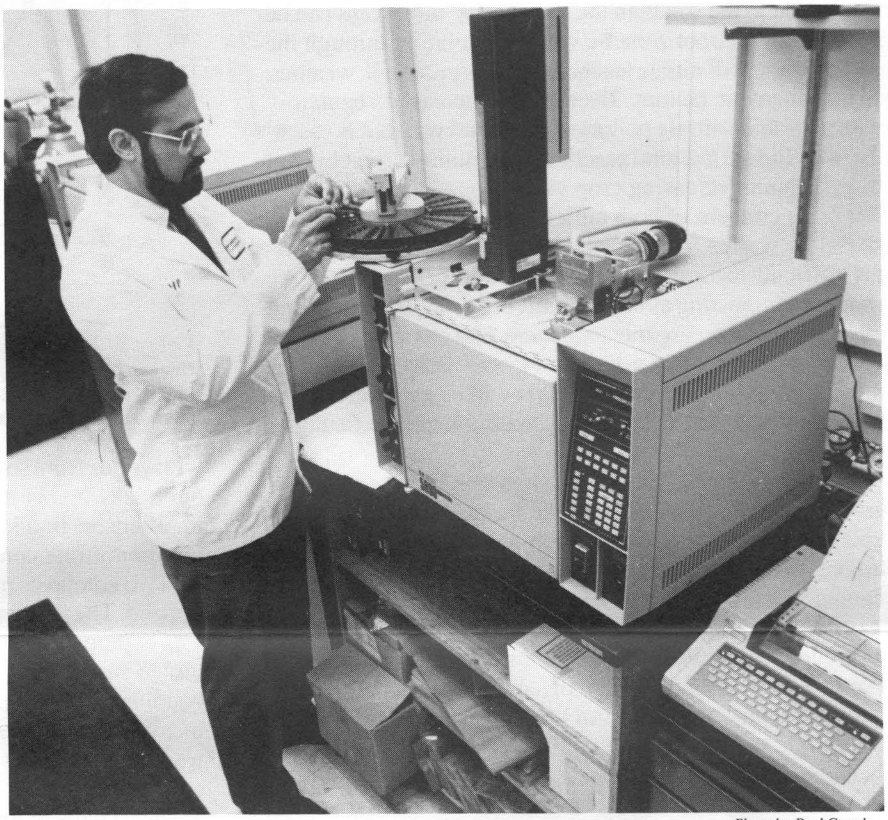
FRONTIERS of Plant Science

FALL 1989
Volume 42 No. 1



Harry M. Pylypiw, Jr.
Preparing Pesticide Samples

Photo by Paul Gough

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ISSN 0016-2167

Agricultural composts as amendments reduce nitrate leaching from soil

By Abigail A. Maynard

Elevated levels of nitrate in ground water are a problem of increasing importance in Connecticut. If more nitrogen fertilizer is added to the soil than the crop needs, the excess can be leached from the root zone by water percolating through the soil. The amount of nitrate leached depends upon soil, weather, and management factors. Because of increased regulatory pressure to abate nitrate pollution of ground water, it is essential to develop agricultural practices that minimize leaching of nitrate without decreasing crop yield.

Another concern of both agriculture and municipalities is disposal of wastes. As acceptable landfill sites are increasingly difficult to find, municipalities and private firms are turning to composting as an alternative. Composting has been widely promoted by organic gardeners, and compost has been found useful for home gardens and lawns. However, utilization of large amounts of compost that will be generated in the future requires its use on land for agricultural and horticultural crops.

Virtually all nitrogen in compost is in organic forms and must be decomposed to inorganic ammonium and oxidized to nitrate before it is available to most crops. The release of nitrogen from finished composts is relatively slow, thus reducing potential losses to leaching as crops readily utilize the available nitrogen. Utilization of compost as a soil amendment could reduce the need for commercial nitrogen fertilizers and reduce the possibility of contamination of ground water. The long-term impact of yearly applications of composts on nitrate leaching and crop yields has yet to be determined.

To determine the benefits of compost while addressing the problem of pollution of ground water with fertilizers, I compared yields of vegetables grown in compost-amended soils with yields from soils receiving conventional fertilizer both at our Lockwood Farm in Mt. Carmel and our Valley Laboratory in Windsor. In addition, I installed test wells at Windsor to monitor nitrate concentrations in the ground water.

