terrific general reference for clinicians. Dr. A. MacNab may still have copies available.)

Gotlieb, A.R. 19__. Corn Smut. Univ. Vermont Ext. Service. GD 3, Burlington Vt. 1 p.
GD7. 2 pp.

Gotlieb, A.R. 19__. Potato scab. Univ. Vermont Ext. Serv., Burlington Vt.

Judkins, W.P. 1977. Organic Gardening - Think Mulch, pp. 78-83. In 1977 Year Book of Agric. USDA. Gardening for Food and Fun.

Kucharek, T. 1978. Control of *Pythium* root and stem rots on foliage plants. Florida Coop Ext. Serv. PPP 24. 5 pp. (Good cultural techniques summarized.)

Kucharek, T. 1984. Disease control program for watermelons. Florida Coop. Ext. Serv. PPP 15. Plant Pathol. Dept. Rm. 1415 HS/PP Bldg. 717. Univ. of Florida. Gainesville, Florida 32611.

La favore, M., Anderson, T., Cogsdon, G., Hill, L. et al. undated. An Organic Gardeners Guide to Weeding. Reprints from Organic Gardening Magazine, Rodale Press, Emmaus PA. 16 pp.

Lamey, H.A. and C.L. Ash. 1981. Homegarden disease control begins this fall. North. Dak. State Coop. Ext. Serv. Circular PP-737. 3 pp.

Liese, A. 19__. Powdery mildew (of cucurbits). Univ. Vermont Ext. Serv. Burlington, Vt. GD4. ibid. 2 p.

Lindgren, D.T., and D.H. Steineggor. 1981. Organic Gardening in the Backyard. Univ. of Nebraska Coop. Ext. Serv., Neb. Guide Publ. G81-548. 3 pp.

Linduska, J.J., Knight, S.L., Wood, F.E., Dutky, E.M., Kantzes, J.G. and S. Andrews. 1982. Control of Insects and Diseases in the Home Vegetable Garden. Univ. Maryland. Coop. Ext. Serv. Bull. 252. 29 pp. $1.00.

MacDaniels, L.H. 1975. Facts about organic gardening. Ext. Info. Bull. 36. N.Y. State Coop. Extension Service Public., Cornell Univ. Ithica, N.Y. 8 pp. .25 cents/copy.

MacDaniels, L.H. 1976. The Compost Pile. N.Y. State Coop. Ext. Serv. Bull. 96, 4 pp. .20 cents/copy.

MacHardy, W.E. Undated. Guideposts to Growing Healthy Plants. Coop. Ext. Serv. Bull., Univ. of New Hamp. 2 pp.

Miller, P.M. and J.F. Ahrens. 1969. Marigolds - a biological control of meadow nematodes in gardens. Corn. Ag. Expt. Stn. Bull. 701. 10 pp. (NEMA).

Mullen, J. 1982. Leaf and stem gall of azalea and camellia. Alabama Coop. Extn. Service Pest Management Series, PP-52. 1 p.

Naegele, E.C., Taylor, J.L. and J. Cloutier. 1977. Organic gardening. Mich. State Univ. Coop Extn. Serv. Extn. Bull. E-824. East Lansing, MI. 48824. 4 pp.

Overdahl, C.J. and W.P. Martin. 1972. Organic farming and gardening. Univ. Minn. Ag. Extn. Serv. Soils Factsheet #21. 2 p.

Overdahl, C.J., Turnquist, O.C., Miller, G.R. Pfleger, F.P., Ascerno, M.E. and V.S. Packard. 19__. Organic Gardening: An integrated approach. Univ. Minn. Ag. Extn. Serv. St. Paul, MN. 55108. 18 pp.

Philley, G.L. and H.W. Kaufman. 1982. Non-chemical Control of Plant Diseases in the Home Garden. Tex. Ag. Ext. Service Factsheet L-2016. Texas A & M Uniiv. College Stn. TX. 4 pp.

Philley, G.L. and H.W. Kaufman. 1982. Non-chemical control of plant diseases in the home garden. Texas A & M Univ. Coop. Ext. Serv. Publ. L-2016. 4 pp.

Sutton, J.C. 1974. Vegetable Seed Treatments. Ontario Ministry of Agric. and Food. Factsheet # 74-104. Agdex 250/23. 3 pp.

Taber, H.G., Davison, A.D., and H.S. Telford. 1974. Organic gardening. Wash. State Univ. Coop Extn. Serv. Publ. EB648. 16 pp.

Topoleski, L.D. 1981. Cited in question 8.

Utzinger, J.D., Otrierweiler, J., Janson, B., Miller, R.L., Saddam, A. and D.E. Crean. Undated. Organic Gardening. Purdue Univ. Coop Extension Service Bull. HO-70, West Lafayette, Ind.

Zimmer, R.C. 1984. Effect of date of seeding on the incidence of powdery mildew of field peas. Agric. Canada, Canadex Publ. 632.142.

Magazines commonly referred to were: Organic Gardening, Harrowsmith, New Farm. A few diagnosticians keep files of clippings from these magazines to use if necessary.

Some clinicians expressed frustration that there is "no trustworthy, organized source of organic pest control information available." Some refused to recommend such popular magazines as those listed above or Organic Plant Protection because much of the info contained therein is not proven by scientific research. Indeed, Stuart Hill said of the references disseminated by EAP that "some information in all the literature is of value, and all contains some unsubstantiated (but not necessarily incorrect) information."

Nevertheless, the question is raised about credibility and liability for recommendations. "Not necessarily incorrect" is not good enough for recommendations, unless such advice is specified as unproven and to be used on a trial basis only. Commercial agrichemical companies, including those which produce pesticides acceptable to organic gardeners, must at great cost assemble a data package for supervisory agencies to prove efficacy, establish toxicological and environmental effects, tolerance and residue levels in foods, etc. How then can the popular press especially for the purposes of making money, promote the use of unproven non-chemical methods and perhaps dangerous concoctions without due registration and testing procedures? Surely you may give an unproven recommendation, but you are liable for the results.

It is unfortunate that the popular literature is so fraught with heresay, testimonials, unreplicated, inconclusive testing, etc. It is about time that such recommendations are tested systematically to separate the fact from the folklore. Some books to avoid are as follows:

****Each book is fraught with fancy, intermingled with some facts.****

Gillespie, J. 1972. Peacock Manure and Marigolds. Ballantine Books. NY.

Hunter, B.T. 1971. Gardening without Poisons. 2nd edit. Houghton Mifflin, Boston, MA. 352 pp.

Kramer, J. 1972. The Natural Way to Pest-free Gardening. Scribner, NY. 118 pp.

Tyler, H. 1972. Organic Gardening without Poisons. Pocket Books, NY. 224 pp.

13) Question: What other resource people or institutions do you rely upon for answering organic inquiries?

Twenty-seven percent of clinicians had no resource people, and some expressed the desire to find some.

Resources mentioned were in order of frequency: University Faculty and Extension personnel (especially Horticulture Departments), Organic grower associations (Canadian Organic Growers, National Organic Farmers Association, etc.) or individual growers, Organic publishers (Harrowsmith {Camden House Publ. Co.}), Organic Gardening, New Farm, Biocycle, (Rodale Press)), Experimental Stations, local extension agents, Rodale Research Center, Arboreta (National Arboretum, Local Botanical Gardens), and Organic suppliers (e.g., North Country Organics, P.O. Box 107, Newbury, VT. 05051, Wholesdale distributor of 100% natural (biological) fertilizer and pesticides (<u>own description</u>).

<u>Organizations</u>:

Bio-Integral Resource Center publishes The IPM Practioner, New Address: 1307 Acton St. Berkeley, CA. 94706 (415 (524-8404). (<u>Good resource</u>.) The IPM Practitioner is a monthly publication which summarizes information on agricultural, forest and urban IPM. Current research, useful books, reviews of educational materials and promising programs, announcements of products and services, and a calendar appear in each issue. In addition, each issue contains a feature article addressing specific pest problems, or describing an useful technique.

An annual subscription to The IPM Practioner costs $15--low income; $25--regular, $50--institutions. If you pay with your order, you receive a 10% discount. For $1, a sample copy will be sent to you. Camden house Publishing Ltd. Camden East, Ontario, Canada. KOK 1JO. Harrowsmith magazine. 6 issues/yr., $15.00, each issue has articles relevant to organic gardening.

Canadian Organic Growers Association, (COG) 33 Karnwood Dr., Scarborough, Ont. M1L 2Z4. Have list of suppliers of organic fertilizers, pesticides, other amendments.

Hill, Stuart (Dr.), Ecological Agriculture Projects (EAP), Macdonald College, McGill Univ., Box 225, Ste. Anne-de-Bellevue, Quebec H9X 1C0. (publication list, 1984. prices given. Several mimeos on Natural control of garden pests; many other references, e.g. Ecological Pest Control; Confronting the Causes, Organic Gardening, Bibliographies on Ecological Pest Control, etc.)

IFOAM, c/o Research Institute of Biological Husbandry, Postfach, CH-4104, Oberwil, Switzerland. (Coordinates and networks developments in research, agricultural techniques, and education on organic farming worldwide.) Quarterly bulletin in English, French, or German. $4.00.

Indiana Organic Growers Assoc. c/o David Richards, Rt. #1, Box 349E, Nineveh, IN. 46164.

International Fed. of Organic Agricultural Movements (IFOAM), Executive Director, The Collidge Center, Topsfield, Massachusetts. publishes quarterly bulletin re developments in organic agriculture)

Institute for Alternative Agriculture, 9200 Edmonston Rd., Suite 117, Greenbelt MD 20070.

Maine Organic Farmers & Gardeners Association, P.O. Box 187, Hallowell, ME. 04347 (apparently this group has worked with State Departments of Agriculture to provide extension agents and assistance to organic farmers, for certification, and distribution. A monthly newsletter for $2.50/yr, U.S., ($3.00 outside US).

National Organic Farmers Association (NOFA) - no address available.

Natural Farmers' Federation of Ontario, R.R., Ethel, Ontario. NOG 1TO, Periodic newsletter, Directory of Organic Farmers and Products Sold, 4 or 5 annual meetings. $15/yr. membership

Regenerative Agriculture Assoc., 222 Main St., Emmaus, PA. 18649. $15/yr. membership includes 7 issues of New Farm magazine per year and various other services.

Tilth, Rt. 2, Box 190-A, Arlington, WA. 98223. Newsletter, $5/yr. Tilth, a non-profit agricultural association with over 1400 members and twelve local chapters in the Pacific Northwest, helps farmers by providing an organic certification process--the Tilth-Provender Certification Program--as well as publications promoting natural farming and permaculture.

The Tilth-Provender Certification Program lists standards for the traditional Organic grades of foods, including a transitional grade for newcomers. These standards either comply with or are stricter than existing state laws in California and Oregon. Approved materials are of a natural origin with a minimum of processing. Tilth has also added a new grade, called Integrated Pest Management (IPM). This is for the commercial-sized growers who have substantially reduced but not totally eliminated the use of synthetic pesticides and/or fertilizers. Traditional organic organizations have usually excluded these farmers, forcing them in some instances to return to totally conventional methods to survive. Tilth believes that these farmers deserve special recognition and encouragement rather than rejection.

The Tilth-Provender Certification Program is administered in Oregon by the Willamette Valley Chapter of the Tilth Association and in Washington by the Washington Producers' Cooperative. Write:

Tilth Association	Tilth Producers' Cooperative
Route 1, Box 308	P.O. Box 1005
Sheridan, OR 97378	Okanogan, WA 98840

Papers

Altier, M.A., D.K. Letourneau and J.R. Davis. 1983. Developing sustainable agroecosystems. BioScience 33: 45-49. (Condensed view of conventional vs. alternative strategies of managing agroecosystems. "The ecological and socio economic aspects of developing alternative, self-sustained, energy efficient, less resource-intensive agroecosystems are analyzed".)

Amonkar, S.V. and L. Vijayalakschmi. 1979. Control of anthracnose disease of grape vines by garlic oil. Trans. Br. Mycol. Soc. 73(2): 350-1. (_Sphaceloma_ _ampelinum_ de Barry.)

Anonymous. 1979. Eco-agriculture, past or future? _Agrologist_. 8(4), Fall, 1979. Special issue on ecological agriculture.

Azzouz, M.A. and L.B. Bullerman. 1982. Comparative antimycotic effects of selected herbs, spices, plant components and commercial anti-fungal agents. J. Food Prot. 45(14): 1298-1301. (Antifungal effects of 16 herbs and spices, other materials and commercial antifungal agents as food preservatives against _Penicillium_ and _Aspergillus_ spp.)

Beard, G.M. 1978. Organic and Conventional Wheat Production: Examination of Energy and Economics, _Agro Ecosystems_, 4: 367-376.

Beye, F. 1978. Insecticides from the vegetable kingdom. Plant. Res. Developm. 7: 13-31.

Carter, L.J., Organic Farming becomes "Legitimate", _Science_, 209: 254-256, 1980.

Dixit, R.B. and J.S. Gupta. 1980. Studies on the biological control of leaf blotch disease of barley by _Streptomyces_ _olivaceus_. Acta. Botanica Indica. 8: 190-2.

Fawcett, C.H., and D.M. Spencer. 1970. Plant chemotherapy with natural products. Ann. Rev. Phytopath. 8: 403-418.

Hamlen, R.A. 1980. Alternatives to the total chemical approach to greenhouse pest control. Foliage Digest 3(3): 7-9.

Hardison, J.R. 1976. Fire and flame for plant disease control. Am. Rev. Phytopath. 14: 355-379.

Heye, C.C. and J.H. Andrews. 1983. Antagonism of _Athelia_ _bombacina_ and _Chaetomium_ _globosum_ to the apple scab pathogen, _Venturia_ _inaequalis_. Phytopath. 73: 650-54. (Antagonists in leaf litter decreased ascospore production of apple scab fungus, other references on antagonists cited.)

Hill, S. 1983. Ecological pest control: Confronting the causes. In Proceedings Can. Pest Mgmt. Soc. 1983. or from Ecol. Agric. Projects, McGill Univ. 5 pp. 50 cents.

Homma, Y., Arimoto, Y. and T. Misato. 1981. Effect of sodium bicarbonate on each growth stage of Cucumber powdery mildew fungus (Sphaerotheca fuliginea) in its life cycle. J. Pestic. Sci. 6: 201-209.

Klepper, R., Lockeretz, W., Commoner, B. Gertler, M., Fast, S., O'Leary, D., and R. Blobaum. 1977. Economic performance and energy intensiveness on organic and conventional farms in the cornbelt: a preliminary comparison. Am. J. Ag. Econ. 59(1): 1-12.

Koehler, C.S., Barclay, L.W. and T.M. Kretchum. 1983. Pests in the Home Garden: Soaps as insecticides. Calif. Agric. 37: 11-13.

Koehler, C.S. and L.W. Barclay. 1983. Pests in the Home Garden: Snail barriers. Calif. Agric. 37: 15.

Kohler, C.S., Barclay, L.W., and T.M. Kretchum. 1983. Pests in the Home Garden: Companion plants. Calif. Agric. 37: 14-15.

Lockeretz, W., Shearer, G., Klepper, R., and S. Sweeney. 1978. Field crop production on organic farms in the Midwest. J. Soil Water Cons. 33(3): 130-134.

Lockeretz, W., Shearer, G., and Kohl, D.H., 1981. Organic farming in the Corn Belt. Science 211: 540-547.

Lockeretz, W., Shearer, G., Sweeney, S., Kuepper, G., Wanner, D., and Kohl, D.H., 1980. Maize yields and soil nutrient levels with and without pesticides and standard commercial fertilizers. Agron. Jour. 72: 65-72.

Lockeretz, W., and Wernick, S., 1980. Commercial organic farming in the Corn Belt in comparison to conventional practices. Rural Sociology 45: 708-722.

McKay, J.M. and P.T. Shipton. 1983. Heat treatment of seed tubers for other diseases. Plant Pathology 32: 385-93. (Powdery scab, Spongospora subterranea, and black scurf, Rhizoctonia solani). (HW)

Miller, P.M. and J.F. Ahreus. 1969. Marigolds in the garden. Hort. 47: 30-31.

Misra, S.B., and S.N. Dixit. 1979. Antifungal activity of leaf extracts of some higher plants. Acta Botanica Indica. 7: 147-150. (Water extracts of angiosperms. 14 species showed high fung. toxicity vs. loose smut of wheat, loose smut of barley [Ustilago tritici, U. hordei]).

Myers, D.F., Campbell, R.N. and A.S. Greathead. 1983. Thermal inactivation of Plasmodiophora brassicae Woron. and its attempted control by solarization in the Salivas Valley of California. Crop Protection 2(3): 325-333. (HW)

Pandey, D.K., H. Chandra and N.N. Tripathi: 1982. Volatile fungitoxic activity of some higher plants with special reference to that of Callistemon lanceolatus. D.C. Phytopath. Zeit. 105: 175-82. (Volatile fungitoxicity of leaves of 20 plant species was tested against Fusarium oxysporum f. sp. udum, with an essential oil of C. lanceolatus showing greatest activity. Work done at Natural Pesticides Laboratory, Botany Dept., Gorakhpur Univ., Gorakhpur, 273001, India.)

Risch, S.J. 1983. Intercropping as cultural pest control: prospects and limitations. Envir. Mgmt. 7: 9-14. (Entomologically oriented.)

Russell, P.E. and A.E.A. Mussa. 1977. The use of garlic extracts to control foot rot of bean caused by Fusarium solani f. sp. phaseoli. Ann. Appl. Biol. 86: 369 (garlic extract or garlic powder as seed trt. controls foot rot).

Shearer, G., Kohl, D.H., Wanner, D., Juepper, G., Sweeney, S., and Lockeretz, W., 1981. Crop production costs and returns on Midwestern organic farms: 1977 and 1978. Am. J. Ag. Econ. 63: 264-269.

Spencer, D.M. and P.T. Atkey. 1981. Parasitic effects of Verticillium lecanii on two rust fungi. Trans Br. Mycol. Soc. 77: 535-542. (Uromyces dianthi and Puccinia recondita).

Strobel, G.A. and G.N. Lanier. 1981. Dutch elm disease. Scientific American 245(2): 56-?

Reports

Aldrich, S.R. et al. 1980. Organic and conventional farming compared. Council for Agriculture, Science, and Technology, ISSN 0194-4088 (CAST). Report #84. Ames, Iowa. 32 pp. (The Title says it - good references.)

Armstrong, J.M., and H.J. Jensen. 1978. Indexed Bibliography of Nematode-Resistance in Plants. Orgeon State Univ. Ag. Expt. Stn. Bull. 639. Corvallis, OR. Western Regional Res. Project. W-134.

Assoc. of Applied Biologists. 1983. Tests of agrochemicals and cultivars, 4. Supplement to Ann. of Appl. Biol. 102. 144 pp. (Papers on such topics as: hot water treatment of tulip bulbs; resistance of wheat cvs. to Rhizoctonia cerealis; okra cv. resistance to Okra mosaic virus; tomato cv. resistance to alternia blight; raspberry cv. resistance to yellow rust (Phragmodium rubi-idaei).

Lockeretz, W., R. Klepper, B. Commoner, M. Gertler, S. Fast, and D. O'Leary. Organic and Conventional Farms in the Corn Belt: A comparison of economic performance and energy use for selected farms. Centre for the Biology of Natural Systems, Report No. CBNS-AE-7, Washington Univ., St. Louis, Mo., 1976.

Lockeretz, W., R. Klepper, B. Commoner, M. Gertler, S. Fast, D. O'Leary and R. Blobaum, A Comparison of Organic and Conventional Farms in the Corn Belt, Center for the Biology of Natural Systems, Report No. CBNS-AE-6, Washington Univ., St. Louis, Mo., 1975. (Many other related reports and papers are available from this source. Center for the Biology of Natural Systems, Washington University, Box 1126, St. Louis, Missouri 63130. List available upon request.)

