Department of Agriculture, Trade and Consumer Protection
• Bureau of Plant Industry •



WISCONSIN DATCP

UNIFORM ENFORCEMENT GUIDE •PLANT PROTECTION SECTION

DEPARTMENT OF AGRICULTURE, TRADE & CONSUMER PROTECTION
DIVISION OF AGRICULTURAL RESOURCE MANAGEMENT
BUREAU OF PLANT INDUSTRY
2811 AGRICULTURE DRIVE MADISON, WI 53708-8911



Table of Contents

OBJECTIVE AND AUTHORITY OF THE DEPARTMENT

The Plant Industry Bureau works with the agricultural community to monitor and control serious plant pests, diseases and exotic species that threaten Wisconsin's crops, forests, honeybees and plant communities. Each year the industry that we support produces $1.38 billion of corn grain, and 1.6 million acres of soybeans, valued at more than $511 million. Additionally, Wisconsin leads the nation in snap bean production ($61 million, annually) and ranks third in potato production ($293 million). Wisconsin apple orchards produce a yield of $28 million and the beekeeping industry contributes $192 million to the economy of the state, in pollination value and hive products.

The Bureau licenses and inspects nursery growers and dealers, Christmas tree growers and seed labelers. The Bureau is also responsible for gathering, evaluating and distributing statewide pest survey information that assists Wisconsin agriculture in crop production. We inspect, regulate, survey and implement treatment programs as necessary to control plant pests and diseases to ensure the health and profitability of the forestry, crop and nursery industries. Our work assists agricultural producers with crop production and facilitates the interstate and international movement of Wisconsin plant commodities. Reports on pests of importance to agricultural crops, nursery and forests are published weekly during the growing season in the Wisconsin Pest Bulletin, an online publication. The Bureau works closely with the businesses it regulates, farmers, food processors, and the University of Wisconsin, University of Wisconsin Cooperative Extension, Department of Natural Resources, USDA Animal and Plant Health Inspection Service, the USDA Forest Service, and many other industry groups.

The Plant Industry Bureau and its staff are responsible for administering and enforcing numerous state statutes (ch. 93, ch. 94) and administrative rules, including ATCP 21 (Plant Inspection and Pest Control), ATCP 20 (Agricultural and Vegetable Seed), NR 40 (Invasive Species Identification, Classification and Control) and others.

DATCP Plant Pest & Disease Specialists (PPDS) charged with enforcing Wisconsin statutes, rules and regulations perform a minimum of four tasks:

1. Inspect plant products offered for sale or distribution in their area. The inspections should reflect the consumer usage of the products. To accomplish this, the specialist must have a working knowledge of the plants, pests and diseases; sampling techniques; inspection methods; and steps that must be taken with regard to violations. The specialist, as liaison between license holder and DATCP, is charged with the responsibility of assisting them with any problem involving non-compliant products. This may encompass removing product/stock from channels of trade.

2. Assure that all products offered for sale or distribution are properly labeled and the distributor/labeler/grower/dealer is licensed.

3. Serve as the principal contact between the consumer and DATCP. The consumer should be made aware of the service and product assurance available. Understanding investigative procedures is vital to conducting effective inquiries into consumer complaints.

4. Assist the administrative program section of DATCP through personal contact with firms and individuals with regard to their product/stock, licensing, or meeting the requirements of an Order or voluntary Compliance Agreement.

ENFORCEMENT GUIDELINES

Purpose

This manual is a guide to achieving uniform enforcement of the laws and rules under the jurisdiction of the Division of Agricultural Resource Management, Bureau of Plant Industry. This is a guidance document and does not set policy, as each inspection has unique factors that will determine the final compliance response. The guidance reflects the Department's regulatory philosophy, which relies on voluntary compliance. In cases where voluntary compliance cannot be achieved, it relies on progressive enforcement. The goal of progressive enforcement is to bring individuals into compliance with "just enough" enforcement action to gain permanent compliance. However, when we encounter willful or dangerous violations, our enforcement must be swift and sure, to protect citizens, natural resources, and industries.

The manual is intended for use by both office and field staff within the Plant Industry Bureau. This manual does not replace the good judgment of department staff. It provides uniform enforcement guidelines for action in routine situations and the proper statute, code citations and wording to be used while taking enforcement actions. Actions proposed in the following tables are to be followed whenever possible. In unusual circumstances, department staff will decide what enforcement action is appropriate by drawing on training, experience, and judgment. To ensure uniform approaches, consultation between staff is essential when selecting alternative compliance responses. Decisions must always serve the best interests of the public.

Voluntary Compliance

Most people want to comply with the law. Our approach to regulation is to work collaboratively with the groups we regulate to gain voluntary compliance. In developing administrative rules needed to implement state laws, the department relies on input from the regulated public, and other groups to help us set reasonable, science-based standards that reflect current technologies and practices. In seeking voluntary compliance we rely on: customer service, outreach and education, and collaborative problem solving. Education of the regulated community is a powerful tool to help us secure compliance. When problems are identified, our guidance must be immediate, clear and concise. Voluntary compliance can only be achieved when we are direct in our approach at pointing out violations. Often the lack of compliance is due to a lack of knowledge. Our jobs do include a responsibility to help our regulated customers understand what is expected of them, and why the law is in place. This information must be provided promptly and in a form our regulated customers can understand and use.

Progressive Enforcement

Where voluntary compliance cannot be achieved, our approach is to provide progressive enforcement, a sequence of steps to gain compliance with the rules and laws under our supervision. All statutes and codes are enforceable; however, each may carry a different level of enforcement depending on the best interests of the public. Criteria department staff may apply when deciding a level of compliance are:

- enforcement options available
- adequacy of informal and educational measures to secure compliance or resolve problems
- the nature, extent and seriousness of potential harm to the public or environment
- the immediacy of potential harm, and the likelihood of continued harm if no action is taken

- the willfulness of the violation, and the likelihood that the violation will continue if no action is taken
- past history of compliance or noncompliance by alleged violator
- responsiveness of the violator
- clarity and interpretation of the applicable statute(s) or rule(s)
- number of violations encountered

The progressive enforcement process which is outlined in this guide includes three levels of compliance actions, with several enforcement tools within each level. The tables later in this enforcement guide recommend the appropriate level for a first time enforcement action, consistent with the above criteria. The actions taken by an inspector will normally be within the enforcement level identified, but may be adjusted where selection of a differing enforcement level is justified based on the criteria listed above. (If, for example, a nursery has many violations or repeated violations, a higher level enforcement will normally be justified.) The three enforcement levels are:

- Level 1 - Compliance Assistance
- Level 2 - Warning
- Level 3 - Formal Enforcement

As a general rule, the Progressive Enforcement Levels 1 and 2 will be implemented in the field, unless designated as an office response. Level 3 actions will normally be coordinated through the central office, however many Level 3 actions can also be discussed while the inspector is still at the site. Where a violation shows multiple levels the selection should be made based on the level of knowledge, level or harm and other criteria shown above.

Whenever a compliance action must be taken, be sure to fill out a compliance form. When a form must be issued, the "comply/correct by" date will vary depending on the violation. Some orders, such as a Pest Abatement Order or an Order Prohibiting Sale or Movement, have specific timeframes written into the statutes; 10 days and 30 days for nursery stock or seed, respectively. Other forms, such as an Activity Report do not have specific timeframes assigned. They are to be assigned by the inspector, based on the type of violation. Suggested timeframes are included in the table, but should be assigned at the discretion of the inspector.

Level 1 – Compliance Assistance

This level assumes voluntary compliance will be effective once the person is made familiar with the detailed requirements and the importance of compliance. The person may or may not be familiar with the provision in the past, but either through lack of training or passage of time, compliance is not in place. Where the violation is more significant (potentially harmful to the consumer or the environment), the compliance assistance will be more formal, issuing an Activity Report with an expected compliance date and more detailed information provided to the customer.

Goal:
To communicate the occurrence of a violation to a responsible person and provide education and information on how to correct that violation.

Tools:

- Verbal Communication
- Information & Educational (I&E) materials, including copies of laws, rules and handouts
- Regulatory Actions written on Inspection Report

- Activity Report with "Correct By" date

Minimum Expectations:
- Discuss the violation(s) and corrective option(s) with the most responsible facility representative present at the site.
- If the person best able to correct the violation cannot be reached during the inspection, that person will be contacted that week by the inspector by mailing a copy of the inspection report and/or Activity Report and, if necessary, a phone call, email or informational letter.

Documentation:
- Inspection Report with Regulatory Actions noted; copy left at site at conclusion of the inspection if any nursery staff is present.
- If the violation is more significant, use the Activity Report with a "Correct By" date and follow-up shortly after that date, either by phone, email or in person to assure the problem has been rectified.

Level 2 - Warning

This enforcement level assumes that a basic level of awareness has already been established, or that the risk is readily apparent even if not specifically discussed with the facility in the past. This level of enforcement re-emphasizes the seriousness of the matter, either as a stepping stone to more formal enforcement or as an incentive to re-establish voluntary compliance. This level also assumes that the appropriate compliance assistance tools from LEVEL 1 will be used.