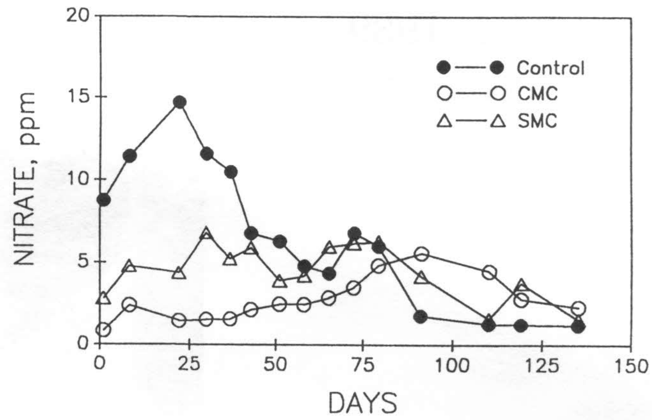

Figure 2. Nitrate concentrations (ppm) under plots receiving 50 T/A chicken manure compost (CMC) and 50 T/A spent mushroom compost (SMC) compared to control receiving 1300 lbs 10-10-10/A. The experiment was conducted at Windsor from April 27 to Sept. 8, 1989.

Two composts produced by Earthgro (Lebanon, CT.) were utilized. The first was spent mushroom compost (SMC) which was composted outdoors for about six months in static piles turned monthly. It consisted primarily of horse manure and bedding with some chicken manure, gypsum, cottonseed meal, and cocoa bean shells added. The total nitrogen content was approximately 0.5% (dry weight basis). The second was chicken manure compost (CMC) which was composted for about 20 days in the International Process Systems in-vessel system utilizing forced air and an agitated bed. It consisted of chicken manure (43%), horse manure (14%), spent mushroom compost (29%), and sawdust (14%). The total nitrogen content was approximately 2% (dry weight basis). The composts were applied in fall 1988 at rates of 25 or 50 T/A (dry weight basis). The plots were 20 X 20 ft., surrounded by 3-foot aisles and replicated four times. These rates were equivalent to about 0.5 and 1 inch of compost. The compost was incorporated into the soil by rototilling in the spring. No inorganic fertilizer was added to plots receiving compost. Control plots received the conventional rate of 10-10-10 fertilizer (1300 lbs/A), but no compost was applied. The vegetables included spring broccoli and cauliflower, eggplant, peppers, and tomatoes. Soil samples from the different treatments were analyzed monthly for their chemical and physical characteristics.

Photo by Wade Elmer

Figure 1. Abigail A. Maynard with an eggplant and tomatoes harvested from compost plots.

Nitrate concentrations in the ground water throughout summer 1989 are shown in Figure 2. Nitrate beneath the control plot (optimum fertilizer with no compost) increased to 14.7 ppm, well above the 10 ppm drinking water standard, while the plots receiving compost remained well below 10 ppm. Plots receiving 50 T/A SMC increased to 6.3 ppm while the plots receiving 50 T/A CMC reached only 5.6 ppm. The nitrogen in inorganic fertilizer is readily available to plants but is also easily leached as evidenced during the heavy rains that occurred during spring 1989. Organic nitrogen in composts is released more slowly by bacterial decomposition. Thus, although more total nitrogen was applied in composts compared to the fertilized control plots (2000 lbs N/A in CMC compared to 130 lbs N/A for the fertilized control), less nitrogen leached to the ground water.

Yields from the different treatments showed that many vegetables can be grown successfully on compost-amended soils. For spring broccoli, statistical analysis showed yields in compost-amended plots equalling or exceeding yields in control plots (Table 1). For spring cauliflower, plots amended with CMC had the greatest yields, but yields in the SMC-amended plots were below yields in the control plots.