Manuel, J.S., Bendixen, L.E., and R.M. Riedel. 1982. An Annotated Bibliography of Weeds as Reservoirs for Organisms Affecting Crops. 1a. Nematodes. Ohio State Univ. OARDC, Woodster, OH. Res. Bull 1146. 34 pp. pp. (NEMA)

Moore, W.S., Profita, J.C., and C.S. Koehler. 1979. An Evaluation of Soaps, Detergents, and Food-derived Sprays for Home Garden Insect Control. Univ. Calif. - Berkeley Coop Extn. Report. 26 pp.

U.S. Department of Agriculture. 1980. Report and Recommendations on Organic Farming, USDA Report #July 1980-0-310-944/96. (Excellent.)

Publishers and Magazines

Acres, USA, 10227 East 61st St., Raytown, MO. 64133. Monthly publication, $5.50/yr. (Covers research, news, politics, practical "how-to" articles, ads, midwest-based.)

Garden Way Publishing Co., Charlotte, VT. 05445. Catalogue of publications available.

Rodale Press, Inc. 33 East Minor St., Emmaus, PA 18049. Organic Gardening Magazine (caters to the home gardener), New Farm Magazine (caters to the organic farmer), Biocycle (non-refereed journal re: composting, recycling, etc.

Books

Boeringa, R. (ed.) 1980. Alternative Methods of Agriculture. Elsevier Scientific Publ. Co. N.Y. 199 pp. Overview of 8 different alternative agricultural systems and philosophies. Chapter on Diseases, Pests and Weeds.

Bruehl, R.M. (ed.) 1975. Biology and Control of Soil-borne Plant Pathogens. Amer. Phytopath. Soc. 216 pp.

Carr, A. 1983. Rodale's Color Handbook of Garden Insects. Rodale Press. 256 pp. 344 color photos, paperback $10.95 U.S.

Cook, R.J. and K.F. Baker. 1983. Nature and practice of biological control of plant pathogens. Amer. Phytopath. Soc., St. Paul, Minn, 450 pp.

Hayes, J. (ed.) 1977. Gardening for Food and Fun. USDA Yearbook of Agriculture. U.S. Gov't. Printing Office., Washington D.C. 20402, 392 pp.

Knorr, D. (ed.) 1982. Sustainable Food Systems. AVI Publ. Co., Westport, CT. 400 pp.

Koepf, Herbert, H., Petterson, B.D., and W. Schannan. 1976. Bio-Dynamic Agriculture: An Introduction. Anthroposophic Press, Spring Valley N.Y. 429 pp.

Oelhaf, R.C. 1978. Organic Agriculture: Economic and Ecological Comparisons with Conventional Methods. J. Wiley & sons, N.Y. 271 pp. (good background and comparative overview).

Philbrick, H. and J. Philbrick. 19__. The Bug Book. Garden Way Publ. Co., Charlotte, Vt.

Rice, Elroy, L. 1983. Pest Control with Nature's Chemicals. Univ. of Oaklahoma Press, Norman Oklahoma. 224 pp.

Shurtleff, M.C. 1962. How to Control Plant Diseases in Homes and Gardens. 1st Ed. Iowa State Univ. Press. Ames, IA. 520 pp.

Stonehouse, B. 1981. Biological Husbandry: A scientific approach to Organic Farming. Butterworths, Boston, Mass. 352 pp. (Chapters on Biological Pest Pontrol, The Place of Agric. Chem. in Biological Husbandry; Allelochemicals in a Future Agriculture; Organic Field Crop Production in Midwestern U.S.)

Yepsen, R.B. Jr. (ed.) 1984. The Encyclopedia of Natural Insect and Disease Control. Rodale Press. Emmaus PA. 464 pp. $21.95 U.S. (latest edition of Organic Plant Protection).

Magazine Articles

Airhart, D.L. 1983. About alternative sprays for home pest control? Bedding Plant News. XIV (7): 8-9. (Recipes for pesticides made from "non-commercial chemicals" or readily available materials, including disinfectants, asphyxiates, soaps, repellents, eradicants, and a disclaimer about efficacy, health precautions, etc.)

Bennett, J. and A. Forsyth. 1984. Horticultural hocus-pocus? Harrowsmith IX (1): 83-87. (discusses the issue of companion planting, cites research on this topic by Wukasch, U. of Guelph; U. Calif., Virg. State Univ. & others.)

Hiron, J.-C. 1981. Organic argriculture. The Furrow. Mar.-April: 2-4.

Kessler, K. 1983. Updating organic farming: new looks at old ways. The Furrow 88(3): 10-13. (Examples of commercial organic farmers in the U.S. and Canada.)

Lodgson, G. 1980. Crop Rotation: Key to a healthy garden. Organic Gardening Feb. 1980, 109-115.

13) Question: What other resource people or institutions do you rely upon for answering organic inquiries?

Twenty-seven percent of clinicians had no resource people, and some expressed the desire to find some.

Resources mentioned were in order of frequency: University Faculty and Extension personnel (especially Horticulture Departments); Organic grower associations (Canadian Organic Growers, National Organic Farmers Association, ec.) or individual growers; Organic publishers (Harrowsmith, Organic Gardening, New Farm (Rodale Press)); Experimental Stations, local experimental agents, Rodale Research Center, Arboreta (National Arboretum, Local Botanical Gardens), and organic suppliers (e.g., North Country Organics, P.O. Box 107, Newbury VT 05051, wholesale distributor of 100% natural (biological) fertilizers and pesticides (<u>own description</u>).

14) Question: Give examples of scientific research programs which you are aware of which are exploring organic methods of plant disease control:

There were several general research emphases cited, such as plant breeding for disease resistance, integrated pest management, biological control, and the influence of cultural practices or disease. There are very many research programs underway which are not mentioned below, but those which were cited by respondents were:

Name and Address	Research Projects
Prof. J.H. Borden Simon Fraser Univ., Burnaby, B.C., Canada Dr. H.F. Madsen Agr. Canada Res. Stn., Summerland, B.C. Canada	Major groups of scientists and grad students working on pheromone confusion and mass trapping of several spp. of tree fruit and forest Lepidoptera and Coleoptera.
J. Rahe Simon Fraser Univ.	Microbial antagonists for control of onion white rot, clubroot of crucifers, crown rot of apple
R. Utkhede Ag. Canada Summerland Res. Stn. Summerland, B.C.	Microbial antagonists for control of crown rot of apple, crown gall
R. Robinson Simon Fraser Univ.	Soil amendments for controlling apple scab
Prof. J.Wesbter, <u>et al</u>. Simon Fraser University	Use of microbial antagonists, nematodes
J. Rahe/J. Borden Simon Fraser University	Plant oils and microbial agents in soil for onion maggot management

M. Machaner _et al._ Simon Fraser University	Aphid parasites
B.C. Min. Environment	Herbivorous insects for aquatic weed control.
Judy Myers _et al._ Univ. of British Columbia	Herbivorous insects for range weed control.
H. Thistlewood Simon Fraser Univ. Peter Harris Agr. Canada, Regina, Saskatchewan, Canada	Herbivorous insects for control of an orchard weed.
Unidentified Ph.D. Student Washington St. Univ.	Examining biodynamic agriculture in Washington.
Safers-Soaps Victoria, B.C.	Use of fatty acids as fungicides, algicides, insecticides and as growth regulators.
David Finnamore New Brunswick Dept. of Agriculture P.O. Box 6000 Frederickton, N.B. E3B 5H1	Biocontrol of _Dasineura mali_ using _Platygaster marchali_ _Senecio jacobaea_ control with _Tyria jacobaeae_ (Tansy ragwort) _Cirsium arvense_ control with _Urophora cardui_
Andrew Currie (same address as above)	_Trialeurodes vaporarionum_ control with _Encarsia formosa_ (greenhouse whitefly) _Tetranychus urticae_ control with _Phytoseiulus persimilis_ (two-spotted spidermite)
Tim Tidwell State of California Dept. of Food & Agric. 1220 N. Street Sacramento, Calif. 95814	Soil solarization for weed control, erratic results for disease control
Dr. R. Rimmer Plant Sci. Dept. Univ. of Manitoba Winnipeg, Manitoba, Canada	Biocontrol of _Sclerotinia sclerotia_ with hyperparasitic fungi
Dr. Welch Zoology Dept. Univ. of Manitoba	Biocontrol of Elm Bark beetles using parasitic nematodes
Dr. Reeleder Plant Sci. Dept. McGill Univ. Ste. Anne de Bellevue, Quebec, Canada	Biological control of plant diseases

Abawi, G.C. Dept. of Plant Pathology NYS Agric. Exp. Station GENEVA, NY 14456	Soil-borne diseases of vegetable crops and biological control is part
Aldwinckle, H.S. GENEVA	Devel. resistant varieties of apples to apple scab, cedar apple rust, fire blight, powdery mildew and apple rootstock with resistance to Phytophthora root rot and fire blight
Burr, T.J. GENEVA	Agrobacterium radiobacter and grape crown gall is small part
Gonsalves, D. GENEVA	Cross-protection with plant viruses (Citrus tristeza virus, Tomato RSV, Papaya RSV)
Hoch, H.C. GENEVA	Biocontrol of soil-borne pathogens (Pythium ultimum) with mycoparasites and antagonists
Hunter, J.E. GENEVA	Breeding resistant vegetables
Martin, S.B. GENEVA	Biocontrol of Pythium root rot of table beet
Pearson, R.C. GENEVA	Biocontrol for grapes and small fruits
Provvidenti, R. GENEVA	Identifying sources of resistance in vegetables
Beer, S.V. Dept. of Plant Pathology Cornell University Ithaca, NY 14853	Biocontrol of fire blight with strains of bacteria
Brodie, B.B. ITHACA	Biocontrol of Golden Nematode on potato is part
Jones, E.D. ITHACA	Potato Seed Certification program
Wilkinson, R.E. ITHACA	Dry Bean resistance breeding
Kotcon, J. Dept. of Plant Pathology L.I. Hort. Res. Lab. R.D. 1, Riverhead, NY 11901	Potato nematode cultural control
Loria, R.L. LONG ISLAND	Potato scab management

B.N. Dhanvantari Ag. Can. Res. Stn. Harrow, Ont., Canada	Biocontrol of Crown gall of fruit trees
W.R. Jarvis Ag. Can. Res. Stn. Harrow, Ont. Canada	Biocontrol of vegetable diseases
L.L. Burpee Dept. of Env. Biology Univ. of Guelph Guelph, Ont., Canada	Biocontrol of snow molds of cereals
H.A. Hoitink Dept. Plant Path. OARDC Wooster, Ohio 43691	Several papers on use of composted bark media for controlling root rot diseases of ornamentals (See Plant Dis. 65: 796-7, 64: 142-147.)
U. Soehingen Alberta Hort. Res. Cen. Brooks	Companion planting vs insect pests
M. Steiner Alta. Env. Centre Vegreville	Biocontrol of greenhouse pests
J.J. Marois USDA-ARS	Biological control of *Verticillium*, especially using *Talaromyces flavus*.
I. Chet Dept. of Plant Path. & Micro., Hebrew Univ. of Jerusalem, Faculty of Agric., Rehovot, Israel	Biological control of *Rhizoctonia solani* with *Trichoderma harzianum*. See Plant Disease 65: 675-677.
Dutky, Ethel Univ. Maryland College Park, MD	Reports a M.Sc. student comparing oils, insecticidal soap, and several other "organic" pesticides in control of some pests on urban plants with traditional methods, presumably at U. MD., College Park

<u>Reports</u>

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Anonymous. 1983. Progress in Research. 1982. Agric. Canada Publ. 1630. Communications Branch, Agri. Can. Ottawa, Canada K1A 0C7. General overview of research programs of Agric. Canada, e.g., p. 64 - incorporation of lettuce crop residue reduces dramatically the incidence of Fusarium crown and root rot in greenhouse tomatoes. p. 48 - resistance breeding for Sclerotinia white mold, bean anthracnose in white beans.

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15) **Question: are you involved in efforts to decrease the polarization between organic and conventional agriculture in your area? If so, how?**

This question assumed a polarity between conventional and organic agriculture. Certainly, there are polemical positions taken by some in both camps. Perhaps these extreme positions are motivated by sales of pesticides and fertilizers, or by sales of organic amendments, magazines, and other literature. Perhaps some are motivated by ideology and lifestyle. In reality, there is a continium of opinion and practice between these camps. It is the perpetration of generalized misinformation about either camp that is addressed by this question.

The majority of clinicians felt that they were not directly involved in efforts to decrease the polarity between conventional and organic agriculture in their area. As extension agents, they felt called upon to give high quality, objective information based upon accurate diagnosis and research to all comers, regardless of their organic vs conventional position. The view of most diagnosticians was summed up by Alan MacNab, Penn. State as follows: "Basically, my philosophy is to respect the wishes of all clientele regarding their orientation to organic gardening. If they tell me what they do not want to consider, I will give them only information they will consider using. At the same time, if one asks for non-pesticide controls, and evidence indicates pesticides probably are essential, I will give them this information as well."

Organic farmers and gardeners are usually excellent growers, having much to offer by example in crop and animal husbandry, sanitation, and other cultural practices to reduce pest and disease problems. It would be an eye-opener for extension representatives and for conventional growers to visit and evaluate the organic farms in their area. Why not have an organic farmer give a talk at meetings, or an open-house, on tours which you arrange? If anything, it is those who are working hard to maintain a clean operation and to minimize the use of pesticides who should be encouraged. On the other hand, why not become familiar with and lend your expertise to organic groups.

Integrated pest management programs are doing much to bridge the conventional-organic gap. Ethel Dutky (Md.) reports involvement in an Urban IPM program while many others exist in vegetables, fruit, and field crops throughout the US and Canada. For example, in Ontario, Government-grower funded IPM programs exist in apples, onions, carrots, and are expanding to lettuce, celery, cole crops, stone fruits, and grapes. Which programs exist in your state, province, or region and could be utilized in your extension efforts? Both orientations of agricultural practice stand to benefit from such programs.

A major factor contributing to polarity is inadequate communication. Stuart Hill stressed the need to do more listening than talking, thus allowing clients to express their feelings as well as describing the crop-related problem. Indeed, the "medical model" (I am the doctor expert, you are the patient listener) is inappropriate in handling any inquiry. Today's practitioner must take the time to hear out the client, whatever their persuasion. However, be prepared to spend more time with organic growers, since they tend to be more interested in the total system and relevant background information than a quick what-is-it-how-do-I-kill-it? recommendation.

It is important for the advisor to help the client sort out what is fact vs fancy, and to encourage gardeners to try non-chemical alternatives on a limited scale, leaving a control area for comparative purposes. It is important for those who know the value of replicated research to convey the necessity of objective evaluation of testimonial claims.

Speaking of polarities, the question was raised as to why Rodale Press and other organic groups have not funded state or provincial research programs at experimental stations or universities, but instead have created their own separate institution for research? Does not this increase the polarity, instead of promoting cooperative effort?

16) Question: Choose three diseases: one foliar, one vascular, and root rot, on any crop for which you can recommend a control program <u>entirely</u> based on "organic" methods, and give details.

Many different programs were offered which could successfully prevent or control disease without pesticides. A few control programs mentioned were integrated programs, involving non-chemical and pesticide alternatives to the client. The following are summaries of those diseases cited:

<u>Foliar disease</u>

crop	disease	control recommendations
wheat or barley	scab	- avoid planting wheat or barley into corn or sorghum stubble fields - deep plow corn or sorghum fields to reduce inoculum after summer fallow <u>or</u> plant non-cereal crop into reduced tillage corn and sorghum fields - do not irrigate wheat or barley during or just prior to flowering - no resistant varieties available
tomato	Septoria	- Resistant varieties (Cynthia Ash, N. Dak., has done some research on this topic). - plow under or remove crop residue - 3-5 year rotation excluding Solanaceous crops - no overhead irrigation - well drained soil, mulch heavily after soil warms - good air circulation, adequate plant spacing, stake or cage the plants - weed control - fertilization and watering for vigorous growth, especially in mid-summer
horse chestnut	<u>Guignardia aesculi</u> leaf blotch	- rake and destroy/discard/compost at adequate temperature all fallen leaves in autumn - fertilize with mature compost broadcast under tree. Excessive nitrogen in compost will prevent adequate hardening off; therefore, rake such compost off by mid summer. - water thoroughly to depth of 6" (15 cm) every 2 wks. during extended drought or when less than 1 inch of rain falls in 2 weeks. - education that low level of disease will not adversely affect tree health, only its appearance

turf	dollar spot	- resistant cultivars - adequate fertility, especially nitrogen - water infrequently but deeply when drying conditions are best - syringe the turf in the morning to minimize extent and duration of dew - remove and dispose of infected grass clippings - dethatching as necessary
Juniper, apple	cedar-apple rust	- remove alternate host or widely separate
cantelope	powdery mildew and downy mildew	- resistant varieties
azalea	leaf and stem gall (Exobasidium)	- remove young galls in spring before sporulation occurs
cabbage	black rot	- use only seed certified free of b.r. bacteria or hot-water treated. - no overhead irrigation - no cruciferous weeds within and around the field
bean	bean yellow mosaic virus	- avoid planting beans near white or red clover or other legumes - plant resistant varieties - destroy leguminous weeds in and near garden - grow successive crops of beans, not staggered - aluminum foil or aluminum-coated mulches help prevent aphid transmission of the virus.

<u>Vascular disease</u>

tomato	Fusarium or Verticillum wilt	- prevent introduction in infected plants and soil - use VF (N) resistant varieties - crop rotation, at least 4 yrs. avoiding susceptible crops such as potato, eggplant, peppers, strawberries, etc. - dig out and remove infected plants - fertilize and water to encourage vigorous growth

ref. Dutky and Kantzes

Chyrsanthemum	Fusarium wilt	- plant only disease-free stock - sterilize potting media, pots, and benches - practise rigorous sanitation - keep water hose nozzles off the ground - use resistant varieties - workers must change shoes upon entering and leaving to keep extraneous soil out - wash hands and other implements
tomato	Southern bacterial wilt	- use only healthy transplants, resistant tomato varieties Venus, Saturn
	<u>Pseudomonas solanaceanum</u>	- avoid dispensing the bacteria on equipment and in drainage water - maintain optimum water balance and avoid root injury from cultivation, etc. - crop rotation out of tomato, potato, eggplant, pepper, geranium, marigold, zinnia, petunia, and nasturtium for 4-5 yr.
watermelon	Fusarium wilt	- resistant varieties - reputable seed source - rotation out of melons for 2-3 yr.
in general	any	- remove and destroy infected plant material - rotate to non-susceptible crop - improve soil conditions which would intensify the disease

<u>Root Rot</u>

Green beans peas	Fusarium and other root rots	- use resistant varieties - delay planting until soil warmed to > $65^{o}F$ - plant in ridges to keep soil warmer and drier - crop rotation, 2-3 years - hill up infected beans with soil to promote secondary root growth above the lesions
Crucifers	club root	- soil pH raised to >7.2 with hydrated lime, about 6 wks before planting - avoid or drain wet soil - practise long rotation, excluding crucifers and related weeds - use resistant varieties

Many crops	Complex of Pythium Rhizoctonia Fusarium	- plant disease-free seed or healthy transplants - use sterilized soil - adequate plant spacing so soil will dry out better, good ventilation in greenhouse - disperse plants of same species to variety of locations within garden to reduce chances of complete loss - crop rotation, expecially with non-susceptible grass or grain crops - plant seed at correct depth - adjust soil mosture to optimum levels using organic amendments - increase soil OM to improve the competition for root rot organisms in the field - control weeds
alfalfa	phytophthora root rot	- resistant varieties
many crops	southern stem-blight (<u>Sclerotium rolfsii</u>	- rotate crops - turn under old plant residue early to promote decomposition

17) Question: For those of you in integrated clinics, if time permits: Are there sources as in Question 12 and 14 which you are aware of for insect and weed management using organic or non-chemical methods?