Goals:

To provide and record a formal notice to responsible persons that observed violations are serious in nature, or represent previously observed violations that were not corrected, and require prompt action.

Tools:
- Warning Notice form with "correct by" date specified (Wis. Stats. §93.06(10), 94.01)
- Order Prohibiting Sale or Movement (Wis. Stat. §93.18, 94.76, 94.10(9), Admin. Code ATCP §21.03(1))
- Pest Abatement Orders (ATCP §21.03(2))
- Releases (Conditional or Complete) (see individual program for applicability)
- Requiring a written/phone response
- Re-inspections

Minimum Expectations:
- Discuss the violation and corrective options with the most appropriate facility representative present at the site (this communication may be brief if the only person present is unable to resolve the violation).
- Use of a Warning Notice, Order Prohibiting Sale or Movement, Pest Abatement Order or in very limited situations, a Quarantine Order.
- Always leave the compliance form on site with the person that the violation was discussed with.
- If the most appropriate contact is not present or if others need to know, send a letter as soon as possible with the compliance form. Alternatively, the inspector may call the facility the next day to discuss the violation and corrective options and to let that person know that the compliance form has been left at the site, with a copy being sent to them directly.
- Always specify a correction date and request notification once the violation has been remedied on the compliance form, and in the letter/email (if a letter/email is sent).
- Always follow-up if no response arrives by the specified date. The follow-up may be by phone or in

person, but generally if the violator has not responded, a re-inspection is needed. When a response does arrive, a follow-up visit can be planned, if the inspector deems it necessary, but the time within which the follow-up is conducted is more flexible.

Documentation:

- Warning Notice, Order Prohibiting Sale or Movement, Pest Abatement Order
- Documentation of violation (via samples, photos, Activity Report or brief narrative as appropriate to the situation)
- Follow-up letters/emails (if sent by inspector) or phone conversation notes on an Activity Report if a more responsible individual was called to discuss violation.
- Responses (if received by inspector)
- Follow-up inspection report (if a follow-up occurred). The documentation may be an Activity Report if corrected, or case narrative if not corrected.

Level 3 – Formal Enforcement

This level is intended to address those situations where voluntary compliance has not by itself been effective. The level includes several options that vary from program to program, and that require a high degree of office/field cooperation to assure the selected action fits the situation, and is both timely and effective. Formal enforcement is coordinated by the Madison office, but relies on information collected by the inspector. It is designed to maximize the long term working relationship between the inspector and facility management. This level also assumes that the appropriate compliance assistance and warning tools from LEVELS 1 and 2 have be used while still at the site when a violation is readily evident.

Goals:

Assure that the violator has a full understanding of the requirements, obtain a written commitment to a compliance plan and promote future compliance through appropriate penalties or other specified efforts, up through removal from business.

Tools:

- Formal Compliance Conference (coordinated with and including central office staff) with written compliance plan follow-up
- Assurance of Voluntary Compliance
- Administrative Complaints and Orders (Special or Summary)
- Civil Complaints and Forfeitures
- Administrative Complaint with License Order
- Criminal Complaints and Penalties

Minimum Expectations:

- Where a violation can be verified in the field, a Written Warning Notice, Order Prohibiting Sale or Movement or Pest Abatement Order will be issued, consistent with the process described in LEVEL 2.
- The inspector will notify the Madison office for initiation of an investigation and the violation(s) will be fully documented, possibly including a narrative report regarding the circumstances of the violation and prior actions. Or in the case of a chronic failure to get licensed, the Madison office may initiate.
- Follow-up actions, including follow-up inspections or investigations must be coordinated between the program manager, section supervisor and inspector.
- Enforcement actions beyond a compliance form will be coordinated through program managers, Plant Protection Supervisor and the inspector, with specific roles determined on case-by-case basis.

Documentation:

- Warning Notice, Order Prohibiting Sale or Movement, Pest Abatement Order as appropriate
- Narrative Report
- Documentation of all violations associated with the case, including samples, photos, narrative text, affidavits, etc., as appropriate to the case
- Correspondence from or to a suspected violator (correspondence from the inspector should be reviewed through the Madison office before being sent on cases at this level.)

General Authorities and Violations

Each program we work with has its own statutory authorization, and all programs include specific penalty and enforcement provisions. Wis. Stats. Chapter 93, includes a number of general authorities and enforcement tools that can be used in our program areas.

Our general authority to inspect and sample products is found in ss. 93.07(12), 93.08(1) & (3), Stats. & 94.01(4)

Refusal to provide records in the course of an inspection/investigation is a violation of s. 93.15(3) Stats. & 94.10 (4)

Denying access to the department is a violation of Wis. Stats. 93.08, 93.15(2), 93.21(2), 94.10 (8) & 94.76. Once denied access the department may obtain a special inspection warrant pursuant to ss. 66.122 and 66.123, Stats.

Violating a special order, or any order or regulation of the department, is found in s. 93.21(3), stats., and additional penalty provisions may be found in each program statute.

Violating a conditionalized license is found in s. 93.06(8), Stats.

Nursery Policy & Procedures ***Table Of Contents***

Notes

INSPECTIONS **SECTION 1**

Memorandum of Understanding between DATCP and DNR for NR 40

MOU applies to all Plant Pests over which both DNR and the Agricultural Resource Management Division of DATCP have jurisdiction. DNR's and DATCP's relevant statutory authorities related to Plant Pests overlap, thus cooperation between agencies is imperative for preventing and controlling Plant Pests efficiently and effectively.

RECOMMENDED STEPS AND PROCEDURES FOR NURSERY INSPECTIONS

The purpose of the Wisc. Stats. Chapter 94 and Chapter ATCP 21 Plant Inspection and Pest Control is to prevent the introduction into and the propagation and dissemination within this state of plant pests and to provide for their suppression and control. To accomplish this purpose, inspections of nursery stock are made to assure freedom from plant pests. Inspection of Nursery Growers and Dealers provides a first line of defense against infested stock and provides consumers protection against purchasing stock with problems. This purpose should be in mind when conducting inspections.

Due to the inspectors: growers/dealers ratio, priorities for inspections have to be set. Dealers in your territories should be visited at least every three years, preferably every other year, and if you have the time, every year. Growers in your territory should be inspected **every** year if they **ship interstate and/or have a PHC**. Growers who only **sell locally** should be inspected **every other** year, or every third year if that's all time permits. Inspection reports for all licensed nurseries are printed annually.

Organizing and Planning Inspections

1. Efficient use of time is critical to a successful inspection season. Time spent in the office organizing and planning the assigned inspection route can save hours lost in the field. The beginning of the week is the best time to do this organizing and discuss problems or raise questions with fellow inspection staff, the program coordinator or the supervisor. Scheduled office time also gives your growers a time to communicate with you.

2. Inspectors are responsible for organizing workload and scheduling inspections in their assigned territory. Dealer inspections should begin May 1 and should be winding down by mid June. Grower inspections should begin mid-June and typically go till September 1, when Christmas tree inspections begin. Weather dictates how late in the season inspections are effective. Once leaves begin to turn, inspections become more difficult. After Christmas tree inspections, Eggmass inspections are done from November 1 through mid-March. Eggmass inspections need to be done by mid-March so treatment letters can be sent out.

3. When planning your week, consider contacting new businesses or those with sites which have proven difficult to find or access in the past to clarify directions. Refer to your copies of inspection reports from last season or electronic files in the i:\drive or even the white copies in the main office to provide insight into your visit. (Problems previously encountered, special instructions, location info. etc.)

4. Inspection reports have applicant information pre-printed and will be distributed to inspectors

before May 1. These report forms will have directions to the fields, if provided. Use this space to include additional location information or to update current information (i.e. better field directions, field no longer in use, etc.) to be entered into the database by the LPPA. Inspection reports for new license holders will be printed as they are issued throughout the season. New inspection forms will be emailed to the assigned inspector.

5. Always be sure that your assigned cell phone is in working order and that it is ready to receive messages. When traveling or inspecting, phones should be on at all times, and carry it with you into the field in case of emergency. Check for messages regularly. Don't forget—it's also your GPS unit and your camera.

Conducting the Inspection

1. Upon arrival at the inspection site, prepare preprinted Inspection report for the inspection by confirming the information printed on the form is correct. Make changes to spelling, address, GPS coordinates, etc. on the form so the correction can be made in the database by the LPPA. Complete as much of the form as you can before you leave the car. **Signing and dating** the form right away will assure you don't forget later. Collect GPS coordinates for inspection site, saving waypoint as the property RSN. *For GPS Collection – See GPS Collection Instructions in Section 9*

2. For new license holders, introduce yourself to responsible person presenting your business card and explain that you will be doing an inspection of the nursery stock. You can ask if they have been having any issues or problems they would like you to look at or sample.
For GROWER inspections: Confirm directions to any additional growing locations and establish an understanding of all stock to be sold this year. Ask if any field maps are available to help with identifying locations/blocks where problem stock is found.

3. Focus on problem areas and begin to organize inspection. Anticipate situations, which may require closer inspection. At production sites, select a vantage point and divide nursery into manageable sections. Be sure not to block field roads or areas where work is being done. (Digging, cultivating etc.).