To ascertain whether low yields of any of the vegetables were due to nutritive deficiencies or to phytotoxic substances found in composts in other studies, I established additional plots at Mt. Carmel in which two levels of fertilizer (10-10-10) were added to the low rate of the composts (25 T/A). The two levels included the full rate (1300 lbs/A) and half rate (650 lbs/A). For cauliflower, the yields from the plots receiving the half rate of fertilizer and compost were as much as three times higher than the yields from the other plots amended with compost alone at a rate of 25 T/A. Yields from these fertilizer and compost plots also exceeded the fertilizer controls. The plots receiving full fertilizer and compost were not significantly different from those receiving the half rate of fertilizer (data not shown). For cauliflower, it appears that the highest yields are obtained with a combination of fertilizer and compost with compost alone not supplying enough nutrients. The full rate of fertilizer, however, is not required if compost is used and nitrate leaching can be reduced. Broccoli, on the other hand, was grown successfully on compost alone, completely eliminating the need for inorganic fertilizers.

The yields for eggplant, peppers, and tomatoes through September 15 are shown in Table 2. The yields of eggplant on all of the compost-amended plots equalled or exceeded the control plots at Mt. Carmel. However, only the CMC-amended plots exceeded the control plots at Windsor. The yields at Windsor were as much as two-times greater than those at Mt. Carmel where verticillium wilt disease lowered yields. However, relative yields of the compost-amended plots remained consistent at both places, with the higher nitrogen content in the CMC-amended plots providing the greatest yields. The SMC supplied enough nitrogen to sustain yields equal to the control plots only at Mt. Carmel where soil tests revealed there was a greater nitrogen reserve already present in the soil.

Peppers were similar to eggplant with CMC-amended soils producing the greatest yields. Soils amended with SMC had yields which equalled the fertilized control. Mt. Carmel had the greatest yields compared to Windsor. At Windsor, the shallow rooted pepper plants were generally smaller, probably due to moisture stress in the sandier soil. Compost aids in alleviating this problem as the organic matter content increases the water holding capacity. The soil at Windsor also had a lower nitrogen concentration, as determined by soil tests, before the composts were added. Even after the composts were added, there was insufficient nitrogen to sustain yields equivalent to Mt. Carmel.

Tomatoes growing in the CMC-amended plots had the greatest yields at both Mt. Carmel and Windsor and the SMC-amended plots had the lowest compared to the fertilized controls. The only exception was the SMC-amended plots at Mt. Carmel in which additional fertilizer had been added.

Table 1. Yields (lbs/A) of spring broccoli and cauliflower in plots at Mt. Carmel (MC) and Windsor (W) amended with chicken manure compost (CMC) and spent mushroom compost (SMC).

	CMC T/A			SMC T/A			
	25	25*	50	25	25*	50	CON**
Broccoli MC	5760	6000	6710	4390	5400	4950	4550
Broccoli W	4150	—	4790	3220	—	3230	3150
Caul. MC	5930	11500	8000	3000	11400	3750	4660
Caul. W	4200	—	4160	2080	—	1970	3600

* Fertilization rate of 650 lbs 10-10-10/A. Experiment conducted at Mt. Carmel only
**Fertilization rate of 1300 lbs 10-10-10/A.

Table 2. Yields (lbs./plant) as of Sept. 15 in plots at Mt. Carmel (MC) and Windsor (W) amended with chicken manure compost (CMC) and spent mushroom compost (SMC).

	CMC T/A			SMC T/A			
	25	25*	50	25	25*	50	CON**
Eggplant MC	4.7	6.5	6.7	3.9	3.9	4.2	3.7
Eggplant W	11.1	—	13.8	6.6	—	6.7	7.1
Peppers MC	2.4	1.7	2.0	1.5	1.4	1.3	1.3
Peppers W	1.0	—	1.3	0.5	—	0.5	0.5
Tomatoes MC	12.2	13.8	14.9	7.8	12.2	9.6	11.2
Tomatoes W	10.8	—	15.3	7.7	—	7.8	9.8

* Fertilization rate of 650 lbs 10-10-10/A. Experiment conducted at Mt. Carmel only.
**Fertilization rate of 1300 lbs 10-10-10/A.

Tomatoes have higher nutrient requirements than the other crops and it appears that the SMC provided insufficient nutrients even at Mt. Carmel. However, when SMC was used with half the normal rate of fertilizer, an 8% increase in yield was observed compared to full fertilizer and no compost.

This study demonstrates that compost not only provides nutrients to plants but modifies other soil properties such as organic matter content. Compost increases water holding capacity and leads to generally higher yields. Annual additions of compost should keep improving the physical properties of the soil and raise the nitrogen reserve as well.