Time did not permit; no significant responses.

18) Question: What pesticides, especially fungicides are you aware of which organic gardeners will accept or use?

The level of acceptance of pesticides varies greatly with organic gardeners. Some are purists, abstaining from <u>all</u> pesticides. To them, it is wise to suggest planting extra of the crops to compensate for losses from pests. Others will use "organic" pesticides on an emergency basis. Others have become "nozzle heads", just like some conventional agriculturists, assuming that the magical cure is "organic" rather than synthetic pesticides. Though hypersensitized to the dangers of "synthetic poisons," they fail to realize the potential toxicity of the acceptable "organic" pesticides. How many are aware of the low acute oral LD_{50} to rats of rotenone or nicotine, or the lung problems from diatomaceous earth, or the allergenic properties of ground-up plants and insects, etc. We should be advising all of the same precautions with organic as well as conventional uses of pesticides. Below is a compiled list of products which may be acceptable to organic gardeners.

Fungicides

sulfur (flowers of, elemental, wettable, flowable) e.g., That or Thiolux;
copper ($CuSO_4$, $Cu(OH)_2$) e.g., Kocide;
Bordeaux (various ratios of copper sulfate, hydrated spray lime, and water) e.g., usually a home brew, am not aware of commercial manufacture;
lime sulfur, many different sources;
horsetail tea - Equisetum infusion - a "home remedy";
insecticidal soap - see Foliage Digest, 1983, can't recall reference;
Galltrol - Agrobacterium radiobacter strain 84

Insecticides/Acaricides: sulfur - elemental - acaricidal

diatomaceous earth;
boric (boracic) acid, borax;
nicotine sulfate (or tobacco infusion);
rotenone;
Ryania;
sabadilla;
pyrethrum Chrysanthenum cinerariifolium;
neem seed extract (Azidirachta indica);
oils (dormant, superior) - Dr. Warren Johnson, Cornell is an authority on these;
fish oils;

Soaps e.g. Ivory liquid (see Profita, et al. 1979);
insecticidal soaps e.g., Safer's;

garlic extract;

Bacillus thuringiensis - several strains vs black flies and mosquitoes, Lepidopterans, Colorado potato beetle, e.g., Dipel, Thuricide, Bactimos, Vectobak, Teknar.
Hirsutella thompsoniella - Mycar - acaricide.
Verticillium lecanii - Vertalec - myco-insecticide, specific to Homopterans (aphids, mealybugs, scales, whiteflies, etc.).
Bacillus popilliae - Milky spore disease vs some Scarabidae larvae such as June beetles, chateus.
Nosema locustae - Protozoan disease of grasshoppers e.g., Grasshopper Spore

water - high pressure water sprays to wash off aphids, mites, etc.;

bug juice, and lots of other interesting and incredible concoctions.

Herbicides

herbicidal oils;
salt (unfortunately ruins soil structure and promotes soil compaction problems);
boiling water or salt - between bricks, patio stones, or pavement;
soil solarization, using clear, or black plastic. Though not herbicidal in and of itself, when used to cover weeds, the increased temperature underneath kills weed growth;
Devine - a myco-herbicide pathogenic to milkweed (used in Florida).

Rodale Press has an good compilation of these and other products, containing manufacturers and suppliers list, a reprint of 1982 Suppliers of Beneficial Organisms in North America, Larry G. Bezark, Eric J. Rey, Calif. Dept. of Food and Agric., Biological Control Services Program, 3288 Meadowview Rd., Sacramento, CA 95832., and pest control materials which one can grow or make at home (bug juice, pyrethrum daisies, etc.). See Riggle, D., and K. Foreman. Undated. Resources for Organic Pest Control. Rodale Press Inc., Emmaus, PA. 8 pp.

19) Question: Other suggestions and comments

Some respondents found the questions to be too general, and offered suggestions on how to ensure getting more useable responses. Others did not have enough time to fully answer the questions. Admittedly, the questionnaire was long and broad, as is the topic under consideration. I appreciate the time and effort which all of those responding gave. Your ideas were very helpful and when put together, presented an introductory, but diverse overview, with a wealth of sources for more information for those who want to delve deeper.

Some diagnosticians welcomed this topic, hoping to gain more substantiated information upon which to base recommendations. They felt that it was in our best interest to encourage those who want to use less or no pesticides. As clinicians giving recommendations, the majority felt strongly that we should stress all of the non-chemical, cultural controls as are feasible, offering pesticides as part of the package, respecting the client's wishes regarding their use or disuse. Regardless of the fact that organic gardeners (as well as conventional gardeners) vary from unthinking zealots to intelligent, responsible people, our approach will be sensitive and professional.

Some respondents were convinced that present organic methods were not reasonable for large-scale agriculture, but were more useful in small farms or hobby gardens. While this may apply in some crops, in some areas and crops, totally organic farms of large scale are successful (e.g., organic fruit production in Okanogan Valley, B.C., or field crop production in the Midwest). The point was made that re-organizing our society into an agrarian high labor mode (as in China), with localized production and if the cosmetic standards were relaxed in the market place, then organic agriculture would become a more acceptable option. To some extent, this is occurring as people grow their own food (see U.S.D.A. Yearbook of Agriculture, 1977).

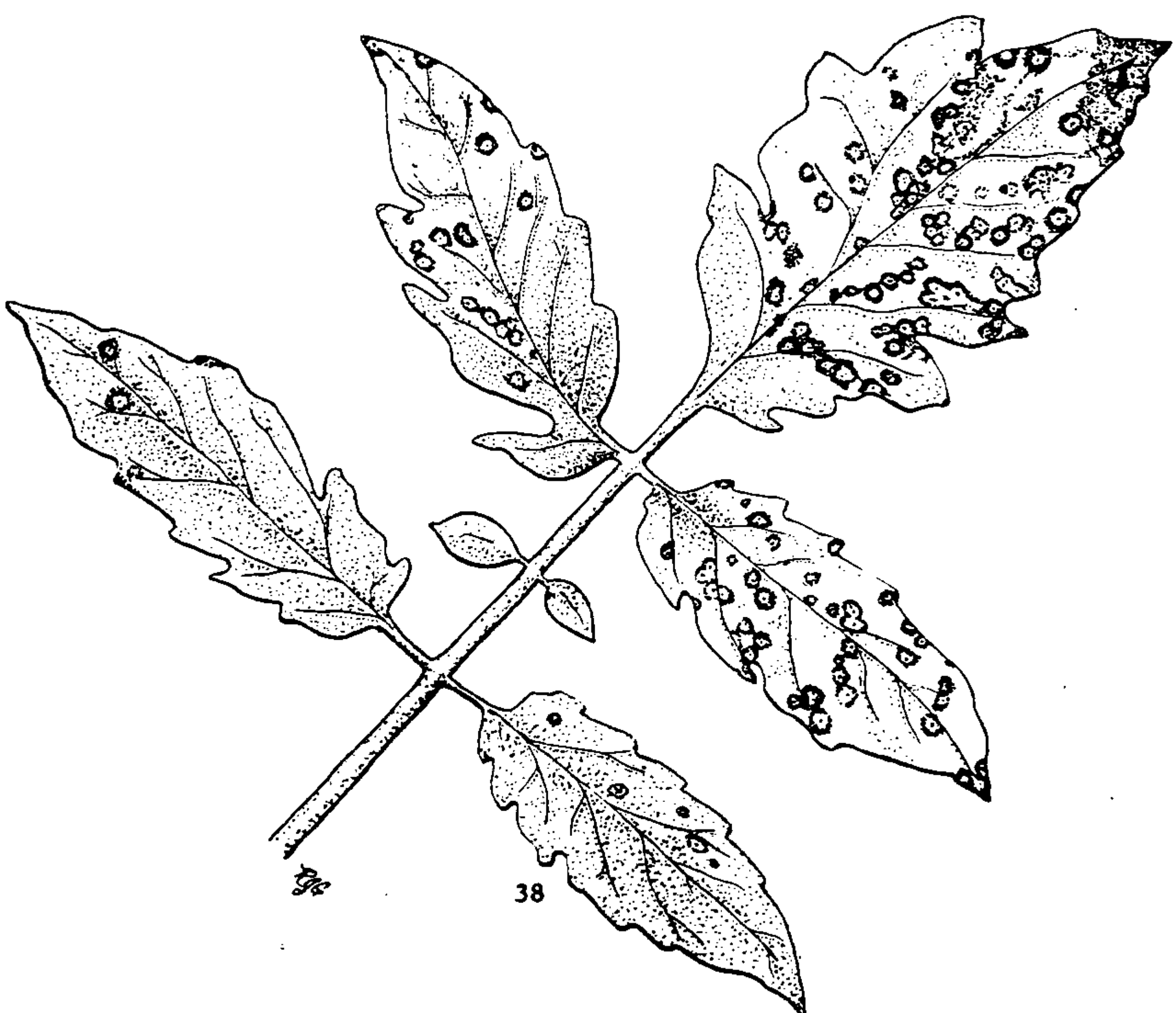
Another fundamental issue was raised regarding the practice of recommending "band-aids" to solving agricultural problems of more far reaching import. Dr. Stuart Hill addresses this problem (Hill, 1983) contending that we are treating the symptoms with the one "magical bullet" rather than making many small changes which buffer the ecosystem from catastrophic pest attacks. The point is, that our advice to clients must be of a more holistic nature than simply resorting to a one-shot pesticide spray.

One frustration in this topic has been to compile in an orderly manner the abundant, but scattered and often unavailable documentation on the subject of non-chemical controls for plant diseases. Dr. John Hartman (U. Kentucky, Lexington) reported that an APS committee has recently completed a report determining the feasibility of publishing reports on non-chemical (cultural, genetic, biological) control of plant disease. The format would be similar to the current APS Fungicide Nematicide Tests. This is a terrific idea and would be of great benefit to those of us making recommendations. Has anyone heard of a decision made re this report?

In conclusion, there are many crop-disease situations which lend themselves to non-chemical control measures. A wide variety of these measures were cited previously and can be factored into the design of a cropping system to minimize or eliminate the need for chemical controls. I personally hope that the PDQ newsletter would also serve as a forum for sharing such ideas and resource material in this area as they arise in the future.

Sometimes the recommendation to "live with it" is far more economical, makes good sense (environmentally speaking), and injects perspective into the view of a client whose perceived aesthetic or economic threshold for disease may be over-reactionary.

However, as those being held liable for recommendations, considering what may be at stake in a farm enterprise, and in efforts to present all possible control options, we should include pesticides when deemed necessary. Our expertise in alternatives to pesticides may be well utilized in a discussion with the client about how to prevent the problem next time.



UNIVERSITY OF KENTUCKY FIELD REPORTS

Plant Disease Clinic records, in the form of annual reports, are frequently consulted to determine what the major problems have been. However, Clinic records often present a biased picture of the statewide disease problems. Diseases that are easily identified may be diagnosed at the county level, so samples are never submitted to the lab. Should these "easily diagnosed" diseases become severe or widespread, the low number of samples received by the Clinic may not reflect the actual seriousness of the problem. On the other hand, a large number of the more difficult to diagnose problems may be submitted to the lab, while the disease actually remains a minor problem.

In 1983, we decided to supplement our clinic records by also keeping track of on-site observations made during field visits, IPM and county agent training sessions, and field days. Informtion may also be received via the phone from county agents. These observations are recorded onto data sheets (Figure 1) by an extension specialist.

Periodically, the data is entered into a computer database, FIELDS. The CONDOR Database Management System (CONDOR Series 20-2 DBMS, (c) Condor Computer Corp., P. O. Box 8318, Ann Arbor, Michigan 48107) was used to set up the FIELDS database on our HP-125 microcomputer. The FIELDS database is a variation of our clinic database (LEXLOG), also reported in PDQ. The computer "form" and a sample of a completed record are shown in Figure 2. Explanations of the data items are found in Figures 3 and 4, respectively.

The data items DISTRIB (distribution) and COND (conditions favoring disease) are converted from frequently lengthy explanations on the data sheets to briefer "standard" terms when entered into the computer. For example, the specialist reporting record no. 11 (shown in Figure 2B) entered "entire field" for distribution; this was shortened to "entire". In addition, "cool to cold damp weather" was filled in as the conditions favoring disease, but was shortened to "cool, wet" when entered into FIELDS. In using the list of standard terms (new terms are added as needed) care is taken to select words which will not alter the meaning of the information originally entered by the specialist.

FIELDS can be sorted and summarized in a variety of ways using the CONDOR program. At this point, we do not have any plans for incorporating FIELDS information into our clinic annual report, but merely plan to use it as supplemental information. We hope that together, FIELDS and LEXLOG, will provide a clearer picture of the actual disease situation in Kentucky.

Cheryl A. Kaiser
Plant Disease Diagnostician

FIELD OBSERVATIONS

Crop/Var. ______________________________ Date ________ Reporter ________

County/Farm ______________________________ Planting size ________ %Infection ____

Diagnosis/CA ____

Distribution ____

Prev. crop ____________________ Drainage ____________ Planting date ______

Chemicals & Fertilizers ______________________________________

Conditions favoring disease ____________________________________

______________________________ Info source (circle): phone/visit/other

Comments ____

____

Figure 1, Field observations "raw data" entry form. Three copies of the form fit on an 8½ x 11 sheet of paper.

B

1983 FIELD REPORTS (LEXINGTON)

NO : 11 CROP :WHEAT VAR :MCNAIR1003 DATE :04/20/83

REPORTER :RES COUNTY :WARR GROWER :UNK PLTSIZE :95A

GC :C GRP :AG-SG %INFECT :10 DIAG :POWDERY.MILDEW CA :ERYSIPHE

DISTRIB :ENTIRE PREVCROP :UNK PLTDATE :10/25/83

CHEM :USUAL FERT :USUAL COND :COOL,WET

****

A

1983 FIELD REPORTS (LEXINGTON)

[NO]:____ [CROP]:________________ [VAR]:__________ [DATE]:________

[REPORTER]:___ [COUNTY]:____ [GROWER]:__________ [PLTSIZE]:______

[GC]:_ [GRP]:_____ [%INFECT]:___ [DIAG]:_______________ [CA]:___________

[DISTRIB]:__________ [PREVCROP]:__________ [PLTDATE]:________

[CHEM]:_______________ [FERT]:__________ [COND]:______________

****

Figure 2. Field observations computer database (A) screen form prior to data entry and (B) sample entry.

Data field	Explanation
NO	Number
CROP	Common name of the crop
VAR	Variety
DATE	Date of observation
REPORTER	Initials of the specialist reporting the information
COUNTY	County abbreviation
GROWER	Grower name or other information pertaining to location
PLTSIZE	Size of planting
GC	Grower code (Figure 4)
GRP	Commodity group (Figure 4)
%INFECT	Percent infection
DIAG	Diagnosis
CA	Causal agent
DISTRIB	Distribution (using standard key terms)
PREVCROP	Previous crop
PLTDATE	Planting date (or year only)
CHEM	Chemicals used
FERT	Fertilizer used
COND	Conditions favoring disease (using standard key terms)

Figure 3. Data fields and their explanations.

FIELDS COMPUTER CODES

COMMODITY CODES (GRP)

Agronomic	AG-	Identifications	ID-
corn	-C	fungal	-F
forages	-F	plant	-P
small grains	-SG	Miscellaneous	MISC
soybeans	-S	Ornamentals	OR-
tobacco	-T	herbaceous	-H
Fruit	FR-	houseplants	-HS
small fruits	-S	turf	-T
tree fruits	-T	woody	-W
Herbs	HB	Vegetables	-VG

GROWER CODES (GC)

Commercial	C	Institution	I
Homeowner	H	Researcher	R

COUNTY CODES

Uses the first 4letters of the county name; exceptions:

Greenup	GREP	Out of State	OS + abbrev.
Lee	LEE	Indiana	OSIN
McCreary	MCCY	Ohio	OSOH etc

Figure 4. Computer codes used in the FIELDS database.

FACT SHEETS FROM THE UNIVERSITY OF KENTUCKY

The following is a list of fact sheets that deal specifically with biotic and/or abiotic plant problems (or which contain some plant disease information). Information sheets dealing with collecting and handling disease specimens are also included in the list. These publications have been written by members of the Departments of Plant Pathology (PPA), Horticulture (HO), and Agronomy (AGR). Inter-departmental (ID) publications represent a cooperative effort of two or more departments. To obtain a copy, write to the College of Agriculture Bulletin Room, University of Kentucky, Lexington, KY 40546.

GENERAL

Collecting plant specimens for disease diagnosis PPA-9
Root knot nematode PPA-20

AGRONOMIC

General

Plant disease control guide for field crops PPA-10

Grain and Forage Crops

Fungicide seed treatment for grain diseases PPA-6
Preventing storage rots of grain ID-3

Soybeans

Soybean cyst nematode PPA-3
Taking soil samples for SCN analysis PPA-12

Tobacco

Black root rot AGR-35
Chemical control for tobacco field diseases PPA-21
Chemical control for tobacco bed diseases PPA-8
Manganese toxicity AGR-22

FRUIT

Commercial fruit spray schedule ID-37
Disease and insect control for home fruit ID-21

ORNAMENTALS

Houseplants

Houseplant problems and care HO-44

Turfgrass

Chemical control of turfgrass diseases PPA-1

Woody ornamentals

Anthracnose disease of shade trees PPA-17
Important pine diseases PPA-16
Pruning landscape shrubs HO-59
Roses and their care HO-53
Verticillium wilt of woody ornamentals PPA-18
Warning: Topping is hazardous to your tree's health ID-55
What's wrong with my taxus? ID-52

VEGETABLES

Bacterial spot of pepper and tomato PPA-15
Bean diseases PPA-15
Blackleg disease of potatoes PPA-14
Tomato wilt problems PPA-19

THE COMPUTERIZATION OF KENTUCKY PLANT DISEASE CLINIC RECORDS

-A Progress Report-

Cheryl A. Kaiser and Paul R. Bachi

The 1983 growing season marked the beginning of the "computer era" for the two University-run Plant Disease Diagnostic Labs in Kentucky. Specimen log-in and log-out procedures, once accomplished by entering information long-hand into a log-book, are now computerized. While information entry now takes as much time, and frequently more than the "long-hand" method, the real benefits are in information retrieval. Searching for specific records or summarizing data used to be tedious and time-consuming. Now, through the use of a computer, these tasks have been speeded up tremendously.

The database programs (software) and equipment (hardware) used at the two Labs are very different. The Lexington Lab in central Kentucky makes use of a microcomputer and a "canned" program purchased on a 5 1/4" flexible disc. On the other hand, the Princeton Lab at the western Kentucky Research and Education Center uses a minicomputer and the IMAGE/3000 Database Management System accessed by QUERY/3000. Despite their differences, the systems serve the same function with essentially the same capabilities. A remote computer line, along with some special programs, enables the transfer of records from one lab to the other, a distance of approximately 200 miles. We are inclined to feel that our system is unusual, if not unique, for plant disease diagnostic labs. For this reason, we are providing an overview of the two computer systems (see Figure 3).

LEXINGTON COMPUTER SYSTEM

Why a microcomputer?

A significant obstacle to using the on-campus Hewlett-Packard-3000 (HP-3000) minicomputer (located at the College of Agriculture Data Center) was the lack of the availability of a direct computer line from the lab. A telephone hook-up would not be practical since inquiries regarding the status of samples also come via the phone. Even if a separate phone line could be obtained, access to the records would still be subject to computer availability. A microcomputer can be quickly and frequently accessed without these problems.