4. Look for signs of insect or disease problems and inspect more closely plants that are off color, browning or dying back. Collecting samples for verification/identification of a disease may be necessary; follow the guidelines on the back of the Plant Disease Identification Form from the Plant Lab, and flag with orange flagging tape any stock for which regulatory action will be necessary. Note the location, species/variety and number of plants affected. Use the pest names and corrective action detailed on the HIS Regulatory Action sheet. *Being consistent in regulatory action is very important.*

5. Inspect Barberry for compliance with the Federal Black Stem Rust Quarantine (Regulations found in Section 10). Proper labeling with botanical name and presence of federal stamp or label on shipping documents is the most important. Determination of the variability of morphological characteristics should be secondary. Contact section supervisor if there are questions regarding variability.

6. Perennials are nursery stock and must be inspected. Keep in mind that some perennials may not be active throughout the summer. Attempt to schedule inspections when plants are in a mature stage of growth. All stock must be held in conditions to maintain viability.
Packaged dormant plant material, is also to be inspected, and should be kept in conditions to maintain

viability. Once they break dormancy and initiate growth the retailer has the options to either pot the plants and care for them as potted stock, return them to the shipper, or destroy them.

7. Samples of unknown plant pests or diseases can be collected and submitted to the PIB Lab for identification. A completed Lab Form must accompany the sample.

Enforcement

Section 2 of the Nursery Section covers enforcement policy for violations.

Inspection Report Submission

1. Inspection reports should be completed during the inspection. Discuss problems noted on the inspection form with the most responsible person on site. Provide referrals or related information when appropriate. Include detailed explanations on the form if no one can be contacted. Leave your business card or refer to phone number on the form and indicate a time when you can be reached with questions. Leave a copy with an employee at the location being inspected (put it in the mail if not possible to leave at site) and keep a copy for your own records. ***Mail the top, white, inspection reports to the Madison office weekly.***

2. If any compliance forms were issued during the inspection, consider the need for a follow up inspection for a serious violation or history of non-compliance. Plan to conduct such inspections when routing later inspections.

3. Some inspectors have multiple large nurseries that can be inspected much easier when done as a Group Inspection. Each inspector should attend as many Group Inspections as possible during the season.

4. Cooperative Agricultural Pest Survey (CAPS) data will be collected by the Nursery coordinator from all reports sent in. This information is collected by county and if not found, will be considered a negative result of an official survey for several plant pests of quarantine and regulatory significance.

Special Inspections

Special inspections for houseplants being moved interstate are another service we offer. Based on where they're moving, the houseplants may require a Plant Health Certificate or a State Phytosanitary Certificate. A blank inspection report can be used for these inspections. Cost should be determined, discussed and agreed upon with the person requesting the inspection. Payment must be received at the time of inspection. Record the check number and the word ***paid*** on the report form, with copies distributed to the customer, the office and inspector file. The check should be mailed promptly to the Madison office with the top copy of inspection report.

A Systematic Approach to Diagnosing Plant Damage

I. Five Steps for More Accurate Diagnosis of Plant Problems

A. Determine if the plant's growth is normal. Know your "patient". Be able to distinguish

normal from abnormal growth.

B. Check for the distribution of overall patterns
   1. Random distribution of injured plants is most often associated with biotic agents such as infectious disease problems or insect/animal injury.
   2. Uniform distribution of injured plants is most often associated with abiotic or noninfectious agents such as pesticides, fertilizers, environmental or site stress and mechanical damage.

C. Examine the damaged plants closely to distinguish which part is injured.
   1. Leaf
   2. Stem
   3. Root
   4. Vascular system
   5. Flower or fruit

D. Check for specific symptoms
   1. Leaf Injury
      a. Necrotic spots
      b. Off-colored leaves
      c. Enlargement of spots (i.e. "active" spots vs. "inactive" spots)
      d. Spots with fungal fruiting bodies
      e. Tissue removal (e.g. shotholes, scrapings)

      A uniform pattern of injury on a leaf (e.g. marginal leaf scorch) is usually caused by an abiotic or noninfectious causal agent. A random pattern of injury (e.g. leaf spot) is more likely due to a biotic factor. Use your reference books and pictures for comparisons. Be careful not to jump to conclusion on the basis of symptoms alone. Several different causal agents may produce nearly identical (look-alike) symptoms (e.g. aphid infestations, virus infections and growth regulator injury).
   2. Stem Injury
      a. Injury located at junction of diseased and healthy tissue
      b. Cankers present
      c. Holes in the stem
      d. Stem breakage
      e. Abnormal growth
   3. Root Injury
      a. Dark, mushy roots
      b. Stunted root system

      Root injury may initially be most apparent through above ground symptoms such as wilting, chlorosis or chronic leaf scorch.
   4. Vascular Problems
      a. Leaf wilt and yellowing
      b. Discoloration of vascular tissue
      c. Sudden injury to one side or an entire plant
   5. Flower or Fruit
      a. Abnormal development/poor fruit set
      b. Discoloration

E. Ask Questions and Listen To the Answers

1. Cultural practices
   a. History of the problem?
   b. Previous plantings?
   c. Pesticides/fertilizers?
   d. Varietal differences?
   e. Watering practices?
   f. Sanitation?
2. Weather Conditions
   a. Last summer/Fall/Winter
   b. Present time?
   c. At time pesticides were applied?
   d. Last week?
3. Area/Site Problems
   a. Drainage?
   b. Soil type?
   c. pH/salts/nutrients?
   d. Exposure?
   e. Topography?
4. Neighboring Plants
   a. Similar problems?
   b. Same types of plants affected?
   c. Patterns?

II. A Systematic Approach to Diagnosing Plant Damage

To determine what factors damaged a plant requires an inquisitive, investigative approach combined with careful observation and the ability to put all the pieces together to reconstruct the event(s) that produced the plant damage. Accurate diagnosis must be made before corrective action can be taken; even if no corrective measures are available, there is satisfaction in simply knowing what the problem is and what its future development might be.

Probability of correct diagnosis based on only one or two clues or symptoms is low. Similarities of symptoms produced on the same plant by completely different factors frequently make the use of symptoms alone inadequate.

In diagnosing plant damage a series of deductive steps can be followed to gather information and clues from the big, general situation down to the specific, individual plant or plant part. Through this systematic, diagnostic process of deduction and elimination, the most probable cause of the plant damage can be determined. Steps to follow in gathering diagnostic information are presented in Table 1. Each step will then be expanded and guidelines presented as we proceed through the diagnostic process. We will first identify the problem, then attempt to distinguish between living and nonliving damaging factors based on the observed damage patterns, development of the patterns with time, and other diagnostic signs.

Factors causing plant damage can be grouped into two major categories:

- Living factors: living organisms such as *pathogens* (fungi, bacteria, viruses, nematodes)

and *pests* (insects, mites, mollusks, rodents...). With living factors, "Something is missing, and something is gained."

- Nonliving factors: *mechanical factors* (i.e., breakage, abrasions, etc.); *physical, environmental factors* (extremes of temperature, light, moisture, oxygen, lightning); and *chemical factors* (chemical phytotoxicities, nutritional disorders).

Table 1. Flow Model for Diagnosing Plant Damage

I. Define The Problem (Determine that a "real" problem exists):

A. Plant identification and characteristics. Establish what the "normal" plant would look like at this time of year. Describe the "abnormality": Symptoms & Signs.
B. Examine the entire plant and its community. Determine the primary problem and part of the plant where initial damage occurred.

II. Look For Patterns: On more than one plant? On more than one plant species?

A. Nonuniform damage pattern (scattered damage on one or only a few plant species) is indicative of *living factors* (pathogens, insects, etc.).
B. Uniform damage pattern over a large area (i.e., damage patterns on several plant species) and uniform pattern on the individual plant and plant parts indicates *nonliving factors* (mechanical, physical, or chemical factors).

III. Delineate Time-Development Of Damage Pattern:

A. Progressive spread of the damage on a plant, onto other plants, or over an area with time indicates damage caused by *living organisms*.
B. Damage occurs, does not spread to other plants or parts of the affected plant. Clear line of demarcation between damaged and undamaged tissues. These clues indicate *nonliving damaging factors*.

IV. Determine Causes Of The Plant Damage. Ask questions and gather information.

A. Distinguish among living factors
   1. *Pathogens* - Symptoms and signs.
   2. Insects*, mites, and other animals* - Symptoms and signs.
B. Distinguish among nonliving factors
   1. *Mechanical factors*
   2. *Physical factors*
      a. Temperature extremes
      b. Light extremes
      c. Oxygen and moisture extremes
   3. *Chemical factors*
      a. Analyze damage patterns in fields and other plantings.
      b. Injury patterns on individual plants.

c. Pesticide-pollutant phytotoxicities - damage patterns.
d. Nutritional disorders - key to nutritional disorders.

C. References (check reports of damaging factors on identified plant); may need *laboratory analyses* to narrow range of probable causes.

V. Synthesis Of Information To Determine Probable Causes.

If we suspect that it is a living damaging factor, we will look for signs and symptoms to distinguish between pathogens and insects. If the accumulated evidence suggests that it is a pathogen, we will seek evidence to distinguish among fungal, bacterial, viral pathogens and nematodes. If the evidence indicates the damaging factor is an insect or other animal, we will seek further evidence to distinguish between sucking and chewing types.