Composts will be reapplied in fall 1989 to determine the effect of cumulative additions of composts on nitrate leaching and vegetable yields. The preliminary results are encouraging. It appears that many vegetables can be grown successfully on compost-amended soils with no additional fertilizer. More importantly, composts retain nitrogen in the soil so it does not leach readily to the underlying ground water.

Genetic improvement of photosynthesis with plant cell cultures

By Neil A. McHale

Attempts to develop improved crop varieties date back to the earliest periods of organized agriculture 5 to 6,000 years ago. Early farmers altered the genetic makeup of their crops by collecting and planting seeds from strains best adapted to local conditions. Following the discovery of Mendel's laws of heredity in the early 1900's, this process was accelerated by controlled hybridization of proven strains to generate material for selection. As we move into the 21st Century, the procedures of recombinant DNA technology are being employed along with hybridization to produce genetically superior crop plants.

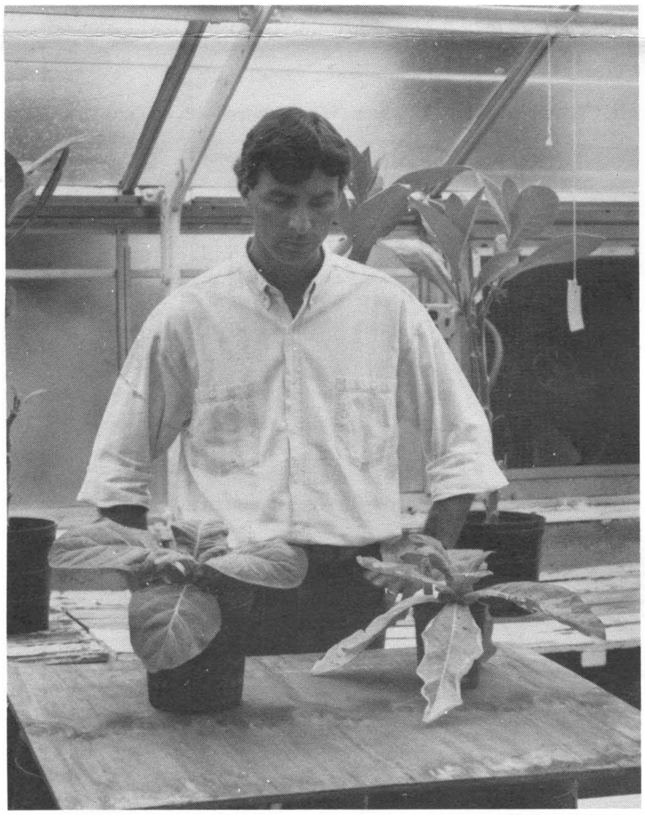

Photo by Wade Elmer

Figure 1. Neil A. McHale examining mutant tobacco plants in a Station greenhouse.

Techniques for growing isolated plant cells on nutrient media and regenerating whole plants from cultured cells have provided several new avenues for genetic manipulation of crop plants. Cloned genes from distantly related plants can now be inserted into cultured cells, which are regenerated into whole plants carrying the new trait. In addition, cell culture procedures permit rapid screening of large populations for beneficial new mutants which can be regenerated into whole plants.

I have focused my efforts on development of cell culture systems for recovery of mutations improving the efficiency of photosynthesis. Photosynthesis is the process by which green plants use energy from sunlight to synthesize carbohydrate from atmospheric CO_2. The rate of photosynthesis is one of the most fundamental aspects of crop productivity. In many crop plants, the efficiency of photosynthesis is diminished by the presence of oxygen in the atmosphere. The deleterious effect of oxygen is two-fold. Oxygen inhibits CO_2 uptake, and also stimulates the loss of CO_2 through a process known as photorespiration. My goal is to employ cell cultures for identification of mutations diminishing photorespiration.

I am working with tobacco in the initial stages of this project because of its amenability to cell culture. Rapid advances in technology of gene transfer should provide a direct avenue for introducing beneficial mutations from tobacco into crop plants, where increased photosynthesis would contribute greatly toward ongoing efforts to improve agricultural productivity.