With the opening of the Princeton Diagnostic Lab in the spring of 1983, we felt communication between the labs was vital to their success. We believed it was important to be able to view each others records, so the "right hand" would know what the "left" was doing. A minicomputer is also located at Princeton and a remote line from the Lexington HP-3000 to the Princeton HP-3000 already provided a potential means of sharing data between the two labs. This meant our microcomputer in Lexington must also be capable of performing as a terminal. In addition, a program that would allow us to transfer information from the microcomputer to the minicomputer (and vice versa) was also required.

The HP-125 system processor with dual disc drive was the solution for us. As a microcomputer it is self-contained and, therefore, can be easily and quickly accessed without the use of phone lines. This model can also be used as a terminal to access the HP-3000. In addition, a Hewlett-Packard program (LINK/125) provides the necessary communications interface between the HP-3000 and the HP-125.

The dual disc drive (HP model #9135A) contains a 4.6 megabyte fixed disc, as well as a 5 1/4" flexible disc drive. The fixed disc serves as our primary disc for record storage and flexible discs serve as back-ups. The fixed disc is always enclosed, providing some protection from the "dirty" environment common to all diagnostic labs. Several software programs were purchased on 5 1/4" flexible discs, including a database management program (CONDOR), a word processing program (WORD), and the data transfer progam (LINK). A dot matrix serial printer (HP #82905B) is used to make hard copies.

The LEXLOG Database

CONDOR (CONDOR Series 20-2 DBMS, (c) Condor Computer Corp., P. O. Box 8318, Ann Arbor, Michigan 48107) is the database management system (DBMS) being used to store records for the Diagnostic Lab at Lexington. Using CONDOR, the LEXLOG database was set up.

During data entry, one screen form (Figure 1A) at a time appears on the CRT screen. Information is entered data item by data item across the form. The "tab" and "return" keys allow the user to proceed to subsequent data items. Each data item has space for a predetermined number of characters, as represented by the underscores (__) in the figures. A total of 42 commands are available with this particular version of CONDOR. Function keys (soft keys) are a nice feature of this program. Certain operations can be accomplished quite easily by pressing a single key.

The data items are explained below (see Figure 1B for an example of a LEXLOG record):

Data Item	Explanation
NO	Sample (record) number
GROWER	Grower's last name
CROP	Common name of crop
DATE	Date sample was received
VAR	Variety
GRP	Commodity group (Figure 2C)
GC	Grower code (Figure 2D)
PREV.CROP	Previous crop
COUNTY	County (Figure 2E)
REFER	Dept.where sample referred (Figure 2F)
TEST	Special test required (Figure 2B)
CD	Entering an X indicates a quick response postcard was sent to agent
PD	Entering an X indicates payment received for SCN analysis
DIAGBY	Initials of the diagnostician/specialist
CONSULT	Initials of the consultant
DIAG.1	Primary diagnosis using common English terms
CA.1	Primary causal agent
CACODE.1	Primary causal agent code (Figure 2A)
DIAG.2	Secondary diagnosis
CA.2	Secondary causal agent
CACODE.2	Secondary causal agent code (Figure 2A)
OUT	Date the problem was diagnosed
NOTES	Miscellaneous information

Lists and Summaries

Information contained in any CONDOR database can be listed or totalled using a series of simple commmands. The computer establishes the report format. At the end of each day and again at the end of the week, the samples logged-in and/or logged-out for that period are listed by number and printed (Figure 4). A weekly tabulated summary provides information that forms the basis for "Plant Disease Clinic - Highlights" articles that appear in the Pest News Alert newsletter.

PRINCETON COMPUTER SYSTEM

The obstacles involving the use of the on-campus minicomputer (HP-3000) did not exist at Princeton, as they did at Lexington. All terminals at Princeton are direct-wired to the Princeton HP-3000, eliminating the need for any phone connection. In addition, computer availability is generally not a problem for Princeton users. The necessary software (IMAGE/3000) and QUERY/3000, (c) Hewlett-Packard, 19447 Pruneridge Ave., Cupertino, CA 95014) was already available at Princeton, as well.

The PLDIS Database

The PLDIS (for Plant Disease) database was established using the IMAGE/3000 database management system. PLDIS was setup for storage of Diagnostic Lab records at Princeton using data items identical to those of LEXLOG, with the addition of the data item LAB (a "P" is entered to the Princeton records as they are logged-in). During the transfer of records from Lexington to the Princeton database, LAB=L is added to the end of each record by the transfer program. This gives each record a marker that can be used to distinguish one lab's records from the other's.

PLDIS is accessed through QUERY/3000 (a set of IMAGE/3000 commands packaged for ease of operation). Records are displayed with data items listed as shown in Figure 1C. Records are added data item by data item down the screen. Thus, the data item name (eg. CROP) is computer-generated (following a carriage return) and serves as a prompt for data entry. Entries which are too long are truncated by the computer. For example, even though the CA.1 is entered as "Phytophthora", only the first 10 characters are actually stored ("Phytophtho") due to user-determined space restrictions.

Lists and Summaries

QUERY report procedures are more complex than those of CONDOR. Report headings, group titles, sort items (etc.) and their spacings must all be specified for each report. While this is more complicated, QUERY does allow for a much greater lattitude in report formatting than does CONDOR. QUERY users can tailor each report to meet their specifications. Lists such as those in Figures 4 and 5 can be generated, as well as any number of other formatting possibilities. For frequently used report formats, the necessary QUERY commands can be stored in a file and executed in one step (XEQ FILENAME) greatly simplifying the operation.

INTER-CLINIC COMMUNICATION

LINK (LINK/125), (c) Hewlett Packard Co.) is "a communications program which provides data transfer capability between the HP-125 and the HP-3000". This aids in providing the vital "link" between the two Clinics. Using LINK, a selected set of records can be transferred from the HP-125 to a file on the

Lexington HP-3000. This file is then transferred across the state to the Princeton HP-3000 by running a PRINCETONUPDATE program. A DBADD program transfers the records into the PLDIS database. It is during this latter process that the data item LAB=L is added to each record as it is transferred into the Princeton database.

LEXLOG records are transferred to PLDIS on a regular basis. Some records may actually be transferred as many as three times: once when initially logged-in, again when (eg.) a test is coded in and again once the diagnosis has been made. Records of samples not yet diagnosed are marked in LEXLOG in such a way that they can be easily retrieved and deleted in PLDIS once the finalized record has been transferred.

Lexington can directly examine Princeton records on the IMAGE PLDIS database. This is accomplished by logging on to the local HP-3000 and using a remote access line that connects long distance to the Princeton HP-3000.

ANNUAL REPORTS

Tabulated summaries (Figure 5) can be edited on the HP-125 by transferring them into a word processing program (WORD/125, (c) Lexisoft, Inc.). Figure 5 was edited with WORD and the resulting text is shown in Figure 6. Rough listings can be cleaned-up by editing them into a format suitable for reports (such as an annual report).

By the end of the year, PLDIS contains all the Lexington as well as Princeton records. Once the entire database is sorted and tabulated using QUERY commands, the summary can be transferred to Lexington and onto the HP-125. At that point we are able to edit the summary into a form similar to Figure 6. The resulting print-out can be photocopied and distributed as our annual report.

The authors thank John H. Byars for preparing the transfer programs and Freddie A. Higgins for setting up and continually assisting with the Princeton database.

Cheryl Kaiser and Paul Bachi are Plant Disease Diagnosticians with the Department of Plant Pathology at the University of Kentucky. Cheryl is located at the Lexington branch of the Plant Diagnostic Lab, while Paul works at the Princeton branch.

1A

1983 LEXINGTON LOGBOOK (LEXLOG)

```
[NO]:____  [GROWER]:__________  [CROP]:_______________  [DATE]:________

[VAR]:__________  [GRP]:_____  [GC]:_  [PREV.CROP]:__________  [COUNTY]:____

[REFER]:____  [TEST]:_____  [CD]:_ [PD]:_  [DIAGBY]:___  [CONSULT]:___

[DIAG.1]:_______________  [CA.1]:__________  [CACODE.1]:____

[DIAG.2]:_______________  [CA.2]:__________  [CACODE.2]:____

[OUT]:________  [NOTES]:_______________________________________________
```

****

1B

1983 LEXINGTON LOGBOOK (LEXLOG)

```
NO :1329    GROWER :HUGHES        CROP :TOBACCO          DATE :06/30/83

VAR :KY160         GRP :AG-T    GC :C   PREV.CROP :SOYBEAN     COUNTY :LOGA

REFER :        TEST :        CD :    PD :    DIAGBY :CAK   CONSULT :

DIAG.1 :BLACK.SHANK          CA.1 :PHYTOPHTHO    CACODE.1 :FUNG

DIAG.2 :                     CA.2 :              CACODE.2 :

OUT :06/30/83   NOTES :
```

****

1C

```
NO            =294
GROWER        =HOWARD
CROP          =APPLE
DATE'         =06/23/83
VAR           =WINESAP
GRP           =FR-T
GC            =H
PREV/CROP     =UNK
COUNTY        =CALL
REFER         =
TEST          =
CD            =
PD            =
DIAGBY        =PRB
CONSULT       =
DIAG/1        =SCAB
CA/1          =VENTURIA
CACODE/1      =FUNG
DIAG/2        =INSECT
CA/2          =SCALE
CACODE/2      =INS
OUT           =06/24/83
NOTES         =
LAB           =P
```

ure 1. (A) Screen form for the LEXLOG database, (B) a completed LEXLOG record and, (C) a completed PLDIS record.

DIAGNOSTIC LAB COMPUTER CODES

A

CAUSAL AGENT CODES
(CACODE)

Abiotic	ABIO	Insect	INS
Algae	ALG	Nematode	NEMA
Bacterial	BACT	No diagnosis	ND
Chemical	CHEM	Non-applic., none	NONE
Fungal	FUNG	Unknown	UNK
Inadequate	INAD	Virus	VIR
Plant	PLNT		

B

TESTS

Culture	CULT	Pinewood nematode	PWN
Electron microscope	EM	Potato soft rot test	PSR
ELISA	ELISA	Quick nitrate test	QNT
Inclusion (virus)	INCL	SCN, cyst analysis	SCN-C
Incubate	INCUB	SCN, larval analysis	SCN-L
Indicator plants (virus)	INDIC	SCN, race test	SCN-R
Nematode assay	NEMA	Soluable salts test	SS
pH test	PH		

C

PLANT GROUP CODES
(GRP)

Agronomic	AG-	Identifications	ID-
corn	-C	fungal	-F
forages	-F	plant	-P
small grains	-SG	Miscellaneous	MISC
soybeans	-S	Ornamentals	OR-
tobacco	-T	herbaceous	-H
Fruit	FR-	houseplants	-HS
small fruits	-S	turf	-T
tree fruits	-T	woody	-W
Herbs	HB	Vegetables	-VG

D

GROWER CODES
(GC)

Commercial	C	Institution	I
Homeowner	H	Researcher	R

Figure 2. Standard codes used for data entry in the Lexington and Princeton databases.

E

COUNTY CODES

Use the first four letters of the county name, with the following exceptions:

Greenup	GREP	Out of State	OS + abbrev.
Lee	LEE	Indiana	OSIN
McCreary	MCCY	Ohio	OSOH
		etc.	

F

REFERRAL CODES
(REFER)

Agronomy	AGRO	Horticulture	HORT
Animal Diagnostic Lab	ADL	Regulatory Services	REG
Entomology	ENT		

Figure 2. (continued)

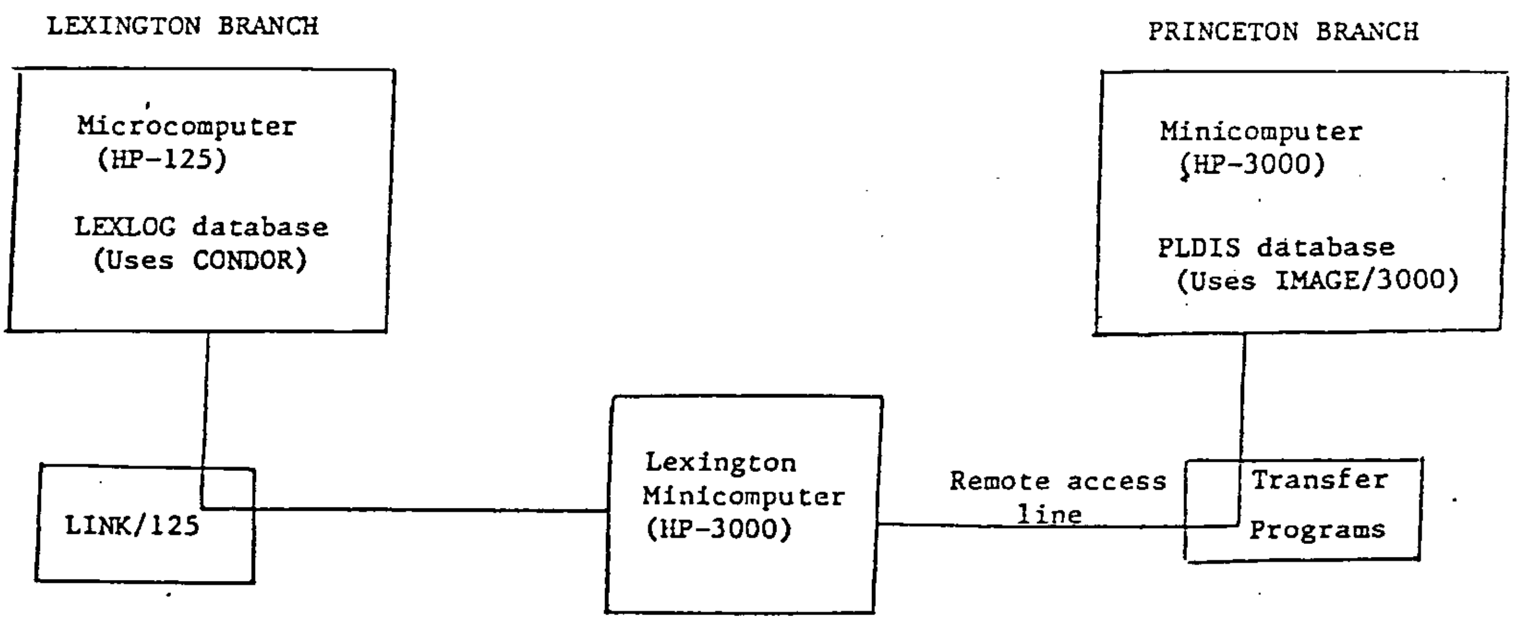


Figure 3. A schematic of the Lexington/Princeton computer systems and their interaction.

NO	CROP	COUNTY	DIAG.1	CA.1	DATE	OUT
2512	TOBACCO	SIMP	BLACK.SHANK	PHYTOPHTHO	08/22/83	08/22/83
2513	PEAR	ROWA	ENVIRON	DROUGHT	08/22/83	08/22/83
2514	HONEYLOCUST	JEFF	INAD	INAD	08/22/83	08/22/83
2515	MAPLE	BOYD	GIRDLING.ROOT	TRANSPLANT	08/22/83	08/22/83
2516	TOBACCO	ALLE	VIRUS	COMPLEX	08/22/83	08/22/83
2517	PEACH	BOYD	BROWN.ROT	MONILINIA	08/23/83	08/23/83
2518	TOBACCO	WARR	ENVIRON	SUNSCALD	08/23/83	08/23/83
2519	HOLLY	SHEL	ENVIRON	DROUGHT	08/23/83	08/23/83
2520	TOBACCO	LOGA	ND	ND	08/23/83	08/23/83
2521	TOBACCO	JEFF	BLACK.SHANK	PHYTOPHTHO	08/23/83	08/23/83
2522	TAXUS	FAYE	ENVIRON	DROUGHT	08/24/83	08/25/83
2523	TOBACCO	HART	BLACK.SHANK	PHYTOPHTHO	08/24/83	08/25/83
2524	TOBACCO	LOGA	SORE.SHIN	RHIZOCTONI	08/24/83	08/25/83
2525	HAWTHORN	SPEN	HAWTHORN.RUST	GYMNOSPORA	08/24/83	08/25/83
2526	WATERMELON	MORG	ENVIRON	DROUGHT	08/23/83	08/25/83
2527	TOBACCO	HART	ND	ND	08/23/83	08/29/83
2528	TOBACCO	WASH	CHEMICAL	GROWTH.REG	08/24/83	08/29/83
2529	CROWNVETCH	FAYE	ANTHRACNOSE	COLLETOTRI	08/24/83	09/01/83
2530	CORN	MARI	KERNEL.ROT	ASPERGILLU	08/25/83	08/25/83
2531	PEACH	LOGA	ND	ND	08/25/83	08/29/83
2532	TOBACCO	GREP	ENVIRON	LIGHTNING	08/25/83	08/25/83
2533	TOBACCO	LOGA	CHEMICAL	BURN	08/25/83	08/25/83
2534	SOYBEAN	RUSS	NUTRITIONAL	PH	08/25/83	08/26/83
2535	TOMATO	BARR	INSECT	STINK.BUG	08/25/83	08/29/83
2536	TOBACCO	WARR	ENVIRON	DROUGHT	08/25/83	08/25/83
2537	BALDCYPRESS	MCCR	INSECT	GALL.MIDGE	08/25/83	08/29/83
2538	TOMATO	FAYE	INAD	INAD	08/25/83	08/26/83
2539	HOLLY	JEFF	BLACK.ROOT.ROT	THIELAVIOP	08/26/83	09/08/83
2540	TOBACCO	BOYL	ND	ND	08/26/83	08/29/83
2541	CYCLAMEN	HENR	SOFT.ROT	ERWINIA	08/26/83	09/01/83
2542	CORN	FULA	INSECT	STALKBORER	08/26/83	09/01/83
2543	TOBACCO	MORG	BLUE.MOLD	PERONOSPOR	08/26/83	08/26/83
2544	SPRUCE	HARD	ENVIRON	TRANSPLANT	08/26/83	08/29/83
2545	TOBACCO	MADI	ENVIRON	LIGHTNING	08/26/83	08/26/83
2546	TOBACCO	MADI	ENVIRON	LIGHTNING	08/26/83	08/26/83
2547	PINE	MASO	ENVIRON	TRANSPLANT	08/26/83	08/29/83
2548	TOBACCO	OSOH	ND	ND	08/26/83	08/29/83

Figure 4. Sample print-out from the Lexington DMBS (using CONDOR). This is a listing of samples logged-in the week of August 22 to August 26.