If evidence indicates that the damage is being caused by a nonliving factor, we will seek further evidence as to whether the initial damage is occurring in the root or aerial environment. We will then attempt to determine if the damage results from MECHANICAL FACTORS, from extremes in PHYSICAL FACTORS (i.e., environmental factors such as extremes of temperature, light, moisture, oxygen), or from CHEMICAL FACTORS (i.e., phytotoxic chemical or nutritional disorders). Once we have identified the plant and limited the range of probable causes of the damage, we can obtain further information to confirm our diagnosis from reference books, specialists such as plant pathologists, entomologists, horticulturists, and/or laboratory analyses.

III. Define the Problem

A. Plant Identification, Characteristics-Growth and Appearance of the "Identified" Plant-Normal?-Abnormal?

Determine that a *real* problem exists. It is essential that the plant be identified (genus, species and cultivar or variety) so that the *normal* appearance of that plant can be established either by personal knowledge or by utilizing plant reference books. Many horticultural plants, or structures on those plants, such as fruits-seeds, lenticels, etc. may appear to be abnormal to the person who is not familiar with the specific plant. For example, the "Sunburst" honey locust might appear to be suffering from a nutrient deficiency because of its chlorotic yellow-green leaf color, but it was selected because of this genetic characteristic. *It is not abnormal for this plant*. Therefore, it is not a problem.

Always compare the *typical* diseased plant with a healthy or normal plant, since normal plant parts or seasonal changes are sometimes mistakenly assumed to be evidence of disease. Examples are the brown, spore-producing bodies on the lower surface of leaves of ferns. These are the normal propagative organs of ferns. Also in this category are the small, brown, club like tips that develop on arborvitae foliage in early spring. These are the male flowers, not deformed shoots. Small galls on the roots of legumes, such as beans and peas, are most likely nitrogen-fixing nodules essential to normal development and are not symptoms of root knot nematode infection. The leaves of

some plants, such as some rhododendron cultivars, are covered by conspicuous fuzz-like epidermal hairs. This is sometimes thought to be evidence of disease, but it is a normal part of the leaf. Varieties of some plants have variegated foliage that may resemble certain virus diseases. These examples illustrate the importance of knowing what the normal plant looks like before attributing some characteristic to disease.

In describing the plant "abnormality," distinguish between SYMPTOMS and SIGNS: Symptoms are changes in the growth or appearance of the plant in response to living or nonliving damaging factors. Many damaging factors can produce the same symptoms; symptoms are not definitive. Signs are evidence of the damaging factor (pest or pathogen life stages, secretions; mechanical damage; chemical residues; records of weather extremes or chemical applications; damage patterns). Patterns of damage are excellent signs and are definitive diagnostic clues.

B. Examine the Entire Plant and Its Community

In defining a plant problem, it is essential to determine the *real* primary problem. There are foliage symptoms that may occur due to root damage. The primary problem would be root damage, not chlorosis of the foliage - examine the roots. In general, if the entire top of the plant or entire branches are exhibiting abnormal characteristics, examine the plant downward to determine the location of the primary damage. Look for the factor causing the damage at the periphery of the plant damage.

Some pathogens and insects as well as nonliving factors are only damaging if the plant has been predisposed by other primary factors. For example, borers generally only attack trees that are already predisposed by moisture or other physical stress. Premature dropping of leaves by foliage plants (i.e., *Ficus benjamina*) and of needles by conifers frequently causes alarm. Evergreen plants normally retain their leaves for 3-6 years and lose the oldest gradually during each growing season. This normal leaf drop is not noticed. However, prolonged drought or other stress factors may cause the tree as a whole to take on a yellow color for a short period and may accelerate leaf loss. If the factors involved are not understood, this often causes alarm. The leaves that drop or turn yellow are actually the oldest leaves on the tree, and their dropping is a protective mechanism which results in reduced water loss from the plant as a whole.

IV. Look for Patterns

Here is where we start making the distinction between living and nonliving factors that cause plant damage.

LIVING FACTORS: There is usually no discernable widespread pattern of damage. Living organisms generally produce no uniformly repeated pattern of damage on a planting. Damage produced by living organisms, such as pathogens or pests, generally results from their using the plant as a food source. Living organisms are generally rather specific in their feeding habits and do not initially produce a wide-spread, discernable damage pattern. Plants become abnormal: Tissues are destroyed or removed, become deformed, or proliferate into galls.

Living organisms are specific, i.e., damage may be greatest on or limited to one species of plant. Living organisms multiply and grow with time, therefore they rarely afflict 100 percent of the host plants are one time. The damage is progressive with time. Likewise, the damage, generally, is initially limited to only one part of the plant and spreads from that initial point of attack with time.

Living organisms usually leave "signs," i.e., excrement, cast skins, mycelium, eggs.

NONLIVING FACTORS: Damage patterns produced by nonliving factors such as frost or applications of toxic chemicals are generally recognizable and wide-spread: Damage will appear on all leaves of a certain age (for example on all the leaves forming the plant canopy at the time a toxic spray was applied) or exposure (i.e., all leaves not shaded by overlapping leaves on the southwest side of a plant may be damaged by high temperatures resulting from intense sunlight). Damage will likely appear on more than one type or species of plant (look for similar damage patterns on weeds, neighboring plants, etc.) and over a relatively large area.

V. Delineate Development

As already mentioned, another clue for distinguishing between living and nonliving factors causing plant damage is to observe the development of the pattern.

Living organisms generally multiply with time, produce an increasing spread of the damage over a plant or planting with time, are progressive.

Nonliving factors generally damage the plant at a given point in time, for example death of leaf tissue caused by a phytotoxic chemical is immediate and does not spread with time. There are exceptions. If a nonliving damaging factor is maintained over time, the damage will also continue to intensify with time: For example, if a toxic soil or air chemical is not removed, damage to plants within the contaminated area will continue to develop, but damage will not spread to plants in uncontaminated areas: Nonliving factors are not progressive. This again re-emphasizes the necessity of piecing together multiple clues to identify the most probable factor causing plant damage.

VI. Determine Causes

Patterns of damage distribution and time patterns in development of damage have been valuable in making the gross distinction between damage caused by living factors and damage caused by nonliving factors. Additional clues must be obtained to distinguish among factors within the living and nonliving categories.

Distinguishing Among Living Factors:

To further identify which subcategory of living factor caused the damage, requires a close examination of the symptoms and signs.

Symptoms are the modified appearance of the affected plant, for example necrotic tissues, chlorosis, cankers, galls, leaf distortion.

Signs are presence of the actual organism or evidence directly related to it. Visual observation of the insect on the leaf, presence of fungal mycelium, spores, insect egg masses, insect frass, mite webbing, etc. Signs can be used as clues in identifying the specific living organism that produced the plant damage. A combination of clues from both symptoms and signs are required for preliminary distinction between pathogen and insect-mite damage.

SYMPTOMS AND SIGNS OF PATHOGENS

Differentiating between bacterial and fungal pathogens is not always clear cut, but certain symptoms are distinctive.

FUNGAL DISEASES. Fungal leaf spots and stem rots are characterized by various symptoms: Dry texture, concentric rings, discoloration and fruiting structures. Fungal leaf spots and stem rots are usually dry or papery. This is especially true in dry climates. The most distinguishing clue of a fungal disease is the presence of signs: Mycelium and fruiting bodies of the fungus itself. The fruiting bodies range in size from microscopic to those easily detected with the naked eye. They are found within the leaf spot or stem rot area. Each type of fungus has it own characteristic structures which enable plant pathologists to identify them.

- Foliar Pathogens: The leaf spots caused by fungi generally have distinct margins. Many times they are circular with concentric rings resulting from growth of the mycelium from the center point of initial infection outward (much like crocheting a doily): The condition of the leaf tissue and associated color ranges from dead (necrotic tan) in the center, to recently dead (darker brown ring), to dying (darker ring with possible light yellow, chlorotic edge indicating the advancing edge of the fungal infection). The margins of fungal leaf spots and stem rots can be brightly discolored, such as purple (Fusarium stem rot) or yellow (Helminthosporium leaf spot), making these symptoms quite striking.

- Root and Stem Pathogens: Root rot and vascular wilt result from fungal infection and destruction of root and stem tissues. The most common visual symptom is gradual wilting of the aboveground shoots.

BACTERIAL DISEASES. Bacteria do not actively penetrate healthy plant tissue like fungi. They enter through wounds or natural openings such as leaf stomata or twig lenticels. Once bacteria enter the plant, they reproduce rapidly, killing the plant cells.

- Bacterial galls: In some cases, toxic materials are produced that cause plant tissues of roots, stems or leaves to grow abnormally as in crown gall.