Plant cell cultures are normally grown on media containing sugars, but earlier work in our department established that green cell cultures of tobacco can use photosynthesis to grow when the sugar supply is removed from the medium. Since photosynthesis is essential for growth, this system provided the first opportunity to screen large populations of cell lines for mutations increasing photosynthetic efficiency. It was initially considered that photosynthetic mutants might be identified simply by their rates of growth. This proved unreliable, however, as growth rates tend to fluctuate in accordance with a number of trivial factors. I have chosen instead to focus specifically on mutations reducing the rate of photorespiration, because this wasteful process is well-defined and provides a clear avenue of approach.

I began by producing special genetic strains of tobacco in which low photorespiration mutants would be easily recognized. This was accomplished by exposing tobacco seeds to a chemical mutagen and selecting mutant seedlings defective in the processing of photorespiratory byproducts. One such mutant strain (NS 349) is lacking an enzyme essential for processing serine, which eventually accumulates to toxic levels and kills the plant. But NS 349 stays green and grows normally when photorespiration is suppressed by growing the plant in a high CO_2 atmosphere. A genetic mutation suppressing photorespiration should have the same effect, restoring the capacity of NS 349 to survive in normal air.

Using this basic principle, I have established a cell culture system designed to identify new mutations in the NS 349 strain that restore survival and growth in air. The cultures are initiated by isolating cells from expanding leaves of plants grown under sterile conditions. Special enzymes are used to digest the cell walls, releasing a suspension of free cells (protoplasts) into a liquid culture medium. By providing essential nutrients and the appropriate balance of plant hormones, the protoplasts are induced to divide and form small colonies. By changing the hormonal balance, colonies can be induced to initiate shoots which develop into new plants (Figure 2).

Although formation of colonies from protoplasts requires sugar in the medium, I found that shoot initiation and plant regeneration can be carried out under conditions promoting photosynthesis and photorespiration. Cell cultures of NS 349 grow normally with sugar in the medium, but induction of photorespiration triggers rapid accumulation of byproducts to toxic levels. In normal air, NS 349 colonies become brown and die even prior to shoot initiation. This provides an ideal opportunity to screen populations of NS 349 colonies for mutations blocking photorespiration, which should appear as green variants against a brown background. Even if such mutations occur at a very low frequency, they can be recovered in this cell culture system, which allows routine screening of 50,000 individuals in a single experiment.

Several such selection experiments have now been completed with NS 349 cultures. From a starting population of 700,000 NS 349 colonies, 23 remained green and grew in air. Our biochemical analysis indicates, however, that these plants are not low photorespiration mutants. Rather it appears they are carrying simple reverse mutations that restore the original enzyme deficiency in NS 349. I am currently employing chemical mutagens to induce a wider spectrum of mutations in this system. The primary objective is to recover individuals that survive in air because of mutations reducing the rate of photorespiration.

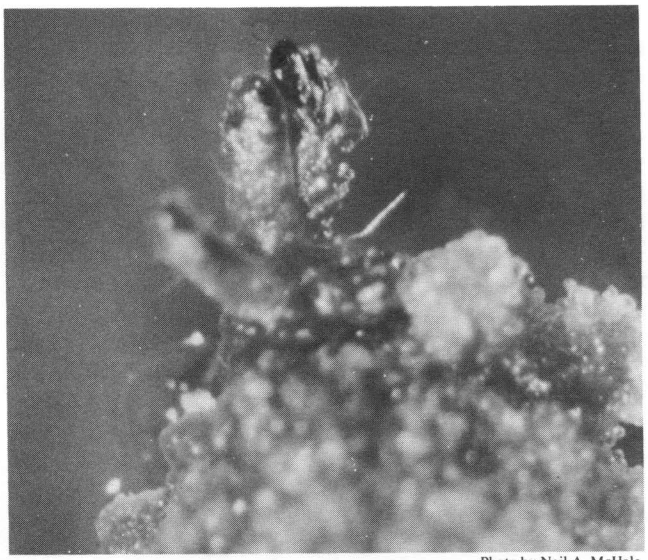

Photo by Neil A. McHale

Figure 2. A shoot developing from protoplast-derived colonies.

Successful use of CO_2 enrichment to bolster the yield of greenhouse crops provides the best evidence that increasing the rate of photosynthesis leads to increased plant productivity. Since there is no practical way to provide CO_2 enrichment for field-grown crops, improvements in photosynthetic efficiency can only be accomplished by changing the genetic makeup of the plant. My goal is to bring the powerful new techniques of cell culture and recombinant DNA to bear on this important aspect of crop improvement.