CROP	DIAG.1	CA.1	{Count}
LACKBERRY	CANE.BLIGHT	LEPTOSPHAE	2
LACKBERRY	CHEMICAL	GROWTH.REG	1
LACKBERRY	CROWN.GALL	AGROBACTER	1
LACKBERRY	INSECT	CANE.BORER	2
LACKBERRY	ND	ND	3
LACKBERRY	ROOT.PROBLEM	UNK	1
BLACKBERRY	VIRUS	STERILITY	2
LACKBERRY	VIRUS	UNK	1
LUEBERRY	ENVIRON	DROUGHT	3
LUEBERRY	INAD	INAD	1
LUEBERRY	INSECT	SCALE	1
LUEBERRY	LEAF.SCORCH	DROUGHT	1
LUEBERRY	LEAF.SCORCH	UNK	1
LUEBERRY	ND	ND	2
URRANT	INSECT	APHID	1
GOOSEBERRY	ROOT.PROBLEM	UNK	1
RAPE	ANTHRACNOSE	ELSINOE	6
GRAPE	BLACK.ROT	GUIGNARDIA	16
RAPE	CHEMICAL	GROWTH.REG	2
RAPE	CROWN.GALL	AGROBACTER	1
RAPE	INAD	INAD	2
RAPE	ND	ND	4
RAPE	POWDERY.MILDEW	UNCINULA	1
ASPBERRY	ANTHRACNOSE	ELSINOE	3
ASPBERRY	CANE.BLIGHT	LEPTOSPHAE	3
ASPBERRY	ENVIRON	DROUGHT	1
ASPBERRY	ENVIRON	STRESS	2
ASPBERRY	INSECT	UNK	1
ASPBERRY	LEAF.SCORCH	UNK	3
ASPBERRY	ND	ND	2
ASPBERRY	ROOT.PROBLEM	UNK	1
ASPBERRY	ROOT.ROT	BASIDIOMYC	1
TRAWBERRY	ANTHRACNOSE	COLLETOTRI	1
TRAWBERRY	BLACK.ROOT.ROT	COMPLEX	4
TRAWBERRY	BLACK.ROOT.ROT	FUSARIUM	10
RAWBERRY	BLACK.ROOT.ROT	RHIZOCTONI	5
RAWBERRY	INAD	INAD	4
RAWBERRY	INSECT	BORER	1
RAWBERRY	INSECT	LEAFROLLER	1
RAWBERRY	LEAF.SCORCH	DIPLOCARPO	2
RAWBERRY	LEAF.SPOT	MYCO.ELLA	11
RAWBERRY	ND	ND	1
RAWBERRY	ROOT.PROBLEM	UNK	1
tal			114

gure 5. A summary of small fruit diagnoses made in 1983 at the Lexington Plant Diagnostic Lab.

SMALL FRUIT DISEASES

BLACKBERRY	CANE BLIGHT - <u>LEPTOSPHAERIA</u>	2
	CHEMICAL INJURY	1
	CROWN GALL - <u>AGROBACTERIUM</u>	1
	INSECT INJURY	2
	NO DIAGNOSIS	3
	ROOT PROBLEM	1
	VIRUS - STERILITY VIRUS	2
	- UNKNOWN VIRUS	1
BLUEBERRY	ENVIRONMENTAL - DROUGHT	3
	INADEQUATE SPECIMEN	1
	INSECT INJURY	1
	LEAF SCORCH	2
	NO DIAGNOSIS	2
CURRANT	INSECT	1
GOOSEBERRY	ROOT PROBLEM	1
GRAPE	ANTHRACNOSE - <u>ELSINOE</u>	6
	BLACK ROT - <u>GUIGNARDIA</u>	16
	CHEMICAL INJURY	2
	CROWN GALL - <u>AGROBACTERIUM</u>	1
	INADEQUATE SPECIMEN	2
	NO DIAGNOSIS	4
	POWDERY MILDEW - <u>UNCINULA</u>	1
RASPBERRY	ANTHRACNOSE - <u>ELSINOE</u>	3
	CANE BLIGHT - <u>LEPTOSPHAERIA</u>	3
	ENVIRONMENTAL STRESSES	3
	INSECT INJURY	1
	LEAF SCORCH	3
	NO DIAGNOSIS	2
	ROOT PROBLEM	1
	ROOT ROT - UNKNOWN BASIDIOMYCETE	1
STRAWBERRY	ANTHRACNOSE - <u>COLLETOTRICHUM</u>	1
	BLACK ROOT ROT COMPLEX - ABIOTIC	4
	BLACK ROOT ROT - <u>FUSARIUM</u>	10
	BLACK ROOT ROT - <u>RHIZOCTONIA</u>	5
	INADEQUATE SPECIMEN	4
	INSECT INJURY	2
	LEAF SCORCH - <u>DIPLOCARPON</u>	2
	LEAF SPOT - <u>MYCOSPHAERELLA</u>	11
	NO DIAGNOSIS	1
	ROOT PROBLEM	1
TOTAL DIAGNOSES		114

Figure 6. Small fruit disease summary from Figure 5 after editing using a word processor program.

Canada Region - Disease of the Quarter

ROOT, CROWN, AND STEM DISEASES OF WHEAT

Coordinator: R.T. Wukasch

Contributors: Dr. R.A. Martin, Agric. Canada, Charlottetown, P.E.I.
Drs. R. Hall, L.L. Burpee, and J.C. Sutton; A. Jamieson, K. Nelson, R.T. Wukasch, Univ. of Guelph, Guelph, Ontario.
Dr. Prem Kharbanda, Alberta Envir. Centre, Vegreville, Alberta.
Marylin Dykstra, Alberta Agriculture, Brooks, Alberta.

A. Most prevalent root, crown, and stem diseases; causal agent(s); where found

1) Fusarium root, crown, and foot rot; Fusarium spp. especially F. avenaceum, also F. graminearum and F. culimorum - in all areas of Canada reporting.

2) Take-all; Gaeumannomyces graminis var. tritici; in all areas of Canada reporting.

3) Common root rot; Bipolaris sorokiniana; minor problem in Ontario and Maritimes, more serious in spring wheat in Western provinces.

4) Eyespots; Pseudocercosporella herpotrichoides, Rhizoctonia cerealis; not reported in Alberta, minor in Ontario and Maritimes.

5) Browning root rot; Pythium spp.; minor in Maritimes and Ontario, more prevalent in Alberta.

6) Pink snow mold; Gerlachia nivalis (Fusarium nivale)
7) Grey snow mold; Typhula spp.

} in winter wheat only (Ontario, Maritimes)

B. Diagnostic symptoms and methods

1) Fusarium root, crown, and foot rot is the most difficult to diagnose accurately. Reddish brown to tan lesions, coupled with isolation of above-mentioned Fusarium spp. is somewhat reliable. Isolate Fusarium onto Nash-Snyder medium after surface sterilization of washed crowns with 0.6% NaOCl for 1 minute. Although the Nash-Snyder selective medium was most cited for isolation, plating onto this medium often yields pathogenic Fusarium spp. from seemingly healthy roots, and saprophytic isolates as well. All isolates of the afore-mentioned Fusarium spp. were found to be pathogenic, except for some isolates of F. avenaceum, in testing done at the University of Guelph. Fusarium identification was most commonly made using Booth (1977).

2) Take-all symptoms are most apparent at heading white, bleached, poorly-filled heads, often over-run by black sooty fungi, on stunted plants. Other root rots also produce such heads, as well as other cultural factors. Blackened roots, a dark mycelial sheath at the stem base, dark runner hyphae with hyphopodia characterize *Gaeumannomyces*. Culturing on media is difficult, since the fungus is easily outgrown by *Fusarium* and other saprophytes. Recently, a selective medium for this fungus has been developed (see Juhnke et al., 1984), and requires 5-9 days for identification at 20-25°C. Another method worth trying is to germinate wheat seed adjacent to diseased stem bases in a moist chamber, and watch for dark runner hyphae on the young roots.

NOTE: To further complicate things, Smiley, and Craven Fowler, 1984, have recently reported symptoms of spring dead spot, *Fusarium* blight syndrome, and Take-all patch which were caused by *Phialophora graminicola* and *Leptosphaeria korrae*. Do the same pathogens appear on wheat and other cereals as well, and have they been overlooked in the past?

3) Common root rot is usually found as a seedling blight with browned sub-crown internode, leaf bases, crown, and roots. The large *Bipolaris* conidia are present on the affected tissue, appear after incubation in a moist chamber, or are found after isolation on acidified PDA following surface sterilization for 30 seconds in 1% NaOCl. Dryland wheat production favors this disease.

4) Browning root rot is distinghished if caught early in the season on roots which are showing recent lesions. Selective media, corn meal agar, or 2% water agar have been used successfully to isolate *Pythium* spp. Again, there are non-pathogenic *Pythium* spp. which are isolated from wheat roots. Pathogenicity tests are necessary to confirm suspected isolates.

5) Eyespot lesions are well differentiated from those caused by other pathogens. Differentiating between eyespot and sharp eyespot is not always straight forward (Wheat Compendium, plates 28 and 30). If sharp eyespot, *Rhizoctonia cerealis*, right angled branching, binucleate hyphae may be visible in the lesion, and sometimes small dark sclerotia as well. *Pseudocercosporella* eyespot may have a tuft of white mycelium in the eyespot. However, it is next to impossible to isolate the organism from stubble or old lesions on stems. According to Powelson, Oregon State University, a method for isolating *Pseudocercosporella* from fresh leaf sheath or green stem lesions is as follows:

a) Dip tissue in 10% NaOCl no more than 5 seconds and blot.

b) Place onto 2% water agar acidified to pH 5.0, or ½ strength PDA, both ammended with 100 ppm streptomycin sulfate.

c) Incubate for 3 weeks at 10°C under near UV radiation and watch for conidial development.

Alternatively, wash the tissue carefully, incubating on moist filter paper at 10-15°C.

Usually eyespot lesions are near the stem base, while sharp eyespot lesions may be present quite high on the stem.

6) If severe, snow molds, though usually foliar diseases, may attack crowns and stems of wheat. They are easily differentiated by the presence of sclerotia if Typhula spp., or by culturing at 10°C on acidified PDA or Nash and Snyder selective medium for Fusarium nivale.

7) Physiological problems - Care should be taken neither to confuse the diseases with problems of physiological origin, nor to ignore abiotic predispositional factors in diagnosis. Soil problems such as pH, especially in acidic regions, field history, overlapping herbicide application, fertility effects, topography, drainage, and the pattern in the field are all key factors in diagnosis.

Control

Crop rotation with non-cereals, resistant varieties, seed treatment, eliminate grassy weeds, and consult references enclosed or cited and Provincial, or regional crop protection publications.

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Pest Diagnostic & Advisory Clinic
Department of Environmental Biology
Ontario Agricultural College
University of Guelph

July, 1980 Circular 36

PSEUDOCERCOSPORELLA FOOT ROT OF WINTER WHEAT
also known as Culm Rot, Eyespot, and Strawbreaker Disease

S.G. Fushtey

In the 60's this disease was a frequent problem in winter wheat in certain areas of Southwestern Ontario. This disease has been reported again from several parts of the Province in 1980.

Cause

The disease is caused by the fungus *Pseudocercosporella herpotrichoides* which attacks the wheat plant just above the soil level and gradually weakens the basal part of the stem until it bends, or breaks over.

Symptoms

The most conspicuous damage is the severe lodging which occurs during the latter part of the growing season. The gradual weakening of the stem with the eventual breaking over results in improper filling of the heads; the kernels become shrunken, and the crop may be hardly worth harvesting.

Lodging caused by this disease differs from that caused by high winds and heavy rains. Storms cause grain to fall over in one direction, or at least in some definite pattern. Foot-rot causes grain to fall in a criss-cross manner usually with no directional pattern unless high winds are also involved. The stem at the point of breaking is often twisted and has a characteristic charred appearance.

Control

Briefly, recommendations for control are:

1. Plough under crop residue.
2. Practice long rotations with legumes included.
3. Maintain high fertility to encourage vigorous plants.
4. Reduce seeding rate. This promotes stronger plants which are more resistant to lodging.

The fungus persists in crop residue. Careful ploughing to cover all stubble and straw will help reduce the amount of Cercosporella fungus that survives as the fungus perishes when the infected straw is completely decomposed.

The disease is most destructive in winter wheat, but also affects winter barley. Crop rotation is the most effective method of control known to date. The most serious damage has been observed where wheat followed wheat in the rotation. Legume crops, alfalfa, clover, soybean, field bean, should be included in the rotation and winter wheat or winter barley should be spaced at least two years apart in fields where the disease has occurred.

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Revised - July, 1979 Circular EB 70-40

TAKE-ALL DISEASE OF WHEAT

S.G. Fushtey

This disease has been reported in Ontario for many years and, along with other foot and root-rot diseases, has caused considerable damage to wheat crops. The disease also affects barley but with less serious damage.

Symptoms

The first obvious symptoms occur about heading time when affected plants, often in roughly circular patches in the field, cease growing and turn pale in colour.

By the time the crop begins to ripen, infected plants are stunted and bleached so that diseased patches usually stand out in contrast to the surrounding crop. Some of the diseased plants die before heading while others produce stunted heads with shrunken kernels or no kernels at all. The reason for this poor development is that the roots, crown and base of the stem become decayed. The basal parts of the plant become dark brown or black in colour and the plant is easily pulled up because the decayed roots break off easily at the crown.

Although the above symptoms are good indications of the disease, diagnosis depends on closer examination of the affected plant parts. The basal stem beneath the lowest leaf sheath becomes dark, almost black, with a shiny appearance and the sheath may be speckled with tiny, flask-shaped fruiting bodies of the fungus (perithecia). Perithecia are not always present but diagnosis is aided when microscopic examination reveals the presence of a network of coarse, dark runner hyphae on the darkened roots.

Cause

This disease is caused by the fungus *Gaeumannomyces graminis* (*Ophiobolus graminis*) which is carried in the soil, on stubble and roots from infected cereals and grasses.

The disease is favored by alkaline, compacted, infertile and poorly drained soil and usually increases in severity with continuous wheat cultivation.

Control

1. Crop Rotation. If Take-All has been observed in a field of wheat this crop should not be grown on the land for the next one to two years. By growing crops which are not susceptible to this disease, such as legumes (alfalfa, clover, soybean, bean), root crops (turnip, potato), oats or corn, the fungus is reduced to a very low level and wheat may then be returned.
2. Balanced fertility. A good supply of phosphate and potash reduces losses by producing a more vigourous and extensive root system.
3. Plough down stubble early to prevent spread of spores to neighbouring fields and to promote decomposition of the fungus in soil.
4. Keep grassy weeds and volunteer wheat plants under control as these serve as reservoirs of the Take-All fungus.

FUSARIUM DISEASES OF WHEAT IN THE MARITIME PROVINCES

Diseases incited by several species of fungi belonging to the genus *Fusarium* cause severe yield loss and reduction in quality of wheat in the Maritime Provinces. These fungi attack the roots, stem, and especially the heads resulting in small, discolored, lightweight kernels. *Fusarium nivale* is the species associated with snow mold while *Fusarium graminearum* incites head blight and *Fusarium culmorum* frequently is the cause of stem diseases. The species of *Fusarium* attacking wheat also incite diseases of other cereals including barley, oats, rye, and corn as well as grasses such as quack-grass, foxtail, barnyard grass, and a number of other cultivated forages including both grasses and clovers. The wide host range of the *Fusarium* pathogens makes control of these diseases difficult.

DISEASE SYMPTOMS AND DISPERSAL

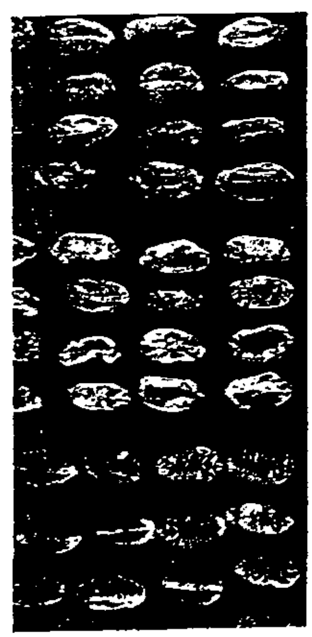
Fusarium diseases of spring wheat become most noticeable in the field after flowering when head discolorations appear usually in late July or early August. Spikelets of wheat heads become bleached and appear to be ripening prematurely. Later these bleached areas become pink to salmon-coloured and the kernels become white or pinkish and very shrivelled. The severity of head discoloration, frequently called scab, varies yearly depending on the weather.

The disease is enhanced by warm moist weather which results in the discoloration spreading over the entire head. Dry weather will limit or halt development of the disease. If the infection spreads to the rachis or stem within the head, then the head will die. Kernels which are pinkish will have the discoloration more severe on the germ end of the kernel.

Seeds which are discolored may have abundant conidia or summer spores of the *Fusarium* fungi on the surface but all seeds including the healthy-appearing ones may carry some spores. If these seeds are planted untreated, the seedling roots become infected shortly after germination. These infected seedlings are stunted, slow to emerge, and may die. If they survive to produce

Head blight symptoms. L— three healthy plants. R— four plants blighted to varying degrees.

Stem breakage of Opal wheat caused by *Fusarium culmorum*. Note pinkish coloration at nodes.



Opal wheat seed, bottom healthy; centre white and top, pinkish.

October 1982

Agriculture Canada

Hon. Eugene Whelan, Minister
J.P. Connell, Deputy Minister

adult plants, they may produce only one tiller and few seeds. These plants will exhibit a brown root and crown rot.

Stems may also show signs of disease as the crop approaches maturity. Stems bleach and close observation of nodes will detect a pinkish coloration. The stems frequently bend or break at the nodes with the upper stem parts remaining hinged to the lower at the broken nodes.

Winter wheat grown in the Maritimes normally escapes head blights but may be damaged during the winter by snow molds incited by a variety of fungi including *Fusarium nivale.* During winters with little ground frost but adequate snow for ground coverage, snow mold fungi are able to infect the winter wheat crop at very low temperatures and kill the plants. In the spring plants do not revive but remain straw-colored and the entire field may take on a pinkish cast. This disease may result in loss of entire winter wheat fields or may occur in patches.

DISEASE CYCLE

The various *Fusarium* species may overwinter in infected kernels, stubble, and straw, other plant debris, and in the soil as spores (conidia), mycelium, or as durable overwintering spores. When straw or stubble is infected in the field, a pinkish cast caused by the fungal growth can be seen at nodes and especially on the inner stem walls when the straw is broken open. The *Fusarium* pathogens on crop debris in the field continue to develop abundantly until the plant tissues decompose.

Temperatures and humidity occurring normally in the Maritimes are within ranges required by the various *Fusarium* species for disease development. Seedling infections can start at temperatures suitable for emergence. Head blights begin within 3 to 4 days from the time of infection when temperatures approach 20°C and moisture is present on the heads overnight. It is only in unusually dry years that insufficient moisture occurs in the Maritimes to prevent head blight.

TOXICITY OF INFECTED GRAIN

Kernels which are blighted and discolored may be contaminated by toxins produced by the *Fusarium* fungi. The *Fusarium* produce, as part of their metabolic processes, mycotoxins which when consumed at low levels by non-ruminants cause vomiting, diarrhea, muscle spasms, and feed refusal. Swine may be particularly susceptible to this reaction. Cattle and sheep are less affected. These mycotoxins may be estrogenic and thus should not be fed to breeding animals since problems such as abortion may develop. These mycotoxins are stable for several years in stored grains. The Maritime spring wheat is particularly susceptible to contamination by the mycotoxin vomitoxin.

Infected or discolored wheat kernels should not be used for flour. Diseased crops produce many lightweight kernels and these may be cleaned out of the harvest before use but complete removal of discolored or contaminated seeds is not possible.

CONTROL

1. Deep and thorough fall plowing or cultivation to bury stubble and other crop debris including weed hosts is recommended. Complete incorporation of host tissue will aid decomposition of such tissue and reduce overwintering of the *Fusarium* fungi. Fields should be cultivated as soon as possible after harvest, bearing in mind any potential erosion problem.

2. Thorough cleaning of seed and treatment with a recommended fungicide is advised. If shrivelled seed is removed through cleaning and the plump kernels of good color which remain are treated, this will aid in control of the seedling phase of these diseases.

3. When land is suitable, sow winter wheat rather than spring wheat. Winter wheat is of a higher yielding potential than spring wheat and normally escapes severe head blight damage by being mature in early August in the Maritimes.

4. Sow adapted and recommended varieties in well-prepared fertile soil. No varieties are resistant but differences in disease severities may be present.

5. Rotate wheat and other cereal hosts with non-cereal crops, such as legumes, allowing at least a one-year break between cereal crops.

H.W. Johnston
R.A. Martin
Agriculture Canada, Research Station
Charlottetown, Prince Edward Island

DISEASES OF CEREALS

Root Rot & Leaf Spots

It is an important disease of spring wheat and barley and may occur on winter wheat and oats to a limited extent.