- Bacterial leaf spot disease: The bacteria usually enter through leaf stomata. Symptoms include water-soaking, slimy texture, fishy or rotten odor, confined initially between leaf veins resulting in discrete spots that have straight sides and appear angular. Many bacterial leaf spots, such as Xanthomonas leaf spot on Philodendron (also called red edge disease), expand until they reach a large leaf vein. This vein frequently acts as a barrier and inhibits the bacteria from spreading further. A chlorotic halo frequently

surrounds a lesion. Lesions may enlarge through coalescence to develop blight lesions. Some lesions exude fluid containing bacteria. Water-soaking frequently occurs in bacterial leaf spot diseases, such as Erwinia blight of Dieffenbachia. Holding the leaf to light usually reveals the water-soaking. The ability of bacteria (usually Erwinia species) to dissolve the material holding plant cells together results in a complete destruction of leaf or stem integrity. Some fungi also produce this symptom but not usually as extensively as Erwinia. In general, bacterial infections show this characteristic more than fungal infections. In final stages, cracks form in the tissue and disintegration follows.

TABLE 2. SYMPTOMS & SIGNS OF FUNGAL AND BACTERIAL LEAF SPOTS

Abnormality	Fungal	Bacterial
Water-soaking	not common	common
Texture	dryish-papery	slimy-sticky
Odor	usually none	fishy, rotten
Pattern	circular with concentric rings	irregular-angular; initially does not cross veins
Disintegration	Uncommon	common
Color changes	common: red, yellow, purple halos	uncommon
Pathogen structures	common – mycelia, spores...	uncommon

VIRAL DISEASES: Viruses are "submicroscopic" entities that infect individual host plant cells. Once inside a plant cell, they are able to infect other cells. Viruses are obligate parasites: They can only replicate themselves within a host's cell. Because the virus commandeers the host cell to manufacture viruses identical to itself, the plant cell is unable to function and grow normally. In the virus infected plant, production of chlorophyll may cease (chlorosis, necrosis); cells may either grow and divide rapidly or may grow very slowly and be unable to divide (distortion, stunting).

The symptoms of most diseases can be put into four categories:

- Lack of chlorophyll formation in normally green organs.

  Foliage may be mottled green and yellow, mosaic, or ringed (yellow or other pigmented ring patterns), or be a rather uniform yellow (virus yellows).

  Veins: Vein clearing is a common first symptom of some viral diseases. The veins have a somewhat translucent or transparent appearance. In vein banding there is a darker green, lighter green or yellow band of tissue along the veins.

- Stunting or other growth inhibition: The reduction in photosynthesis, because of less chlorophyll, leads to shorter internodes, smaller leaves and blossoms and reduced yield.

- Distortions of leaves and flowers, witches' brooms or rosettes result from nonuniform

growth within a tissue or uncontrolled growth.

- Necrotic areas or lesions: Being obligate parasites, viruses require the survival of their host plant for their own procreation. Hence, viruses rarely cause death. Necrosis that does occur is usually confined to discrete areas of the plant; necrosis rarely occurs to such an extent that the entire plant is killed.

Viruses typically discolor, deform, or stunt plants rather than induce necrosis or cause death. Expressed symptoms (chlorosis, stunting, distortions) can be valuable clues for virus identification, but can be easily confused with symptoms induced by other problems such as nutritional disorders, spray injuries, or certain feeding damage induced by mites or insects. In addition, because of their extremely small size, the virus or signs of the virus are not visible to the unaided eye: The virus particles are detectable within the plant cell through the electron microscope.

Viruses are transmitted from plant to plant by insects, mites, fungi and nematodes, rubbing, abrasion or other mechanical means (including grafting or other forms of vegetative propagation). Viruses are occasionally transmitted in seed. Because of the nature of virus transmission, virus symptoms generally spread with time from one infected plant tissue to other plant tissues or from one infected plant to other plants in the community.

NEMATODES: Plant nematodes are microscopic round worms that damage plant tissues as they feed on them. Many feed on or in root tissues. A few feed on foliage or other aboveground organs.

Shoot Nematodes (*Aphelenchoides* spp.) - Foliar nematodes feed inside leaves between major veins causing chlorosis and necrosis. Injury is most often seen at the base of older foliage. When plants with a net-like pattern of veins become infested with foliar nematodes, the tissues collapse in wedge-shaped areas and then change color.

Root Nematodes - The most common aboveground symptoms caused by root-infesting nematodes result from damaged root systems: Moisture and nutrient stress symptoms and general stunting are common. The root lesion nematodes (*Pratylenchus* spp.) and burrowing nematodes (*Radopholus similis*) destroy the root cortex tissues as they feed. The root-knot nematodes (*Meloidogyne* spp.) inject growth-regulating substances into root tissues as they feed, stimulating growth of large tender cells to provide themselves a permanent feeding site, and causing overgrowth of root tissues around them to form visible, swollen "galls" or "knots." Other root nematodes stunt growth, apparently by killing root meristems.

VII. Symptoms and Signs of Insects, Mites and Other Animals

A. Insects

The location of the feeding damage on the plant caused by the insect's feeding, and the type of damage (damage from chewing or from sucking mouth parts) are the most important clues in determining that the plant damage is insect-caused and in identifying

the responsible insect.

An insect's life cycle (complete or incomplete) is important when attempting to detect the insect or design a control program.

Feeding Habits - Chewing Damage or Rasping Damage:

- Entire Leaf Blade Consumed by various caterpillars, canker worms, and webworms. Only tougher midvein remains.

- Distinct Portions of Leaf Missing. Distinct notches cut from leaf margin (black vine weevil adult), circular holes cut from margin of leaf (leaf cutter bees), small randomly scattered holes in leaf (beetles, chafers, weevils, grasshoppers).
- Leaf Surfaces Damaged: "Skeletonization" of leaf surface. Slugs, beetle larvae, pearslug (pear sawfly larvae), elm leaf beetle, and thrips.

- Leaves "rolled": Leaves that are tied together with silken threads or rolled into a tube often harbor leafrollers or leaftiers, i.e., omnivorous leaftier.

- Leaf Miners Feed Between the Upper and Lower Leaf Surfaces. If the leaf is held up to the light, one can see either the insect or frass in the damaged area (discolored or swollen leaf tissue area), i.e., boxwood, holly, birch, elm leaf miners.

- Petiole and Leaf Stalk Borers burrow into the petiole near the blade or near the base of the leaf. Tissues are weakened and leaf falls in early summer. Sectioning petiole reveals insect-larva of small moth or sawfly larva, i.e., maple petiole borer.

- Twig Girdlers and Pruners, i.e., vine weevil and twig girdling beetle.

- Borers Feed under the Bark in the cambium tissue or in the solid wood or xylem tissue, i.e., Mountain pine beetle and smaller European elm bark beetle galleries. Damage is often recognized by a general decline of the plant or a specific branch. Close examination will often reveal the presence of holes in the bark, accumulation of frass or sawdust-like material or pitch, i.e., raspberry crown borer, Sequoia pitch moth.

- Root Feeders, larval stages of weevils, beetles and moths cause general decline of plant, chewed areas of roots, i.e., sod webworm, Japanese beetle, root weevil.

Sucking Damage:

In addition to direct mechanical damage from feeding, some phloem-feeding insects cause damage by injecting toxic substances when feeding. This can cause symptoms which range from simple stippling of the leaves to extensive disruption of the entire plant. Insect species which secrete phytotoxic substances are called toxicogenic (toxin-producing) insects. The resulting plant damage is called "phytotoxemia" or "toxemia."

Spotting or stippling result from little diffusion of the toxin and localized destruction of the

chlorophyll by the injected enzymes at the feeding site. Aphids, leafhoppers, and lygus bugs are commonly associated with this type of injury.

Leaf curling or Puckering - More severe toxemias such as tissue malformations develop when toxic saliva causes the leaf to curl and pucker around the insect. Severe aphid infestations may cause this type of damage.

Systemic Toxemia - In some cases the toxic effects from toxicogenic insect feeding spread throughout the plant resulting in reduced growth and chlorosis. Psyllid yellows of potatoes and tomatoes and scale and mealy bug infestations may cause systemic toxemia.

- General (uniform) "stipple" or Flecking or Chlorotic Pattern on leaf, i.e., adelgid damage on spruce needles and bronzing by lace bugs.

- Random Stipple Pattern on leaf, i.e., leafhoppers, mites.

- Leaf and Stem "distortion" associated with off-color foliage = aphids (distortion often confused with growth regulator injury), i.e., rose aphid, black cherry aphid, leaf curl plum aphid.

- Galls, Swellings on leaf and stem tissue may be caused by an assortment of insects, i.e., aphids, wasps, midge, mossyrose gall wasp, poplar petiole gall midge, azalea leaf gall.

- Damaged Twigs = Split: Damage resembling split by some sharp instrument is due to egg laying (oviposition) by sucking insects such as tree hoppers and cicadas. Splitting of the branch is often enough to kill the end of the branch, i.e., cicada.

- Root, Stem, Branch Feeders - General Decline of Entire Plant or Section of a Plant as indicated by poor color, reduced growth, die-back. Scales, mealybugs, pine needle scale.

Insect Life Cycles - Knowledge of life cycles assists in identifying the damaging insect.

Incomplete Life Cycles:

Insects resemble the adult upon hatching, except they are smaller and without wings. As the insect grows, it sheds its skin or molts leaving cast skins as a diagnostic sign. Adult stage is most damaging.