Plant diseases: Clinical diagnosis and strategies for control

By Sharon M. Douglas

Associated with the extreme weather of the last two years, plant diseases were found in almost every Connecticut homeowner's yard, along roadsides, in commercial growers' fields, and in parks and public areas. Samples from many of these affected plants were submitted to the Plant Disease Information Office of the Department of Plant Pathology and Ecology for both diagnosis and information about control measures.

While we routinely diagnose a range of highly diverse problems and questions, this year we encountered a number of common problems associated with the weather extremes. Fungal leafspots and anthracnoses were abundant on a wide range of herbaceous and woody hosts including black spot of rose, Septoria leafspot of tomato, *Alternaria* leafspot of marigold and squash, black rot of grape, anthracnose of dogwood, and apple scab of crabapple. Fungal blights were also common, especially *Volutella* blight of pachysandra, *Diplodia* twig blight of pine, and *Botrytis* blight of tulip, rose, and geranium. Many samples were submitted with symptoms of winter injury, drying, and dieback. These symptoms were particularly prevalent on needled and broadleaved evergreens such as rhododendron, mountain laurel, juniper, and yew. We also saw evidence of the after-effects of the drought from spring-summer 1988 which caused considerable root damage. Drought-related symptoms were commonly diagnosed on many drought-sensitive trees such as maple and hemlock, on shrubs which had been newly transplanted during the drought, and on many established trees and shrubs that are normally considered drought-tolerant such as birch and juniper.

While some of these diseases are merely aesthetic, as with many of the leafspots, others can be fatal, as with some blights and drought-associated root damage. Accurate diagnosis is therefore the first step in treatment of any type of plant disease; before disease can be effectively treated, it must be properly identified so we can determine its relative importance and severity. There are a few cases where disease diagnosis is as straightforward as observing a specific symptom, as with leaf curl of peach, but in the majority of situations, diagnosis is much more complex. While the possibilities are many, we narrow these down by integrating several factors. These include observations of symptom type, identification of the causal agent, and knowledge of the basic characteristics and growth requirements of the plant host.

Plant diseases are characterized by the type of symptom exhibited by the host. The major types of plant diseases encountered in Connecticut are anthracnose, blight, canker and dieback, gall, leafspot, rot, rust, smut, and wilt. As previously mentioned, the relative importance of these types of disease varies—some diseases are more aesthetic than life-threatening. For example, a fungal leafspot of maple is often not serious enough to require control measures whereas Phytophthora root rot of zucchini, which interferes with water-uptake, can seriously debilitate and eventually kill a plant if left unchecked.

Diseases which mar a prize ornamental or those which cause significant reductions in crop yield are not necessarily fatal but are nonetheless important. This year, Septoria leafspot of tomato was a significant problem throughout Connecticut. This disease can defoliate an entire plant and can cause significant reductions in the quantity of fruit produced if it strikes early and if left uncontrolled. On the other hand, a moderate infection towards the end of the season may be left uncontrolled without any significant adverse effects. The potential incidence and severity of Septoria leafspot of tomato for next year may be reduced by cleaning up all plant debris in the fall. It is therefore necessary to weigh the importance and timing of the disease and the host against a decision to treat in each circumstance.

Disease diagnosis based solely on symptoms can sometimes be misleading and can lead to improper, ineffective controls. In circumstances where different causal agents incite the same or similar symptom on a host plant, accurate diagnosis requires identification of the causal agent. When tomato plants are brought to our office with wilt symptoms, we need to determine whether the causal agent is a bacterium or a fungus since the controls for one type are essentially ineffective for the other type.

We identify specific causal agents using light microscopy and histochemical staining, isolation on artificial media, soil extraction, electron microscopy, studies of host range, and indicator plants. We are currently implementing recently developed biotechnological techniques for detection of many difficult-to-identify causal agents. Once the causal agent has been identified, it is important to know how the disease affects the plant host—this is necessary to make an informed decision about what, if any, action is required. Black Rot of grapes was a particularly serious problem this year. The fungus causing this disease can infect all new growth including young leaves, petioles, blossoms, and young fruit. On leaves, a leafspot symptom develops which many not appear to be serious but infected fruit dry, shrivel, and wrinkle until they become mummified and look much like a raisin. Without accurate diagnosis and understanding of the problem, the leafspot symptom may have been considered insignificant and the entire crop lost because measures for control were not implemented.