CAUSE: - Bipolaris sorokiniana (Helminthosporium sativum) - a fungus.

SYMPTOMS: Infected plants are usually found in patches scattered throughout the field. Badly diseased seedlings fail to emerge. Early infections appear as small brown spots on the base of the seedling. The lesions spread along the coeloptile and into the root system turning these tissues dark brown. On the heads, the disease appears as conspicuous black areas at the embryo end of the kernels. Most leaf infections occur after the plants have headed. The disease on the leaves is referred to as spot blotch and the symptoms usually appear as well defined, oval to longitudinal brown lesions, surrounded by green tissue. Spots coalesce to form blotches which in turn cause the leaves to die. Toward maturity most leaves on these plants are dead, the crowns are rotted and few branch roots remain.

DISEASE CYCLE: The fungus overwinters in soil, on crop refuse, on seed, and in winter cereals and susceptible grass weeds. Large numbers of spores are produced in the spring and infect wheat and barley. Soil- and seed-borne spores are responsible for most of the seedling crown and root infections.

CONTROL:

1. Avoid planting susceptible variety. Consult 'Varieties of cereal and oilseed crops for Alberta' available from your local District Agriculturists office.

2. Elimination of grass weeds is important, as is a crop rotation that includes noncereals.

3. Disease-free seed, sanitation and good cultural practices help to reduce inoculum.

4. Treatment of infected seed with recommended chemicals will reduce the inoculum load. Consult 'Seed treatment of cereal and oilseed crops'.

Plant Pathology Laboratory

Alberta AGRICULTURE

Agdex 100/632
Revised February, 1983

SEED TREATMENT OF CEREAL AND OILSEED CROPS – 1983

This publication supersedes all previous recommendations.

PURPOSE OF SEED TREATMENT

Seed treatment provides economical insurance against many diseases and some insect pests of seed and seedlings. Chemical treatment can give seedlings a head start by preventing or reducing damage from certain crop pests.

The three prairie provinces have a uniform seed treatment policy. The policy recommends:

- Rye and flax should always be treated because they are very susceptible to seed decay.
- If smut was observed in a crop which will be used for seed the grain should be treated.
- When growing cereal varieties which are susceptible to smuts, and the presence of smut is uncertain, it may be wise to treat the seed every second or third year depending upon the susceptibility of the variety.
- Seed of resistant varieties and seed of susceptible varieties that are free of smut should not normally require treatment.
- Wireworms, which attack all grain crops, and flea beetles which attack rape and mustard seedlings can be controlled by seed treatment with lindane formulations.

Rapeseed should be treated with benomyl or carbathiin to control the seedborne phase of black leg.

Cereal seed should be treated with an insecticide formulation for fields with previous wireworm damage and for the first crop after breaking grassland.

The treatment of cereal seed with fungicides has dropped from 70% in 1968 to 31% in 1979. Of the 76 cooperative seed cleaning plants in Alberta in 1980, 68 have facilities to treat grain with pesticides. The newer seed treatments are safer to use than those available 10 years ago.

Fungicides destroy fungal pests carried on the seed such as covered smuts, leaf-spotting fungi and seed decay fungi.

Systemic fungicides also destroy fungi in the seed such as loose smuts and protect the early growth of the seedling.

The insecticide lindane controls wireworms in cereals and flax, and flea beetles in rape and mustard.

METHODS OF SEED TREATMENT

Liquid Seed Treatment

Liquid seed treatment formulations may be listed as: Sn – solution, Su – suspension and EC – emulsifiable concentrate.

Most municipal cooperative seed cleaning plants are equipped to treat seed with liquid fungicides. Sling bottles are available for accurately metering liquid treatments on grain augers.

Drill Box Formulations

Powder formulations are listed as: Du – Dust or WP – Wettable Powder.

These powder or dust formulations (fungicide, fungicide/insecticide or insecticide) can be mixed with seed in the drill box just before planting.

FUNGICIDE TREATMENT COSTS*

Flax – \$.75 – \$1.15 per bushel
Cereals – \$.18 – \$.75 per bushel

FUNGICIDE/INSECTICIDE TREATMENT COSTS*

Cereals – \$.70 – \$1.45 per bushel
Rapeseed and mustard seed – \$1.65 – \$2.70 per acre
Granular insecticides such as Furadan and Counter cost around \$6.00 per acre but offer longer term protection.

*depending on product used and seeding rate.

PRECAUTIONS

- READ and FOLLOW label directions carefully.
- TREATED seed must not be allowed to contaminate grain intended for food, feed or commercial use. BURY left-over treated seed or store it safely for future use as seed.
- TREATED seed offered for sale must be labelled with the name of the treatment chemical (Canada Seed Act).
- TREATED seed in transit must be bagged or bulk loads tarped to prevent spillage (Alberta Agricultural Chemicals Act).

Copies of this and related publications may be obtained from the Print Media Branch, Alberta Agriculture, 9718 - 107 Street, Edmonton T5K 2C8 or Alberta Agriculture's District Offices.

CHEMICALS REGISTERED[1] FOR SEED TREATMENT OF CEREAL AND OILSEED CROPS IN CANADA, 1983

Trade Name	Common Name[2]	Registrant	Form[3]	Registered Use[4]
FUNGICIDES				
Formaldehyde	formaldehyde	Stanchem	Sn	wheat, oats, barley
Agrox N-M	maneb	Chipman	Du	flax, wheat, oats, barley, rye
Pool N-M	maneb	Alta. Wheat Pool	Du	flax, wheat, oats, barley, rye
Co-op N-M	maneb	I. P. Co-op	Du	flax, wheat, oats, barley, rye
Vitavax Powder	carbathiin:thiram	Uniroyal	Du	flax, wheat, oats, barley, rye
Vitavax Solution	carbathiin	Uniroyal	Sn	flax, wheat, oats, barley, rye
INSECTICIDES				
Counter[7]	terbufos	Cyanamid	Gr	rape, mustard
Furadan[7]	carbofuran	Chemagro	Gr	rape, mustard
Evershield	methoxychlor	Cargill	Su	wheat, barley, rye
Lindane	lindane	Pfizer	Du	wheat, oats, barley, rye
FUNGICIDE/INSECTICIDE DUAL PURPOSE (DP) FORMULATIONS				
Benolin R[5]	benomyl:thiram: lindane	I. P. Co-op	Du	rape
Thiralin Plus[5]	benomyl:thiram: lindane	Niagara	Du	rape
Vitavax RS Flowable[5,6]	carbathiin:thiram: lindane	Uniroyal	Su	rape
Vitavax RS Powder[5]	carbathiin:thiram: lindane	Uniroyal	Du	rape, mustard
Gammasan +[5]	benomyl:captan: lindane	Chipman	Du	rape, mustard
Agsco DB – Green	maneb:lindane	Agsco	Du	wheat, oats, barley, rye
Co-op DP	maneb:lindane	I. P. Co-op	Du	wheat, oats, barley, rye
Mergamma N-M	maneb:lindane	Chipman	Du	wheat, oats, barley, rye
Pool N-M Dual	maneb:lindane	Alta. Wheat Pool	Du	wheat, oats, barley, rye
Trinox	maneb:lindane	Haynes Chem.	Du	flax, wheat, oats, barley, rye
Vitavax Dual Powder	carbathiin:thiram: lindane	Uniroyal	Du	flax, wheat, oats, barley, rye
Vitavax Dual Solution	carbathiin:lindane	Uniroyal	Sn	wheat, oats, barley

[1]Registered under the Pest Control Products Act (Canada).

[2]Most of the fungicides are disinfestants and protectants.
Carbathiin is systemic and the only registered chemical that can control loose smut of wheat and barley, and stem smut of rye.

[3]Sn – solution, Su – suspension, Du – dust or wettable powder, Gr – granule

[4]Application rates for each crop are listed on the label.

[5]Products containing benomyl or carbathiin will control black leg on the seed of rape.

[6]Do not store treated grain for more than 3 months or above 25°C or in direct sunlight. Do not allow product to freeze.

[7]Furadan and Counter are granules and not true seed treatments but are applied with the seed.

CLINIC NEWS

UNIVERSITY OF GUELPH ADDS ANOTHER FULL-TIME DIAGNOSTICIAN

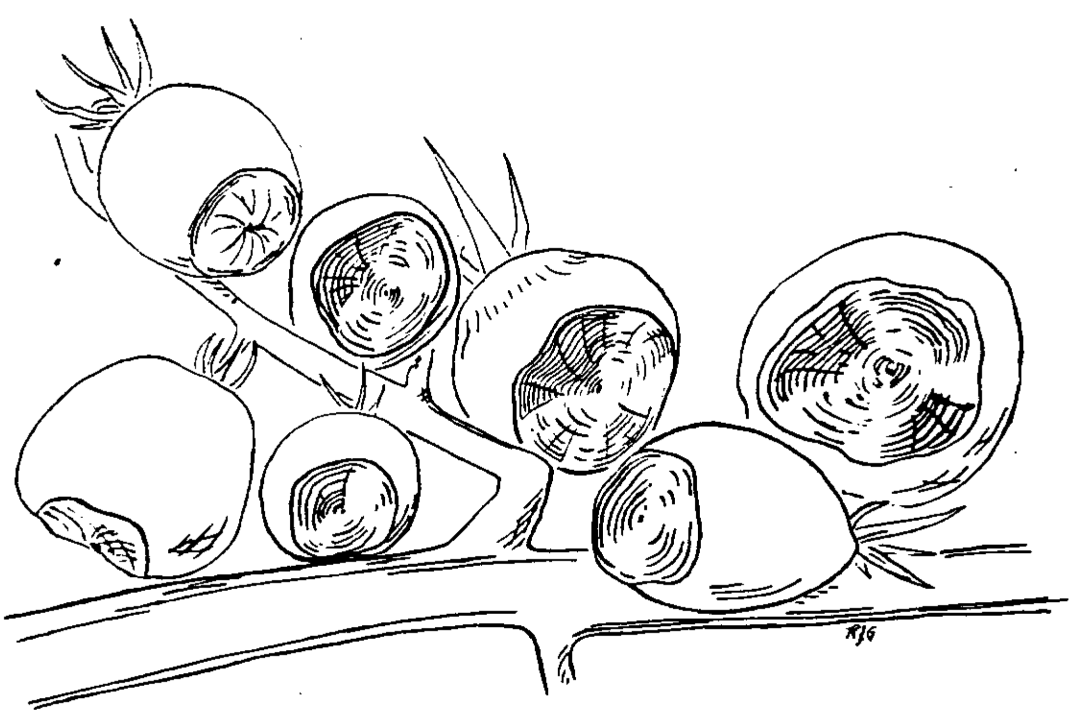
Six years after the clinic began, we now have a renovated lab, a microcomputer for record keeping and word processing and a new full-time diagnostician. Wendy Attwater joined our staff after completing a B.Sc. Entomology and a M.Sc. Plant Pathology.

OTHER NEWS

MICHIGAN STATE LOSES THEIR DIAGNOSTICIAN

Sandy Perry is the new Staff Horticulturist for Tru Green in East Lansing, Michigan. Her responsibilities will include lawn, tree and shrub care. Sandy's new address is 2875 Northwind Drive; Suite 205; East Lansing, Michigan 48823. Phone: 517-351-7227.

Note: Robert Wick, formerly associated with the Diagnostic Clinic at U.P.I. and S.U., has also moved. He is now located at the Suburban Experiment Station, University of Massachusetts, Waltham, MA.



DISEASE OF THE QUARTER COORDINATORS

Southern Region - 1983

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MANY THANKS TO THE ABOVE COORDINATORS FOR THEIR FINE EFFORTS

Pest Management Series

Dollar Spot of Turfgrass

OSU Extension Facts

Cooperative Extension Service • Division of Agriculture • Oklahoma State University

No. 2657

R.V. Sturgeon, Jr.
Extension Plant Pathologist

The fungus responsible for "Dollar Spot" disease is capable of attacking most turfgrasses grown in Oklahoma and it can be very damaging to home lawns and bentgrass golfcourse putting greens. This disease seldom kills the grass entirely, but does kill the leaf blades causing unsightly small spots, 1 to 2 inches in diameter, about the size of a silver dollar—hence, the name "Dollar Spot." Outbreaks occur mostly in late spring and early fall and occasionally under cool, moist conditions during the summer. These disease outbreaks are most serious in the fall because the disease weakens the grass plant which contributes to increased winter injury and winter kill of grass. Control is obtained by the use of fungicides in combination with certain cultural practices.

Symptoms

Dollar Spot is characterized by circular straw-colored, bleached spots about the size of a silver dollar (Fig. 1). In lawns and similar turf areas the disease will form depressions, 15 cm or more in diameter of infected leaves in lawn mowed high toward the end of the season. When not controlled, infected areas may coalesce and cover large area giving the appearance of drought or early dormancy, especially in the fall. On bentgrass putting greens the symptoms are small spots of dead leaves, up to 5 cm in diameter (Fig. 2). If not controlled, these spots develop deeper into the turf and coalesce into large, irregular patches.

First stages of Dollar Spot are observed as dark, wilted blades of grass within the infected area eventually taking on a bleached appearance. Individual infected leaves develop a lesion that is first chlorotic, then water-soaked, and finally, a yellow-tan color. Dollar Spot lesions are characteristically bounded by a tan to reddish brown margin. These lesions usually enlarge to extend across the entire leaf (Fig. 3). Individual leaf blades may have a single lesion or many small lesions or the leaf may be entirely blighted. During early morning hours, when moisture is on the grass and disease is active, tufts of white cottony or cobwebby growth of the fungal mycelium may be seen on diseased grass. As the sun rises and air movement increases, the white cottony mycelium ceases to grow and slowly disappears.

Causal Agent and Disease Cycle

Dollar Spot is caused by *Sclerotinia homeocarpa*. The fungus overwinters in the form of black stromata and as dormant mycelium on infected plant parts in the thatch and soil. The stromata appear as tiny, thin, black flakes on foliage surface. The Dollar Spot fungus resumes growth near 60 F (15 C) with greatest activity for infection occurring between 70-90 F (21-32 C). The fungus grows best during periods of warm, humid weather and cool nights that result in heavy dews. Disease is more severe when soil is dry and grass is maintained under a low nitrogen fertility program.

The fungus apparently does not produce spores in North America. Infection occurs when environmental conditions become favorable in the spring and, the dormant mycelia, or over wintering stroma, starts growing. Whenever aerial mycelium contacts a moist leaf surface, it may penetrate the leaf and cause an infection (Fig. 4). Movement over long distances is by equipment, people, animals, water or wind carrying infected plant debris. On the golf course, the golfer can carry the disease from tee to fairway, to putting green and even to other courses. Once "Dollar Spot" has gained a foothold, it can spread easily. However, the fungus is not able to infect roots or rhizomes, but may produce a toxin in the foliage that adversely affects root growth.

Disease Management

Lawns and other similar turf areas: "Dollar Spot" is often called a "poor man's disease" because it is found most frequently in lawns that have not had proper fertilization, particularly with nitrogen. Therefore, one of the control measures that is recommended is to be sure that proper fertility is maintained, particularly in the very early spring and in the late summer. In spite of the best fertilization, however, the disease may appear, especially in late summer and fall, and in these cases, should be controlled with a fungicide. It is well to remember that if the fungicide is applied as soon as the first spots on leaves appear (this requires rather careful observation), then the unsightly, dead "Dollar Spot" will never show up. The later the control chemical is applied, the longer recovery will take. If a "Systemic" rather than a "Protectant" type of fungicide is used, only one or perhaps two sprays will be needed in each of the spring and fall disease seasons. The systemic fungicide can be used as a preventive treatment by making the first of two applications seven to ten days before Dollar Spot normally appears, and follow with the second application two weeks later. In the fall when a preventive program is most appropriate, the first systemic fungicide application should be applied approximately August 15 with the second application about September 1. In areas where the disease has been severe in past years, a third application may be required after the third week of September. If the "Protectant" type of fungicide is used, the sprays should be applied at weekly intervals during the disease periods.

Bentgrass putting greens: Cultural control of Dollar Spot involves maintaining an adequate to high nitrogen and potassium fertility during the season when the disease is most active. In Oklahoma, this would normally be early spring and late summer. Although Dollar Spot can become active during summer months, nitrogen levels should be adequate, but not high. High nitrogen fertility has been shown to increase incidence of "brown patch" disease. Low soil moisture levels seem to increase "Dollar Spot" incidence. Thus, irrigation practices should keep greens at near field capacity. Do not water late in the evening for this can provide moisture on the leaf and encourage infection, especially during cool nights. Improve air movement over the greens by pruning or removing trees or shrubs. Regular mowing of the green can remove many of the infected leaves. Cultural control practices can be effective under low disease incidence; however, on most Oklahoma golf courses fungicides must be included in the disease control program to insure adequate control. During warm, dry summers, fungicides for Dollar Spot control may only be needed during April thru May and again starting in late August thru October. A full season control program may be needed for summers with weather that favors the disease and for greens located in areas on the golf course that favor the disease.

Chemical control: Table 1 contains a list of fungicides suggested for control of Dollar Spot in Oklahoma. Caution: Use all fungicides in accordance with label directions.

Table 1. Fungicides for Control of Dollar Spot

Prepared: November, 1983

Fungicide[1]	Rate of Formulation per 1000 sq ft
Acti-dione Thiram (Cycloheximide-Thiram)	2-4 oz
Bayleton (Triadimefon)	1-2 oz
Chipco 26019 (Iprodione)	1.5-2 oz
Daconil 2787 (Chlorothalonil)	4-6 oz
Dyrene (Anilzane)	4-6 oz
Fungo (Thiophenate-Methyl)	1-2 oz
Kromad (Cadmium compound)	3-6 oz
Tersan 1991 (Benomyl)	1-2 oz

[1]Trade names are used rather than chemical names for brevity and clarity. This does not imply that one formulation or trade name is recommended over others containing the same ingredient. Fungicide selection was based on evaluations under Oklahoma conditions and label compliance. Read the label and follow manufacturer's instructions.

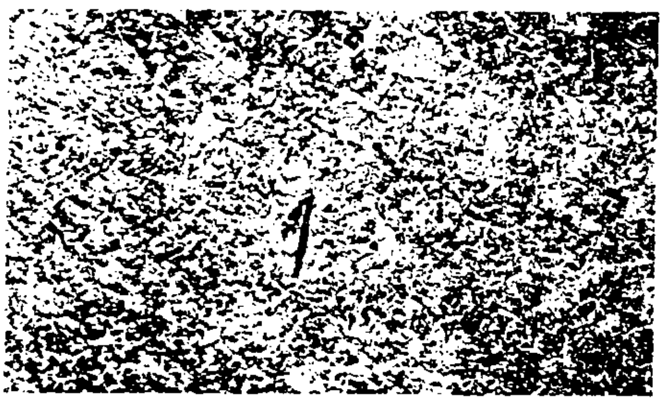

Figure 1. Dollar Spot appears as a circular straw-colored, bleached spot about the size of a silver dollar on a bermudagrass lawn.

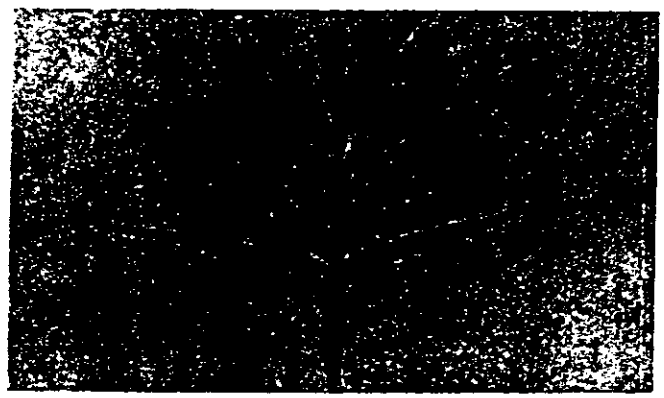

Figure 3. Straw-colored Dollar Spot lesions on bermudagrass leaf.