Lygus bugs, leafhoppers, and grasshoppers are example of insects with incomplete life cycles.

Complete Life Cycle:

Eggs, larva (wormlike or grub-like creature that may feed on various plant parts), pupa (relatively inactive, often enclosed in some form of cocoon), *adult insect is completely different in appearance*. The larval stage with chewing and rasping feeding is most damaging.

Examples of insects with complete life cycles are butterflies, moths, weevils, beetles and flies.

B. Other Animal Damage

Arachnids having sucking mouth parts and have 8 legs instead of six like the insects. SPIDER MITES, incomplete life cycle (mite resembles adult throughout life cycle). Damage is often a characteristic stipple pattern on leaf which then becomes pale color on underside (severe infestation causes leaf bronzing and death). Presence of "dirty" foliage = small fine webbing on the underside of the foliage mixed with eggs and frass. ERIOPHYID MITES = *distorted new growth*, leaf margins roll, leaf veins swell and distort the leaf (symptoms often confused with growth regulator damage).

Crustacea - Sow bugs and pill bugs feed on decaying vegetation. Not considered to be damaging to live plants.

Mollusca - Slugs and snails. Feeding injury to low growing foliage resembles skeletonizing or actual destruction of soft tissue. Signs: Presence of 'silvering' and slime trails on foliage.

Miscellaneous Animals - Millipedes and centipedes (arthropods) feed on decaying plant vegetation (many small legs, brownish or white in color, vary in size from 1/2 - 2"). Not considered injurious to live plants.

Small Mammals - Chewing of bark and cambium tissue on small trees and shrubs is most frequently by rodents (mice, rabbits, squirrels, and possibly beavers). Signs: Note teeth marks.

Large Mammals - Branches torn or clean cut by cattle, goats, deer, and horses.

Birds - Yellow-bellied sapsucker (even rows of holes in the tree trunk). Missing flower petals, puncture splitting of bark.

VIII. Distinguishing Among Nonliving Factors

If patterns of damage in the field planting and on the individual plant are uniform and repeated, this indicates that a nonliving factor is the probable cause of the damage. We will now examine additional information and clues to determine whether the nonliving damaging factor was a mechanical, physical, or chemical factor.

Look for CHANGES in the three categories of nonliving factors of the affected plant's environment: 1) *Mechanical Factors* (Damage/Breakage) - plant damage caused by site changes - "construction damage," transplanting damage, "lawn mower blight," abrasion, bruising. 2) *Physical Factors* - environment or weather changes causing extremes of temperature, light, moisture-aeration. 3) *Chemical Factors* - chemical pesticide applications, aerial and soil pollutants, nutritional disorders.

A. Mechanical Factors

Close visual examination and questioning will often determine if the stems or roots have been broken or girdled or if the leaves have been bruised, punctured, or broken. For example, if a large *Ficus elastica* is dropped while being transplanted and the stem is broken, rapid wilting of the portion of the plant above the break will occur. Examine the plant site for signs of recent excavation, construction, paving, etc.

B. Physical Factors (Environmental Factors)

Primary sources of diagnostic information are damage patterns and weather records to pinpoint time and location of weather extremes. Records are "signs" of the factor that caused the plant damage.

Temperature Extremes:

Heat: The highest leaf temperatures will occur in the early afternoon when the sun is located in the southwest quadrant of the sky. Therefore, lethal leaf temperatures produced by solar radiation absorption will occur primarily on unshaded leaves on the outer surface of the plant canopy on the southwest side. Portions of leaves shaded by other leaves or leaves on the shaded northeast side may be undamaged. Most severe damage occurs on leaves most exposed and furthest from the vascular (roots, stem, leaf vein) source of water, i.e., leaves on outer perimeter of plant, leaf tips and interveinal areas. A recognizable pattern related to leaf tissue that would have the highest potential temperature and be most readily desiccated will occur uniformly over all plants in the area.

Cold: Damage will occur on the least hardy plants and will be most severe on the least hardy tissues of those specific plants. In fall acclimation, cold hardiness is first achieved by the terminal buds, and then with time the lower regions achieve hardiness; the branch crotches are often the last tissues to achieve cold hardiness. And, generally the root systems will not survive as low a temperature as will the tops - root systems are damaged at higher temperatures than are the tops. On the other hand, after hardiness has been achieved, if warm temperatures induce deacclimation (i.e., in the early spring), the terminals (buds) are first to become less cold hardy.

Portion of plant damaged will indicate if low temperature damage occurred before plant achieved cold hardiness in the fall, or if it occurred after cold hardiness was lost in the spring: reverse patterns are produced.

On a given structure (i.e., leaf or bud), the damage will be death of exposed, nonhardy tissues in a recognizable (repeated) pattern. For example, frost damage to foliage, i.e., conifer needles, in the spring will uniformly kill all needles of a given age from the tip of the needle back toward the stem a given distance on each needle. Frost cracks are longitudinal separations of the bark and wood generally on the southwest sides of the trunk - most likely to occur because of daily, wide temperature fluctuations. Freezing death of dividing cells on outer portions of leaf folds inside the bud will cause distorted or lace-like leaf blade because of nonuniform cell division and growth during leaf

expansion. Cold damage to the root system is primarily a concern with container-grown plants where the root temperature fluctuates more and can be expected to reach lower temperatures than would occur with the same plant if field-grown. Cold damage to the root system can be detected by examining the roots: Damage generally occurs from the periphery of the root ball (near the container edge) and evidence includes blackened or spongy roots with lack of new growth or new root hairs. Aboveground symptoms generally will not be evident until new shoot growth in the spring; at that time leaf expansion may be incomplete (small leaf size) because of the restricted uptake of water and nutrients by the damaged root system. With increased air temperatures, the water loss from the shoots and leaves may exceed the root uptake capacity; the plants may defoliate due to this water deficit.

Plants Vary in their Cold Tolerance: The cold tolerance (hardiness) of various plants in the landscape has been rated by the USDA (see Plant Hardiness Zone Map, USDA-ARS Misc. Pub. No. 814). The "indicator plants" listed for the various cold hardiness zones on the map are useful in surveying a group of landscape plants, observing which ones show cold damage and then estimating how low the temperature dropped based on the damaged/undamaged indicator plants.

Light Extremes: Plants can acclimate to various conditions, but the primary requirement for acclimation is time. Plants respond adversely to rapid changes in the environment. Rapid change from low to high light intensity will result in destruction of the chlorophyll pigments in the leaf (yellowing and necrosis = sunburn). Rapid change from high to low light intensity will result in reduced growth and leaf drop; new leaves will be larger. "Sun leaves" are smaller, thicker and lighter green in color than are "shade leaves." Flowering will be reduced, delayed or absent under low light.

Oxygen and Moisture Extremes: Here we are primarily considering the root environment where oxygen and moisture are inversely related. Waterlogging (moisture saturation) of the root environment results in oxygen deficiency; without oxygen, root metabolism and growth come to a standstill. Consequently, uptake of water and nutrients is restricted with subsequent wilting and nutritional deficiency symptoms occurring on the aboveground portions of the plant. Drought and waterlogging produce many of the same symptoms on the aboveground portion of the plant: The first symptoms will be chlorosis and abscission of older leaves. Under severe, continuing moisture stress wilting and necrosis will occur on tips and interveinal regions of recently expanded leaves and new growth.

C. Chemical Factors-Field Patterns of plant injury related to chemical applications.

Look for application, drift, or runoff-accumulation patterns in the field: The pattern of plant injury in a field or other group of plants and date of injury appearance can be helpful in relating the damage to a specific chemical application.

Damage diminishing uniformly from one side to the other: A pattern in a field, yard or on a group of plants that starts on one side and diminishes gradually and uniformly away from that area is typical of wind-drift of droplets.

Damage in individual spots or irregular patterns: Low lying areas in a field where air masses settle would enhance the accumulation of fumes from volatile chemicals, would be frost pockets, and might enhance pathogens. These damage spots might also be related to differences in the soils texture, organic matter, pH or moisture. High pH spots might induce nutritional disorders such as iron deficiency, increase the toxicity of triazine herbicides, etc.

Damage in linear stripes at regular intervals: indicates nonuniform application of a chemical. Regularly recurring stripes of damaged plants at intervals within the width of the application equipment (fertilizer applicator, pesticide spray boom, etc.) indicate an over-sized or worn nozzle, improper setting on one applicator opening, or an overlap in application. Another cause may be carryover of a residual chemical from bands applied the year before - this pattern would match the row width and direction from the previous season.

Damage at ends of field: may be due to double application of a chemical either the year before or the year the injury is observed.

Damage on one part of the field only with a definite break between the damaged portion and the remainder of the field: 1) Was the chemical applicator reloaded or recalibrated at the break-point? If so, a mistake might have been made in the chemical selected or in the rate of application, or the applicator might not have been adequately cleaned of a toxic chemical: the toxic residue was removed in application of the first load of chemical. Check equipment-use records. 2) Check tillage methods, dates and soil conditions (moisture) - resulting differences in soil texture or depth of tillage may cause differences in dilution of carryover chemical residue, differences in volatilization and dilution of an applied chemical, etc.