Photo by Wade Elmer

Figure 1. Sharon M. Douglas answering a question in the Plant Disease Information Office.

After a plant disease has been diagnosed, we can provide information on control strategies. A common misconception of disease control is that chemical sprays, dusts, and soil drenches are the only effective means of reducing the effects of plant disease. While this is an important part of control, it is only one component. Disease control is actually a multifaceted process which can be achieved through the use of culture, sanitation, resistance, and chemicals. This approach has always been important and is particularly significant in light of potential environmental and health-related concerns with pesticide use.

Diseases can be controlled or their effects significantly reduced by cultural methods that modify the plant's growing conditions. Good plant vigor can be maintained by proper watering and fertilizing, appropriately timed pruning and transplanting, adequate spacing between plants, and by improving the tilth of the soil. Many rhododendrons this spring exhibited characteristic symptoms of winter injury. Leaves had marginal or tip browning and curling and in more severe cases, branch tip death. Rhododendrons are more prone to this type of injury and fungal leafspots when not properly maintained or when stressed by root injury from drought. These problems can be minimized by maintaining an acidic soil pH, fertilizing in early spring, and watering during periods of drought and just before the ground freezes in the fall.

Disease control through sanitation consists of using healthy, disease-free seed, bulbs, cuttings, or plants, pruning of affected plant parts, raking/removing affected plant parts such as fallen leaves and mummified fruit, rotating crops, and disinfesting tools such as pruning shears and spades. For example, sanitation is an essential component in control of Brown rot, a common and destructive fungal disease of stone fruits in Connecticut which was particularly severe this year. It is important to remove and destroy mummied fruit on the ground or remaining on a tree and to prune and remove dead and/or cankered twigs. The ground beneath the tree can also be cultivated to prevent spores from forming on the mummies in the spring. Careful harvest practices which avoid bruises, punctures, or tears in the skin of mature fruit also reduce infection.

Resistant plants, when available, may be the most effective control for many viruses, nematodes, wilt diseases, and some leafspots, all extremely difficult-to-control plant pathogens. For example, cultivars of crabapple with resistance to apple scab and of tomato (designated VFN) with resistance to Verticillium wilt, Fusarium wilt, and nematodes are available.

Chemical disease control uses pesticides to limit the effects of the pathogen. The commonly used chemicals are fungicides, bacteriocides, and nematicides. When chemical controls are justified by the nature of a problem and its associated losses, our office can provide information about the pesticides which are registered for use in control of a specific disease and about timing for their application. Chemicals which are applied too late in the disease cycle often provide no control and are essentially wasted. With apple scab, the most troublesome disease of apples in Connecticut every year, the fungus has two distinct cycles of infection—if the pathogen is essentially controlled with properly selected and timed fungicides during the first cycle of infection in the spring, the second cycle does not occur and pesticide sprays are unnecessary for the remainder of the season.

The Plant Disease Information Office is ready to provide clinical diagnosis and information on control strategies for all types of plant diseases, from spotted leaves of crabapple to rotted tomato fruit, for agricultural producers, urban gardeners, and homeowners throughout Connecticut. We continue to seek new techniques to assist in more accurate and expedient plant disease diagnosis and to evaluate alternative strategies for more effective disease control which minimize pesticide usage and maximize environmentally sound practices.

Automated procedure determines Pesticide residues overnight

By Harry M. Pylypiw, Jr.

An automated procedure for analysis of pesticides has been developed at The Connecticut Agricultural Experiment Station and is now in use to determine pesticide residues on fruits and vegetables. The new procedure replaces a labor-intensive method which required two days to prepare and test a maximum of four samples. With the use of the automated procedure, up to 10 samples can be prepared and analyzed each day. Results, which are available the next morning, are produced by equipment that operates overnight. The procedure can test fresh fruits and vegetables for up to 22 organochlorine and organophosphate pesticides.