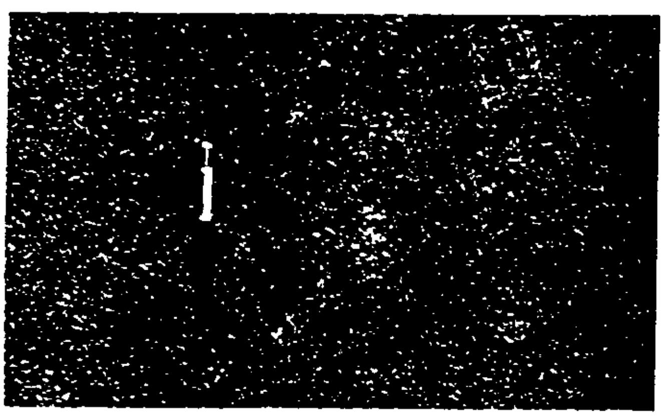

Figure 2. On closely-mowed bentgrass putting greens Dollar Spot symptoms are small spots of dead grass.

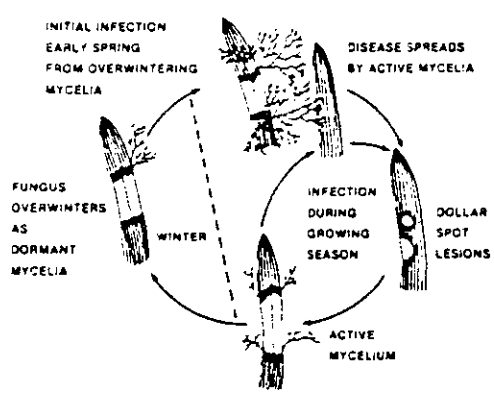

Figure 4. Disease cycle for Dollar Spot (Adapted from Fenstermacher, 1980).

KNOW AND CONTROL

plant diseases

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BROWN STEM ROT OF SOYBEAN

AC-35, Prepared 1984

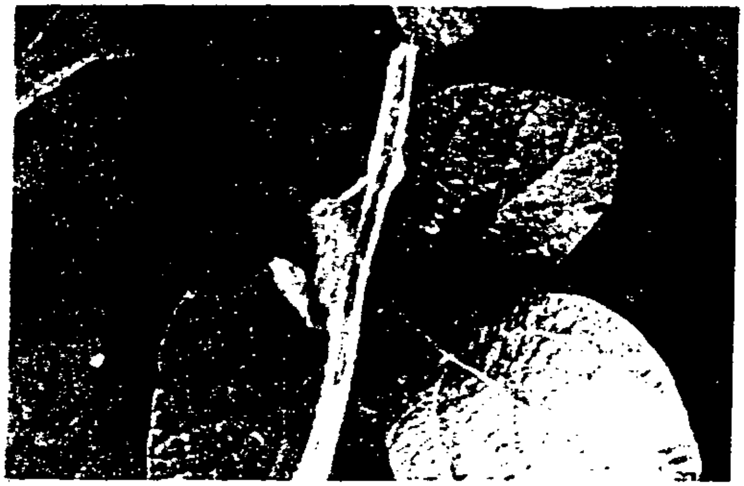

Fig. 1. One of the best ways to identify brown stem rot of soybean is to split the lower stem of affected plants to check for the brown pith region. Healthy plants will have white pith.

Fig. 2. Leaf symptoms of brown stem rot are quite characteristic, however, they do not always occur. Brown interveinal tissue with yellow to green veins are typical symptoms on the leaves.

Brown stem rot has not caused widespread yield losses on soybean fields in Ohio, but in certain isolated fields yield losses have been significant. The incidence and severity of brown stem rot appears to be related directly to the intensity of soybean production. Reports of yield losses from brown stem rot have come from growers who have cultivated soybeans continuously or use a short rotation sequence. In fields that have had a high incidence of infected plants, yields were reduced by as much as 30%.

Symptoms

Symptoms of brown stem rot have been misidentified as frost damage, early maturity or wilting due to insufficient soil moisture. These improper diagnoses probably account for the lack of reports of brown stem rot in Ohio. Symptoms of brown stem rot usually do not appear until after pod formation begins. Since outward symptoms are not evident at this time, infection generally goes unnoticed until later in the season. If the lower 6 inches of the stems were split at this time, brown discoloration of the pith region would be evident (Fig. 1). As soil moisture becomes depleted in mid-to-late August foliar symptoms may appear. General yellowing and curling of the leaves occur first, followed by death of the tissues between the veins of the leaves (Fig. 2). The veins of the leaf generally remain green and are bordered by a yellow margin. Eventually, the leaves wilt and die, but they remain attached to the stem.

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Causal Fungus

Brown stem rot is caused by Phialophora gregata, a soil-borne fungus. P. gregata sporulates profusely on soybean straw buried in soil and can occur several times on the same piece of straw. Spores from colonized straw are the chief source of inoculum. The fungus causes disease because it attacks and occupies the water transport system within the plant and impedes movement of water and nutrients to the leaves and developing pods.

Disease Cycle

The brown stem rot fungus survives in infested debris in the soil between soybean crops. Spores are produced in late spring and cause infection of young soybean roots. The fungus quickly invades the vascular system and remains in the lower portion of the plant until pod formation. If cool temperatures prevail during pod formation (60°-70°F). the fungus advances up the stem. If soil moisture is low during the last half of the growing season, the plants begin to wilt and show typical leaf symptoms. The presence of the fungus in the vascular tissues plus the occurrence of low soil moisture increases the water deficiency in diseased plants, causing poor pod fill, and reduced seed number and seed size. Severely diseased plants may also lodge more than the healthy plants. In years when adequate rainfall occurs throughout the growing season, brown stem rot will be of little significance.

Control

1. Crop rotation with non-host plants like corn and small grains will prevent buildup of the brown stem rot fungus to levels that cause economic losses. Continuous soybeans will build up the fungus in the soil, and when severe disease occurs a rotation of 3 to 4 years away from soybean may be needed to prevent yield losses.

2. When severe disease occurs deep plowing of infested crop debris may reduce the survival of the fungus, but this practice should be used in combination with a good rotation sequence.

3. Brown stem rot resistant varieties have been developed in other states for use exclusively in brown rot infested fields. Their use is recommended only if 75% of the plants in the field are infected and the grower wants to plant beans in the field again the following year. These varieties only have a better yield when the disease is present and generally yield less than other varieties when the disease is absent. Since the disease is severe only when dry weather prevails during the last half of the growing season in Ohio, the best way to avoid yield loss is to have a good rotation and prevent buildup of the fungus in the soil.

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CRAZY TOP OF CORN

AC-34, Prepared 1984

Fig. 1. Corn plant with classic symptoms of crazy top. Note leafy proliferations from the tassel.

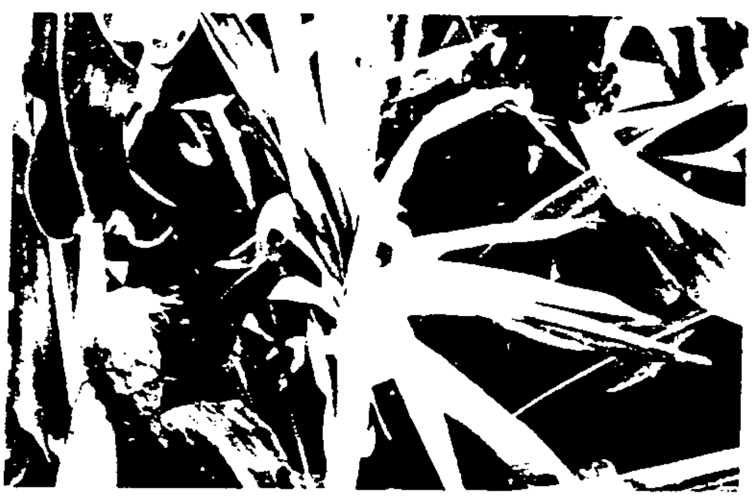

Fig. 2. Other symptoms of crazy top include the development of strap-like leaves from the ears of the plant.

Symptoms

Symptoms expressed by plants vary greatly depending on how soon after germination seedlings become infected and on the degree of colonization of the corn tissues by the fungus. The most characteristic symptom is the proliferation of leafy structures from the tassel (Fig. 1). In many cases, this leafy profusion also occurs in the ears resulting in a mass of strap-like leaves protruding from where ears should be (Fig. 2). This abnormal profusion of leafy structures near the top of the plant earned this disease the name "crazy top".

Causal Fungus

Crazy top is caused by the soil-borne fungus, Sclerophthora macrospora. This fungus attacks all types of corn and a number of wild grasses. Each year it must reinfect a living corn or grass plant for survival. After the fungus infects, it grows systemically within the plant and may be detected in all the above ground tissues of the diseased plant.

Disease Cycle

The crazy top fungus overwinters as oospores in the soil in diseased tissues of either corn or grassy weeds. In spring, when saturated conditions prevail, oospores germinate and swimming spores (zoospores) are liberated into the free water. These zoospores are capable of

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swimming a short distance in water to nearby corn seedlings. Upon reaching a suitable host the spore develops a short germ tube used to infect the plant. The fungus then grows systemically within the plant and develops abundantly in the rapidly growing tissues. The systemic growth of the fungus within these tissues causes a hormonal imbalance which initiates the proliferation of leafy tissues in the tassels and ears.

The fungus has been reported to infect oats, wheat, crabcrass, foxtails, barnyardgrass and many other grasses. However, in Ohio its only economic host is corn.

Control

No highly effective control measures can be recommended for crazy top. Very little is known about the level of resistance in corn hybrids to this disease since it is of little economic significance. In general, good surface and subsurface soil drainage limits the occurrence and severity of the disease. Avoid planting corn in low-wet spots where the disease is known to occur. Seed treatment fungicides of the protectant type will not control crazy top.

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Plant Disease Control

BP-10

Directory of Fungicides for Indiana Vegetable Diseases

Richard X. Latin, Extension Plant Pathologist

This directory can be used to cross-reference selected vegetable diseases and registered fungicides (or bactericides in the case of copper compounds) for their control. Emphasis is given to stem, leaf, and fruit diseases of vegetable crops grown in Indiana. *Fungicide product labels should be consulted for application rates and intervals, harvest restrictions, and safe-handling information.* The product label is the definitive source of information about the fungicide in question.

For satisfactory disease control, diagnose problems accurately prior to selection and application of fungicides. A good reference for diagnosing vegetable diseases is *Identifying Diseases of Vegetables.** It includes color prints and accurate descriptions of disease symptoms. Copies of this and various plant disease control bulletins are available from the Department of Botany and Plant Pathology at Purdue University.

How to Use the Directory

Selected vegetable crops and diseases are cross-checked with fungicides listed by their common names at the top of Table 1. (Common names are names coined for active ingredients of fungicides: Several different commercial products may contain the same active ingredient and have the same common name.) Table 2 lists common names, product trade names, product producers, and product formulations. An alphabetized list of fungicide trade names and corresponding common names is provided in Table 3. Below are two examples of how this directory can be used:

Example 1. Suppose rust has been diagnosed as a problem in snap beans and you wish to know which fungicides can be used against rust. According to Table 1, chlorothalonil, maneb, and zineb will protect beans from rust. Names of commercial products with these common names are listed in Table 2. The commercial products include Bravo 500 (chlorothalonil); Dithane M22, Dithane FZ, Manzate, and Manex (maneb); Dithane Z78 and Zineb 75WP (zineb).

Example 2. Suppose Dithane M45 is recommended for tomato disease control and you wish to know the specific diseases it will protect against. According to Table 3, the common name of Dithane M45 is mancozeb. Refer to the mancozeb column and tomato disease section in Table 1. The tomato diseases which Dithane M45 (mancozeb) will protect against are indicated by "x" and include anthracnose, early blight, gray leafspot, late blight, and Septoria leafspot.

*MacNab, A. A., et al., Dept. of Plant Pathology, The Pennsylvania State University.

Table 1. Selected vegetable crop diseases and registered fungicides. Fungicides registered for control of specific diseases are indicated by 'X'.

		Fungicide (Common Name)																
Crop	Disease(s)	anilazine	benomyl	captafol	captan	chlorothalonil	dinocap	mancozeb	maneb	metalaxyl	metiram	TPTH	vinclozolin	zineb	basic copper sulfate	copper ammonium carbonate	copper hyroxide	copper oxychloride sulfate
Asparagus	rust							x	x		x							
Beans	anthracnose					x			x					x	x			
	bacterial blight														x	x	x	
	halo blight															x	x	
	rust					x			x					x				
	white mold		x															
Cabbage Broccoli Cauliflower	Alternaria leaf blight					x			x						x		x	
	black rot																x	
	downy mildew					x			x					x	x		x	
Carrot	Alternaria leafspot					x		x	x			x		x	x			x
	Cercospora leafspot					x		x	x			x		x	x		x	x
Celery	Septoria blight	x	x		x	x		x	x		x			x	x			x
	Cercospora blight	x	x			x		x	x		x			x	x			x
Cucumber Muskmelon Watermelon	Alternaria leaf blight	x		x		x		x			x				x	x		x
	angular leafspot														x	x	x	x
	anthracnose	x	x	x	x	x		x	x					x	x		x	x
	downy mildew	x		x	x	x		x	x	x	x			x	x	x	x	x
	gummy stem blight	x	x	x		x		x	x		x				x			
	powdery mildew		x				x									x		
Lettuce	downy mildew								x					x	x		x	
	leaf drop												x					

Table 1. Selected vegetable crop diseases and registered fungicides. Fungicides registered for control of specific diseases are indicated by 'X'.

Crop	Disease(s)	Fungicide (Common Name)																
		anilazine	benomyl	captafol	captan	chlorothalonil	dinocap	mancozeb	maneb	metalaxyl	metiram	TPTH	vinclozolin	zineb	basic copper sulfate	copper ammonium carbonate	copper hyroxide	copper oxychloride sulfate
Onion	Botryis blast	x				x		x	x									
	downy mildew				x	x		x	x	x				x	x		x	
	purple leaf blotch	x		x	x	x		x	x					x			x	
Pepper	anthracnose								x					x	x			
	bacterial spot														x		x	x
	Cercospora leafspot								x					x	x			x
Potato	early blight	x		x		x		x	x		x	x			x	x	x	x
	late blight	x		x		x		x	x	x	x	x			x	x	x	x
Spinach	downy mildew								x					x	x			
Squash Pumpkin	anthracnose	x	x		x	x								x	x			x
	black rot	x	x			x												
	powdery mildew		x				x											
Tomato	anthracnose	x		x	x	x		x	x		x			x	x			
	bacterial speck														x		x	
	bacterial spot														x	x	x	x
	early blight	x		x	x	x		x	x		x			x	x	x	x	x
	gray leafspot	x		x	x	x		x	x		x			x	x			
	late blight	x		x	x	x		x	x	x	x			x	x	x		x
	Septoria leafspot	x		x	x	x		x	x					x	x			x

Table 2. Common names, trade names, producers, and formulations of selected fungicides registered for vegetable disease control

Common Name	Trade Name	Producer	Formulation
anilazine	Dyrene	Mobay	50WP
benomyl	Benlate	DuPont	50WP
captafol	Difolatan	Chevron	80DG
captan	Captan	Stauffer	4F,50WP,80WP
	Captan	FMC	80WP
	Captec	Griffin	3F
	Orthocide	Chevron	50WP,80WP
chlorothalonil	Bravo 500	SDS Biotech	4.17F,75WP
dinocap	Karathane	Rohm & Haas	25WP,4LC
mancozeb	Dithane M45	Rohm & Haas	80WP
	Manzate 200	DuPont	80WP,4F
maneb	Dithane M22	Rohm & Haas	80WP
	Dithane FZ	Rohm & Haas	4F
	Manzate	DuPont	80WP
	Manex	Griffin	3F
metalaxyl	Ridomil MZ58	Ciba-Geigy	58WP
metiram	Polyram	FMC	80WP
TPTH (triphenyltin hydroxide)	Du-Ter	Uniroyal	25WP,3F
	Super-tin	Griffin	4F
vinclozolin	Ronilan	BASF	50WP
zineb	Dithane Z78	Rohm & Haas	78WP
	Zineb 75WP	FMC	75WP
*basic copper sulfate	Super-Cu	Griffin	3F
	Triangle	Phelps-Dodge	53WP
	Tribasic Copper Sulfate	Citco	53WP
*copper ammonium carbonate	Copper Count N	MRC	**8EC
*copper hydroxide	Kocide 101	Kocide Chem.	50WP
	Kocide 606	Kocide Chem.	3F
*copper oxychloride sulfate	C-O-C-S	FMC	50WP

Formulation Abbreviations
WP = wettable powder; DG = dispersible granules; F = flowable suspension; LC = liquid concentrate; EC = emulsifiable concentrate.

Formulation Notes
Fungicides are sold commercially as a mixture of active ingredient (that which kills the fungus) and other substances, i.e., carriers, diluents, solvents, wetting agents, or emulsifiers. The formulation indicates the portion of the product which is active ingredient and the physical form of the product. For WP and DG formulations, the number before the abbreviation indicates the percentage of the product that is active ingredient. For F, LC, and EC formulations, the number before the abbreviation usually** indicates the amount of the product that is active ingredient. For example, 50WP describes a wettable powder that is 50% active ingredient, and 4F describes a flowable product that contains 4 pounds of active ingredient per gallon of product.

*The number preceding the type of formulation for copper products indicates the percentage or amount of metallic copper in the product. For example, 53WP describes a wettable powder product that is 53 percent metallic copper, and 3F describes a flowable product containing 3 pounds of metallic copper per gallon.

**In the case of copper ammonium carbonate, the 8EC formulation indicates an emulsifiable concentrate that contains 8 percent metallic copper.

Table 3. Alphabetized list of selected fungicides by their trade names and corresponding common names

Trade Name	Common name
Benlate	benomyl
Bravo 500	chlorothalonil
Captan	captan
Captec	captan
C-O-C-S	copper oxychloride sulfate
Copper Count N	copper ammonium chloride
Difolatan	captafol
Dithane FZ	maneb
Dithane M22	maneb
Dithane M45	mancozeb
Dithane Z78	zineb
Du-Ter	triphenyltin hydroxide (TPTH)
Dyrene	anilazine
Karathane	dinocap
Kocide	copper hydroxide
Manex	maneb
Manzate	maneb
Manzate 200	mancozeb
Orthocide	captan
Polyram	metiram
Ridomil MZ58	metalaxyl
Ronilan	vinclozolin
Super-Cu	basic copper sulfate
Super-tin	triphenyltin hydroxide (TPTH)
Triangle	basic copper sulfate
Tribasic Copper Sulfate	basic copper sulfate
Zineb 75WP	zineb

Diseases of Roses

OSU Extension Facts

Cooperative Extension Service • Division of Agriculture • Oklahoma State University

No. 7607

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Roses continue to be one of the most popular flowers in the garden landscape. Oklahoma roses will produce large quantities of high quality blooms when properly cared for. They require proper grooming throughout the season to maintain a long blooming period. People who like to spend time in the garden will find rose culture can be a rewarding hobby.

Controlling diseases is an important part of a rose maintenance program. Frequent applications of fungicides to prevent fungal infections of leaves is required. Oklahoma's climate favors foliar disease pathogens. Moist soil conditions in rose gardens provide an excellent environment for nematodes and the crown gall bacterium.