Damage intensity increasing along a broad band, indicates inadequate mixing or poor agitation of a wettable chemical powder in a spray tank resulting in increased concentration of the applied chemical toward the end of the tank load.

IX. Chemical Injury Patterns on an Individual Plant

A general uniform pattern of damage occurring over several plant species and over a relatively large area indicates a nonliving factor such as a chemical phytotoxicity. Questions-answers, records, the plant symptoms and knowledge about the mobility within the plant of the common chemicals (nutrients and pesticides) should help determine which chemical caused the damage.

Patterns of injury symptoms on an individual plant that develop because of deficiency, excess or toxicity of a chemical differ depending primarily upon whether the chemical causes damage directly on CONTACT or is absorbed and distributed within the plant through *phloem-trans-location* or through *xylem-translocation*.

A. Symptoms from Direct Contact of Chemical with the Plant:

Shoot-Foliage Contact: Symptoms from shoot-contact chemicals occur over the general plant canopy. If the toxic chemical is applied directly to the aboveground parts of the plant (shoot-foliage contact chemical), the physical pattern of application may be detected, i.e., spray droplet size, etc. If the toxic chemical is spray-applied, the pattern of spray droplets or areas where spray accumulated to runoff along the leaf edges will show most severe damage. If it is a toxic gas (volatile chemical acting as an aerial pollutant), the areas between the leaf veins and along the leaf margins where the concentration of water within the leaf is lower will be the first to show damage. Injury from foliar applications of insecticides, fungicides and fertilizers is primarily of the direct-contact type and is typified by chlorotic-necrotic spotting, especially interveinally and along leaf edges and other areas where chemical concentrates and is least diluted by inter-cellular moisture. Examples of *shoot-foliage contact chemicals* are foliar-applied fertilizer salts and the herbicides paraquat, acifluorfen, dinoseb, and herbicidal oils.

Root Contact: Toxic Contact Chemicals in the root zone, including excess fertilizer, result in poor root development. Symptoms from root-contact chemicals are localized where the chemical contacts the root, but produce general symptoms in the shoot. The shoots may show water and nutrient stress symptoms, i.e., reduced growth, wilting, nutrient deficiency symptoms. The injury symptoms on the shoot and foliage from root damage by direct contact with toxic chemicals or excessive salts resembles a drying injury - the roots are unable to obtain water. Roots are injured and root tips may be killed. This will result in a general stunting of the plant. In severe cases, wilting can occur even though the soil is wet. Lower leaves generally wilt first and this is followed by a marginal drying of the leaves. Many factors injuring or inhibiting root growth may produce similar shoot symptoms: Nematodes, soil compaction, cold weather, salinity, nutritional disorders and certain herbicides (dinitroanilines, DCPA, and diphenamid) cause root inhibition.

B. Symptoms of Deficient or Toxic Translocated Chemicals:

The effects of mobile chemicals absorbed by the plant are dependent upon whether the chemical is transported in the phloem or in the xylem. If transported solely in the xylem system, the chemical will move upward in the plant in the xylem-transpiration stream.

Toxic symptoms from xylem-translocated chemicals occur primarily in the older foliage. Deficiency symptoms of xylem-transported (phloem-immobile) nutrient ions will occur first in the new growth.

If the chemical is translocated in the phloem, it may move multidirectional from the point of absorption, i.e., it may move from the shoot to the root or the reverse.

Toxic symptoms from phloem-translocated chemicals occur primarily in the new growth and meristematic regions of the plant. Deficiency symptoms of phloem-retranslocated nutrient ions occur first in the older foliage.

Xylem translocated chemicals move primarily upward in the plant to the foliage.

Chemical is translocated upward in the xylem (apoplastic movement) of the plant from the point of absorption. Symptoms occur in tissues formed after the toxicity or deficiency occurs.

- Toxic Chemicals - xylem translocated. When toxic chemicals are translocated to fully expanded, older leaves, the toxicity symptoms generally appear on the leaf margins and interveinal areas. When toxic chemicals are translocated to immature, young leaves, the toxicity symptoms generally appear associated with the veins, especially the midrib.

Photosynthetic-Inhibiting Chemicals - Injury from translocated toxic chemicals is primarily to the foliage. Plant injury generally progresses from the lower, older foliage to the top. Individual leaves show greatest injury (chlorosis) along their tips and margins or along the veins. Examples of xylem-translocated herbicides include the photosynthetic inhibitors such as the triazine, urea and uracil herbicides.

Shoot-Inhibiting Chemicals - Examples of toxic chemicals absorbed by the roots and translocated in the xylem to the shoots are the "shoot inhibiting herbicides." The shoot inhibitors cause malformed and twisted tops with major injury at the tips and edges of the leaves; looping of the leaves may occur since the base of the leaf may continue to grow while the leaf tips remain twisted together. Thiocarbamate herbicides cause these symptoms on both grasses and broadleaves. Alachlor and metolachlor herbicides cause similar injury symptoms on grasses.

- Deficient Nutrient Ions, xylem-translocated (phloem-immobile)

Several nutrient ions after upward translocation in the xylem and incorporation in plant tissue are immobile: They cannot be withdrawn when deficiencies develop in the root zone and retranslocated in the phloem to the new growth. Deficiency symptoms of PHLOEM-IMMOBILE nutrient ions develop on the new growth. Boron and calcium are quite phloem-immobile which means that if the external supply becomes deficient, the symptoms of boron and calcium deficiency will appear fist on the new growth. And, with severe deficiencies, the terminal bud dies. Iron, manganese, zinc, copper, and molybdenum are also relatively phloem-immobile and are not readily withdrawn from the older leaves for translocation through the phloem to younger leaves and organs. Deficiency symptoms are most pronounced on the new growth.

Phloem translocated chemicals move mulitdirectionally from point of application or source of the chemical to the meristematic regions.

- Toxic chemicals - Phloem-translocated

Injury from phloem-translocated toxic chemicals is primarily to new leaves and roots because of translocation of chemical to the meristems. Whether taken up by the roots or shoots, these compounds are moved through the living plant cells and phloem (symplastic movement) to both the root and shoot tips. The young tissue (shoots or

roots) will be discolored and injury may persist for several sets of new leaves. Examples of phloem-translocated toxic chemicals, whether absorbed by the roots or shoots, include the herbicides, 2,4-D, dicamba, picloram, glyphosate, amitrole, dalapon, sethoxydim and fluazifopbutyl. These compounds move to the meristems and typically injure the youngest tissues of the plant.

- Deficient nutrient Ions - Phloem mobile

  If phloem mobile nutrient ions become deficient in the root zone, these ions may be withdrawn from the older plant tissue and retranslocated in the phloem to the new growth. In such situations, deficiency symptoms will first occur on the older leaves. Elements that may be withdrawn from older leaves and retranslocated in the phloem to younger leaves and storage organs include nitrogen, phosphorus, potassium, magnesium, chlorine and, in some plant species, sulfur. Sulfur: In plant species where sulfur can be withdrawn from the older leaves and translocated to the newer growth, deficiency symptoms may initially occur on the older leaves or over the plant in general. In plants where sulfur is not readily re-translocated, the older leaves may remain green and the sulfur deficiency symptoms occur only on the new growth.

X. Key to Symptoms of Chemical Disorders on Individual Plants

Symptoms Appearing First or Most Severely on New Growth (root and shoot tips, new leaves, flowers, fruits, buds)

A. Terminal bud usually dies. Symptoms on new growth.

1. Basal part of young leaves and internal tissues of organs may become necrotic. One of the earliest symptoms is failure of the root tips to elongate normally. Terminal shoot meristems also die giving rise to a witch's broom. Young leaves become very thick, leathery, and chlorotic; in some species young leaves may be crinkled because of necrotic spots on leaf edge during development. Young leaves of terminal buds become light green then necrotic and stem finally dies back at terminal bud. Rust colored cracks and corking occur on young stems, petioles, and flower stalks. "Heart rot" of beets, "stem crack" of celery . . . Boron deficiency

2. Necrosis occurs at tip and margin of leaves causing a definite hook at leaf tip. Calcium is essential for the growth of shoot and root tips (meristems). Growing point dies. Margins of young leaves are scalloped and abnormally green and, due to inhibition of cell wall formation, the leaf tips may be "gelatinous" and stuck together inhibiting leaf unfolding. Stem structure is weak and peduncle collapse or shoot topple may occur. Roots are stunted. Premature shedding of fruit and buds is common. Downward curl of leaf tips (hooking) occurs near terminal bud. *ammonium or magnesium excess* may induce a calcium deficiency in plants . . . Calcium deficiency

   Differentiating between calcium and boron deficiency symptoms: When calcium

is deficient, there is a characteristic hooking of the youngest leaf tips. However, when boron is deficient, the breakdown occurs at the bases of the youngest leaves. Death of the terminal growing points is the final result in both cases.