Samples of fresh produce such as strawberries, blueberries, peppers, squash, and corn are picked in Connecticut fields by an inspector of the Department of Consumer Protection. At the Experiment Station, the samples are cut, chopped or blended into a homogeneous mixture before extraction of the pesticides with an organic solvent mixture. The solvent extract is then transferred to a separatory funnel for removal of interfering compounds by addition of distilled water. After several washings, the extract is placed in a sealed container and is ready for chromatographic analysis.

The extracts are analyzed using a computer-controlled gas chromatograph equipped with an automatic injector. After normal working hours, the instrument injects each sample and records data. The next morning the data are reviewed manually by an analytical chemist to determine if any pesticides are present. All samples that contain residues are compared to Environmental Protection Agency (EPA) allowable tolerances for each pesticide. Any sample residue found to be above EPA allowable tolerances is reported to the Connecticut Department of Consumer Protection.

To confirm the accuracy of the testing, one out of every six samples is prepared in duplicate and a known quantity of a pesticide is added to it. The average recovery ranges from 89% to 108% with the median being 97%. The variability from sample to sample falls between 2% to 5%. Pesticide concentrations can be determined accurately to a detection limit of 0.002 parts-per-million (ppm).

Results of the analysis of Connecticut fruits and vegetables tested from June to August 1989, are given in Table 1. Certain pesticides such as Thiodan, an insecticide; Ronalin, a fungicide; Dacthal, an herbicide; and Kelthane, an acaricide, were detected on about half of the samples. Other pesticides, which have not been applied by Connecticut farmers in over 15 years, such as Dieldrin, a chlorinated insecticide, and DDE, the degradation product of the insecticide DDT, are still being found in trace quantities in some samples due to their persistence in the soil.

Overall, 52% of 132 samples tested during the summer of 1989 contained detectable residues. Of the 68 samples that contained residues, three samples, one each of beet, cabbage and peach, exceeded EPA allowable tolerance levels. When additional samples obtained from the same fields were tested, only the cabbage sample was found to be within allowable tolerance limits.

The automated procedure can identify a broad range of pesticides in a variety of crops. It has been tested and validated for 22 pesticide compounds, but has the potential to detect and measure over 60 different pesticide compounds and pesticide metabolites. Research will continue in an effort to extend the capabilities of the testing procedure.

Table 1. Connecticut produce tested from June to August 1989.

Produce (No. tested/No. with residues/No. over-tolerance) Pesticide	Range (ppm)	Allowable (ppm)
Beet (5/3/3)		
Bravo	0.037-0.60	*
DDE	0.002	0.2
Diazinon	0.07	0.75
Thiodan	0.037-0.05*	*
Bell Pepper (11/5/0)		
Dacthal	0.007-0.87	2
Diazinon	0.029	0.5
Thiodan	0.012-0.29	2.0
Blueberry (4/1/0)		
Thiodan	0.005	0.1
Cabbage (4/1/1)		
Diazinon	0.18	*
Kelthane	0.08	*
Carrot (1/1/0)		
DDE	0.01	3
Corn (15/0/0)		
None Found		
Cucumber (6/4/0)		
Bravo	0.023-0.042	5
DDE	0.003-0.018	0.1
Thiodan	0.005-0.11	2.0
Peach (5/5/2)		
Dursban	0.014-0.18	0.05
Rovral	0.13-3.5	20.0

Produce (No. tested/No. with residues/No. over-tolerance) Pesticide	Range (ppm)	Allowable (ppm)
Raspberry (1/1/0)		
Ronalin	0.21	10
Snap Bean (3/3/0)		
Bravo	0.08	5
DDE	0.037	0.2
Dacthal	0.011	2
Thiodan	0.006	2.0
Summer Squash (25/17/0)		
Bravo	0.002-0.20	5
DDE	0.002-0.036	0.1
Diazinon	0.002-0.08	0.5
Dieldrin	0.002-0.036	0.1
Thiodan	0.016-0.15	2.0
Strawberry (40/24/0)		
Dursban	0.010-0.13	0.5
Kelthane	0.025-1.15	5
Ronalin	0.004-1.08	10
Thiodan	0.009-0.17	2.0
Sweet Pea (2/0/0)		
None Found		
Tomato (10/3/0)		
Bravo	0.010-0.17	5
Dacthal	0.006-0.035	1
Diazinon	0.038	0.75
Thiodan	0.034-0.12	2.0

*—Not allowed on this crop.

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