Although some cultivars (varieties) are less susceptible to diseases, there are none that are completely disease resistant. Blackspot, powdery mildew, crown gall and nematode damage are the major disease problems in the state. Damage from plant parasitic nematodes seldom kill roses. They can weaken plants to the extent that plants cannot withstand severe winter conditions, diseases, insects and drought.

Blackspot

Blackspot (caused by the fungus *Diplocarpon rosae*) is a serious disease of rose plants. It is characterized by nearly circular black spots on the leaves. The spots are distinguished from other leaf spots by the generally fringed margins and the darker and consistently black color (Figure 1).

The spots vary in size from less than 1/16 to 1/2 inch or more in diameter. Spots may merge to produce large irregular lesions. Yellowing often occurs over the entire leaf or it may develop only around the spots. When plants are badly infected, leaves drop prematurely and canes may become completely defoliated, thereby reducing the quantity of the flowers and eventually killing the plant.

Warm, wet weather favors spread of pathogens. Spores of the fungus are spread mainly by splashing water or rain. The spores germinate and infection takes place only when water remains on the leaves for periods of six hours or longer.

Control

1. Remove and destroy infected leaves during the season and infected twigs when pruning.
2. Avoid overhead watering.
3. Plant roses in an area with good soil drainage and ventilation. Avoid shady spots among dense plants.
4. For chemical control, use fungicides listed in Table 1. It is important that fungicide applications begin with new growth in the spring and continue until frost in the fall. Sprays may be omitted during hot, dry periods in the summer. Many general purpose rose dusts and sprays are available that contain compatible materials for control not only of blackspot and powdery mildew, but also the most common insect pests. These materials have been well formulated and, if used properly, will give excellent results.

Table 1. Chemical Control of Blackspot

Fungicide[1]	Rate/Gal Water	Interval (days)
Benlate (benomyl)[2]	1 Tbsp.	10-14
Daconil 2787 W-75 (chlorothalonil)	1 Tbsp.	7-14
Fore 80% (mancozeb)	1½ Tbsp.	7-10
Phaltan 50W (folpet)[3]	1 Tbsp.	7-10
Ortho Funginex	1 Tbsp.	7-10

[1]Begin applications of each fungicide when disease first appears and continue at indicated intervals. During long, wet periods, apply more frequently.
[2]Add a surfactant such as Triton B-1956.
[3]May cause foliage burn under very high temperatures.

Powdery Mildew

Powdery mildew (caused by the fungus *Sphaerotheca pannosa*) is one of the most widely distributed and serious diseases of roses. Unlike many foliar diseases, it may be serious in dry climates as well as in humid regions. It develops over a wide range of temperatures.

Powdery mildew produces a powdery, whitish coating on the leaves (Figure 2). In case of severe attack, plants may become stunted, leaves curl, become dried and drop. The unopened buds, young stems and thorns may be entirely overgrown with the powdery coating. Only in very rare cases does death of the plant result from an infection of mildew fungus.

Generally, powdery mildew can be expected to occur at any time during the growing season when (1) rainfall is low or absent, (2) temperatures range near 80°F, (3) Color

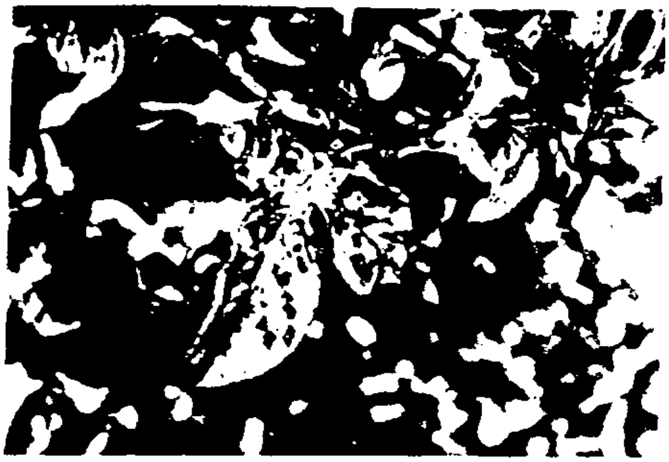

Fig. 1. Blackspot shows up as circular black spots with fringed borders. The spots may merge to produce large irregular lesions. Leaves turn yellow and drop prematurely.

Fig. 2. Powdery mildew is characterized by a white powdery coating on leaves and other plant parts.

nighttime relative humidity is high, and (4) daytime relative humidity is low. It is difficult to generalize, but in semiarid to arid areas these conditions prevail during the growing season, thus control must be made on a regular basis.

Control

In areas of high rainfall in the spring and early summer, control may not be needed until late summer. Fungicides applied properly can control powdery mildew effectively (See Table 2).

Table 2. Control of Powdery Mildew

Fungicide[1]	Rate/Gal Water	Interval (days)
Acti-dione PM[1] (cycloheximide)	2 Tbsp.	7
Benlate (benomyl)[2]	1/2 Tbsp.	10-14
Karathane WD 19.50%[2] (dinocap)	2/3 Tbsp.	7-10
Phaltan 50W (folpet)[3]	1 Tbsp.	7-10
Ortho Funginex	1 Tbsp.	7-10

[1]Begin applications of each fungicide when disease first appears and continue at indicated intervals. With severe disease development, make more frequent applications. Follow label instructions.
[2]Add a spreader-sticker such as Triton B-1956.
[3]May cause foliage burn under very high temperatures.

Crown Gall

Crown gall is caused by the bacterium *Agrobacterium tumefaciens*. The disease is characterized by the formation of outgrowths (galls) which vary in form and size (Figure 3). At first, the galls are small with rounded out-growths on the plant surface. Development continues until galls vary from ¼ to ½ inch to several inches in diameter. They generally form just below the soil line in the crown of the plant. Galls can also occur on roots and occasionally on aerial parts of the rose plant.

Control

1. Transplant only disease-free plants.
2. Avoid wounding during transplanting.
3. Remove infected plants as soon as galls are observed. Where possible, remove and discard all soil in which the root system is growing and replace with sterilized soil to prevent re-introduction of the bacteria to the replanted rose or other susceptible hosts.
4. During cultivation of roses, do not injure roots or crown area.
5. Disinfect pruning and cutting tools frequently. Washing with soap and water or dipping in a 1:9 solution of household bleach (Clorox or Purex) for several minutes will effectively disinfect the cutting tools. This should be done immediately after pruning out a gall or abnormal growth. Cut well below the galled area if stem galls are found. Treat cut areas with Gallex or Galltrol.

Planting stock may be dipped in a suspension of Galltrol. These treatments will not prevent future infection by the crown gall bacterium present in the soil.

Stem Cankers of Roses

Several different stem cankers are found on outdoor planting of roses - stem canker, *Leptosphaeria coniothyrium:* Cane blight canker, *Botryosphaeria ribis* var. *chromogena:* Brand Canker, *Coniothyrium wernsdorffiae;* and Brown canker, *Cryptosporella umbrina*. Cankers usually appear as dead areas of the canes and vary in color from light tan to a dark purplish brown.

The fungal pathogens enter healthy canes through wounds caused by improper pruning, cutting of flowers, wind or winter injury and cultivation injury. Once the fungal pathogen has entered the plant, the canker may grow and eventually girdle the stem causing a dieback of the cane, and, upon reaching the crown, may destroy other canes or the entire plant.

color

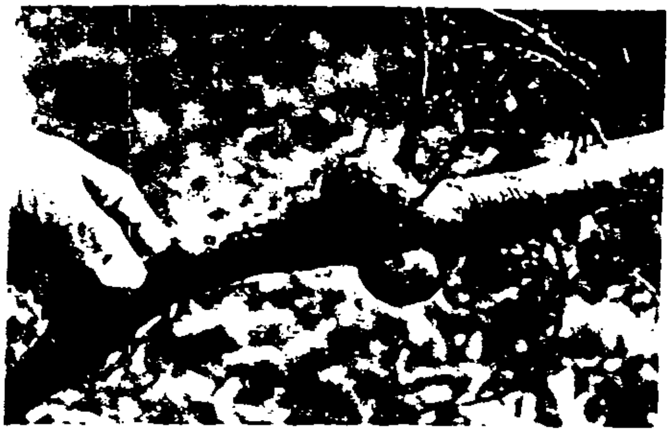

Fig. 3. Crown gall is characterized by outgrowths (galls) generally at the soil line or on roots, as illustrated on this pecan seedling.

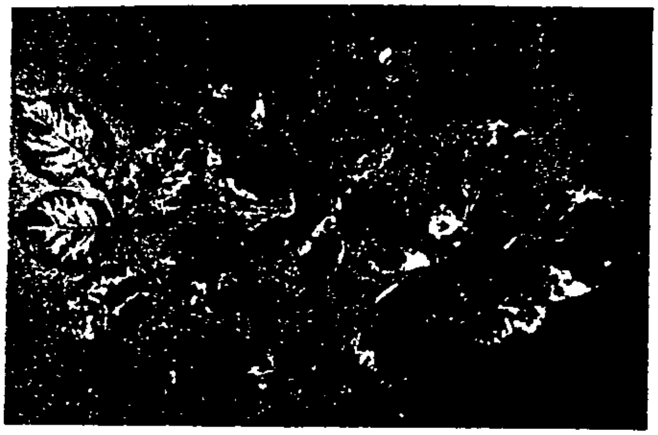

Fig. 4. Rose mosaic virus is characterized by light green to bright yellow mosaic patterns on leaves.

Control

1. Maintain plants in a vigorous growing condition.
2. Prune out and burn all infected canes. Make cuts well back of the cankered area.
3. Disinfect pruning tools after they are used on a diseased plant.
4. Avoid injury when cultivating and transplanting.
5. A good blackspot fungicide spray program will also aid in controlling most stem canker diseases.

Virus and Virus-Like Diseases

Like all vegetatively-propagated plants, roses are subject to infection by virus and virus-like diseases that spread during propagation operations. Diseased plants tend to be less vigorous and less likely to survive than healthy plants, and diseases often detract from the aesthetic quality of the plant. If propagation buds or root-stocks contain virus or virus-like diseases and are used, these diseases are perpetuated.

Rose mosaic is found virtually everywhere roses are grown and can be recognized by light-green to bright-yellow mosaic patterns on the leaves of infected plants (Figure 4). A type of rose mosaic, rose yellow mosaic, causes general yellowing of the leaves or veins. Some infected varieties may be somewhat stunted and suffer greater winter injury than healthy plants. Rose rosette symptoms include leaflet deformation and wrinkling, bright-red leaf pigmentation, witches brooming, phyllody (conversion of flower parts to a leaf-like appearance).

Rose leaf curl (a virus-like disease) symptoms on hybrid teas are downward curling of leaves on estalished plants and dieback of canes. Leaves easily drop off new shoots. The inner back of certain varieties show brown flecks or streaks. Another disease, rose spring dwarf, produces distinctive symptoms when leaves emerge in the spring. The leaves are balled or recurved on very short shoots and exhibit conspicuous vein clearing or a netted appearance.

Control

There is no known practical cure for diseases caused by viruses once infection has occured. Infection with rose mosaic usually does not sufficiently damage plants to necessitate their removal, but plants infected with rose spring dwarf and rose leaf curl should be removed from the nursery or landscape and destroyed. The ultimate control for virus and virus-like rose diseases is to use virus-free buds and root-stocks. Control of virus-transmitting aphids and leafhoppers will help prevent development of virus diseases.

Nematodes in Rose Gardens

Many rose growers in Oklahoma have observed rose plants that have failed to respond to fertilizer, water and pruning. The affected plants exhibit chlorosis, dwarfing, and reduced vitality and become progressively poorer until they have to be discarded. These symptoms may be caused by plant parasitic nematodes: dagger (*Xiphinema*), lesion (*Pratylenchus*), spiral (*Helicotylenchus*), stubby-root (*Trichodorus*), root-knot (*Meloidogyne*), ring (*Criconemoides*), and stunt (*Tylenchorhynchus*) nematodes.

The above-ground symptoms are essentially an indirect result of root damage. The below ground symptoms include: Root galls (root-knot and dagger nematodes) root lesions (root-lesion and ring nematode), root surface discoloration (ring nematode), and injured root tips (stylet and perhaps other nematodes).

Control

1. Plant nematode-free plants.
2. Nematicides in Table 3 may be applied as pre-plant applications.

Table 3. Control of Nematodes in Rose Planting Soil

Nematicide[1]	Application Rate	Remarks
Homeowners Use (Homegardeners)		
Vapam[1,3]	1-1½ pts/ sprinkling can of water/ 50 sq. ft.	Pre-plant treatment when soil temperature is above 60F. For best results, lay a plastic cover over treated area. Seal edges with soil to prevent gas loss.
Commercial Use (Growers, Applicators, Nurserymen)		
Dowfume MC-2 [1,2,3,4]	1½ lbs/150 sq. ft.	Pre-plant treatment when soil temperature is above 50F. Apply under a gas-proof plastic cover sealed at the edges with soil.
Dasanit 15G[1]	6.7 lbs/ 1000 sq. ft.	Pre-plant treatment. Apply evenly over bed and work thoroughly into soil to a depth of 4 to 6 inches.

[1]FOLLOW MANUFACTURER'S RECOMMENDATIONS. READ THE LABEL. Do not use or store in or near human dwellings.
[2]Extremely hazardous liquid and vapor under pressure, inhalation may be fatal. Liquid and vapor will cause burns. Do not spill or discharge contents *outside* of area confined for treatment. Keep children and animals away from area under treatment.
[3]Apply to a deep, freshly tilled bed in seedbed condition and at a temperature above 50F preferably.
[4]To prevent injury to established plants by lateral movement of Dowfume MC-2, stay outside the drip line.

Botrytis Blight

This disease, caused by the fungus *Botrytis cinerea*, affects certain hybrid tea roses. The disease prevents blooms from opening as it causes a brown decay. Sometimes partially opened flowers are attacked and the individual petals turn brown and shrivel. The fungus is always present in rainy seasons when the old flowers are not removed. The fungus also lives in winter-killed canes.

Control

Destroy old blooms and dead canes to remove as much fungal inoculum as possible. This fungus will be controlled if a good blackspot spray program is followed.

Bacterial Leaf Spot

This disease, caused by the bacterium *Pseudomonas syringae*, attacks several cultivars (varieties) of roses. Dark brown, sunken spots on the leaf and flower stalks and flower calyx parts is symptomatic of this disease. Infected flower buds die without opening. The disease is usually observed only during cool, wet weather in the spring.

Control

Prune out and destroy all infected parts.

Anthracnose

This disease, caused by the fungus *Elsinoe rosarum*, attacks all aboveground parts of the rose plant. Early in the season, purplish spots with a brown margin appear on the leaves. Later the centers of the spots turn gray and often fall out. This disease is not very common and usually is not of importance to rose growers.

Control

Control of blackspot disease will control this disease also.

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TURF DISEASES — 12

MOSS AND ALGAE CONTROL IN LAWNS

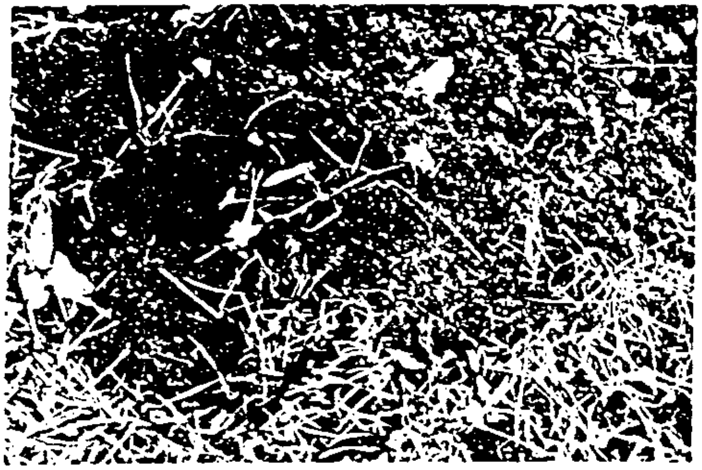

Fig. 1 - MOSS GROWING IN AN AREA UNSUITED FOR GOOD TURFGRASS GROWTH

Algae and moss occur in lawns where conditions are not suitable for growing dense, healthy turf. Mosses are small leafy plants, which appear to be a mass of fine stems (Fig. 1). There are a great number of mosses which are adaptable to a variety of environmental conditions ranging from dry areas to bog-like habitats.

Fig. 2 - ALGAE FORMING A GREENISH HARD SCUM ON THE SOIL SURFACE

Algae are a group of small, primitive filimentous green plants that are often mistaken for moss in moist areas under trees. Algae are not parasitic on grass, but they can produce a greenish to brownish scum on the soil surface (Fig. 2). After the algae have dried, a dark green or black green crust will form on the soil surface. This crust reduces water penetration and air movement into the soil. It must be removed before turfgrass can be established.

CONDITIONS FAVORING MOSS AND ALGAE

Mosses and algae invade areas of the lawn where unfavorable growing conditions restrict grass growth. Such poor growing conditions include excessive shade, low soil pH, poor drainage, compaction, poor air circulation, or low fertility levels. Acid soil (low pH) is most often blamed for moss or algae invasion of the turf, but **any factor** that leads to poor grass growth can encourage the development of moss or algae in the lawn.

Algae is most likely to occur in shaded low, heavily compacted areas that are often wet for prolonged periods of time.

CONTROL

The only permanent control of moss and algae is to correct the conditions unfavorable for grass growth.

A. CULTURAL CONTROL

1. **Maintain Good Soil Fertility** - Soil testing should be done to determine if corrective lime and fertilizer applications are necessary to raise the soil fertility level to a desirable range. Periodic fertilizer applications should be made to maintain the soil fertility.
2. **Improve Drainage** - Soils which are constantly wet because of poor drainage should be contoured so that water will drain off the lawn. In some lawns, tile drainage may be necessary to correct wet conditions. Tiles may be ineffective in heavy soils unless special precautions are taken to facilitate water movement to the tile system.
3. **Provide For More Light** - In some cases a choice between trees and a good lawn must be made. If the lawn is completely shaded, removal of some of the least desirable trees may be the only answer to growing good turf. Other times removal of low branches and selectively thinning out branches throughout the trees will allow enough light to reach the ground surface so that a good turf can be produced.
4. **Cultivate Compacted Soil** - Compacted soil may be loosened by cultivation and addition of large amounts of organic matter if the lawn is to be renovated. Aerification with a machine that removes plugs of soil will help a lawn where it is undesirable to till the soil surface.
5. **Improve Air Circulation** - Low branched trees may be the cause of poor air circulation, as well as dense shade. Lawns surrounded by buildings and high vegetation having limbs close to the ground will require considerable effort to provide air circulation adequate to grow a good lawn.

B. CHEMICAL CONTROL

Chemical controls of moss and algae are only temporary unless conditions favoring their growth are corrected.

Some possible chemical controls for moss are:

1. Copper sulfate at 3 oz. per 1000 sq. ft. in five gallons of water. Wear gloves and old clothes when using this material because copper sulfate will stain clothes and is also caustic to metal containers. Repeated applications can cause damage to existing turf.
2. Iron sulfate at 3 oz. per 1000 sq. ft.
3. Superphosphate at 3 lbs. per 1000 sq. ft.

Possible chemical controls for algae are:

1. Copper sulfate at 3 oz. per 1000 sq. ft.
2. Hydrated lime at 3 lb. per 1000 sq. ft.
3. The best chemical control is to use the copper sulfate treatment, followed by raking to remove the crust, and then treat the area with hydrated lime.
4. Tersan LSR Fungicide (Use according to label directions).
5. Fore Fungicide (Use according to label directions).

Chemical control of either moss or algae is only temporary: unless the real problem is corrected (lawn conditions of moisture and shade), moss and algae will recur. Therefore, correct the condition that is unfavorable for grass growth.

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