3. Tissue breakdown-necrosis and firing of the tip and margins of the leaf. The ammonium cation in itself may become phytotoxic and result in breakdown of the plant tissue (proteolysis - breakdown of plant proteins) initially producing a wet, dark-green, "steamed" appearance at the leaf tips and margins. This destroyed tissue eventually desiccates and becomes a light tan color. Excess ammonium may also induce calcium deficiency (abnormally dark green foliage, scalloped leaf margins, weak stem structure, death of terminal bud or growing point of the plant, premature shedding of the blossoms and buds) . . . Ammonium excess

B. Terminal Bud Remaining Alive. Symptoms on new growth.

1. Interveinal chlorosis on young leaves.

a. Interveinal chlorosis on young leaves with larger veins only remaining green. Necrotic spots usually absent; however, with extreme deficiencies, young leaves are almost white and may have necrotic margins and tips; necrotic spots may extend inward. Potassium, zing or copper excess can inhibit uptake of iron. High pH may also induce iron deficiency . . . Iron deficiency

Iron deficiency symptoms are similar to those of magnesium deficiency, but iron deficiencies occur in young leaves first: Iron accumulated in older leaves is relatively immobile in the phloem.

b. Interveinal chlorosis with smallest veins remaining green producing a checkered or finely netted effect. Grey or tan necrotic spots usually develop in chlorotic areas; the dead spots of tissue may drop out of the leaf giving a ragged appearance. Poor bloom - both size and color. Potassium excess can inhibit uptake of manganese . . . Manganese deficiency

c. Stunted new growth with interveinal chlorosis: Young leaves are very small ("little leaf"), sometimes missing leaf blades altogether, and internodes are short giving a rosette appearance . . . Zinc deficiency

2. Interveinal chlorosis is not the main symptom on new growth.

a. Wilting and loss of turgor of young, terminal leaves and stem tips is common. Symptoms are highly dependent upon plant species. In some species younger leaves may show interveinal chlorosis while tips and lobes of older leaves remain green followed by veinal chlorosis and rapid, extensive necrosis of leaf blade . . . Copper deficiency

There are no known reports of H2PO1-1 toxicity; however, plants may take up the phosphate anion in luxury amounts. Phosphorus excess is associated with impeded uptake and possible deficiency of copper and sometimes of zinc . . . Phosphorus excess

b. Leaves light green, veins lighter in color than adjoining interveinal areas. Leaves over entire plant may become yellowish green, roots and stems are small in diameter and are hard and woody. Young leaves may appear to be uniformly yellow. Some necrotic spots . . . Sulfur deficiency

In plant species where the sulfur is not withdrawn from the older leaves and retranslocated to the new growth, leaves matured prior to onset of sulfur deficiency remain green: This retention of green color of older foliage distinguishes sulfur deficiency in these species from nitrogen deficiency where the nitrogen is translocated from the older foliage into the new leaves. With nitrogen starvation, old leaves as well as new leaves turn yellow.

c. Shoot Inhibition causing malformed and twisted tops with major injury at the tips and edges of the leaves . . . xylem-translocated "shoot-inhibiting chemicals"

- Examples Of Toxic Xylem-Transported Chemicals *include the thiocarbamate herbicides (symptoms on grasses and broadleaves) and alachlor and metolachlor (symptoms on grasses)*

d. Young tissues discolored or deformed and injury may persist for several sets of new leaves . . . Toxic phloem-translocated chemicals

- Examples Of Toxic Phloem-Transported Chemicals *include the herbicides 2,4-D, dicamba, picloram, glyphosate, amitrole, dalapon, sethoxydim and fluazifopbutyl*.

Symptoms Do Not Appear First or Most Severely On Youngest Leaves: Effect general on whole plant or localized on older, lower leaves.

A. Chlorosis General, no interveinal chlorosis. Effects usually general on whole plant.

1. Visible symptoms include yellowing and dying of older leaves. Foliage light green, growth stunted, stems slender, yellow . . . Nitrogen deficiency

Plants receiving enough nitrogen to attain limited growth exhibit deficiency symptoms consisting of a general chlorosis, especially in older leaves. In severe cases, these leaves become completely yellow and then light tan as they die.

They frequently fall off the plant in the yellow or tan stage.

2. Older leaves wilt. Entire leaf is affected by chlorosis, but edges and leaf tissues near main veins often retain more color (chlorophyll) . . . Zinc excess

B. Vein-Clearing, chlorosis-necrosis at leaf tips and margins, older-younger foliage . . . xylem-transported photosynthetic-inhibitors

When toxic chemicals are xylem-translocated to older, fully-expanded leaves, the toxicity symptoms generally occur on the margins and interveinal areas of the leaf. When translocated to young, expanding leaves, toxicity symptoms are generally associated with the veins, especially the midrib.

- Examples of xylem-translocated, photosynthetic inhibitors *include the triazine, urea and uracil herbicides*.

C. Interveinal Chlorosis. Interveinal chlorosis first appears on oldest leaves.

1. Older leaves chlorotic, usually necrotic in late stages. Chlorosis along leaf margins extending between veins produces a "Christmas tree" pattern. Veins are normally green. Leaf margins may curl downward or upward with puckering effect. Necrosis may suddenly occur between veins. Potassium or calcium excess can inhibit uptake of magnesium . . . Magnesium deficiency

When the external magnesium supply is deficient, interveinal chlorosis of the older leaves is the first symptom because as the magnesium of the chlorophyll is remobilized, the mesophyll cells next to the vascular bundles retain chlorophyll for longer periods than do the parenchyma cells between them. Leaves lose green color at tips and between veins followed by chlorosis or development of brilliant colors, starting with lower leaves and proceeding upwards. The chlorosis/brilliant colors (unmasking of other leaf pigments due to the lack of chlorophyll) may start at the leaf margins or tips and progress inward interveinally producing a "Christmas" tree pattern. Leaves are abnormally thin, plants are brittle and branches have a tendency to curve upward. Twigs are weak, subject to fungus infection, usually leaves drop prematurely; plant may die the following spring.

2. Smaller veins in older leaves may turn brown. Small necrotic spots in older leaves spread margins inwards, and finally desiccate the entire leaf blade. At severe, advanced stages, young leaves also display this spotting . . . Manganese excess

3. Chlorotic areas (pale yellow) on whole plant; leaf edges curl upward . . . Molybdenum deficiency

General symptoms are similar to those of nitrogen deficiency: Interveinal chlorosis occurring first on the older or midstem leaves, then progressing to the youngest. Sometimes, as in the "whiptail" disease, plants grown on ammonium

nitrogen may not become chlorotic, but develop severely twisted young leaves, which eventually die. Other characteristic molybdenum deficiency symptoms include marginal scorching and rolling or cupping of leaves. With molybdenum deficiency, nitrogen deficiency symptoms may develop in the presence of adequate levels of nitrate nitrogen in the root environment and high levels of nitrate nitrogen in the plant. Nitrate nitrogen must be reduced in the plant before it can be utilized. Molybdenum is required for this reduction, and if molybdenum is deficient, nitrate may accumulate to a high level in the plant, and at the same time the plant may exhibit nitrogen deficiency symptoms. Molybdenum differs from other trace nutrients in that many plants can develop in its absence provided that ammonium nitrogen is present. Molybdenum appears to be essential for the nitrate-reducing enzyme to function. Molybdenum deficiencies are commonly found in Northeastern Washington.

4. Foliar marginal necrosis is the most common symptom of fluoride toxicity along with Chlorosis along and between the veins occurs in fluorine-sensitive plants. With many plants, the marginal necrosis is preceded by the appearance of gray or light-green, water-soaked lesions which later turn tan or reddish-brown. Injury generally occurs at the tips of the leaves first, then moves inward and downward until a large part of the leaf is affected . . . Fluoride excess

D. Leaf chlorosis is not the dominant symptom. Symptoms appear on older leaves at base of plant.

1. Plant-dark green.

a. At first, all leaves are dark green and growth is stunted. Purple pigment often develops in older leaves, particularly on the underside of the leaf along the veins. Leaves drop early . . . Phosphorus deficiency

Phosphorus deficiency is not readily identified by visual symptoms alone. Visual symptoms of phosphorus deficiency are not always definite, but many phosphorus deficient plants exhibit off-color green foliage with purple venation, especially on the underside of leaves, and plants are stunted and remain stunted even when fertilizers supplying potassium and nitrogen are applied. Older leaves assume a purple-bronze color. Small growth, especially root development; spindly growth and tips of older leaves often dead. Phosphorus is phloem retranslocated from older leaves to new growth.

Aluminum appears to affect root growth in particular: Root tips blacken, no longer lengthen, but become thickened. Excess aluminum accumulation in roots reduces their capacity for translocating phosphorus. Amelioration involves suppression of aluminum activity, for example by liming to bring the medium's pH above 5.5, and not by addition of phosphorus. The toxic amount of aluminum in a soil will depend upon other soil properties such as pH and phosphorus content

and upon the plant grown. Media amendments such as perlite may release toxic quantities of aluminum if the media pH is extremely acid . . . Aluminum excess

b. Leaves are thick and brittle and deep green. In acute toxicity, older leaves wilt and scorch from the margins inward . . . Nitrate excess

2. Necrotic spots develop on older leaves

a. Margins of older leaves become chlorotic and then burn, or small chlorotic spots progressing to necrosis appear scattered on old leaf blades. Calcium excess impedes uptake of potassium cation . . . Potassium deficiency

Potassium deficiency symptoms first appear on the recently matured leaves of the plant (not on the young, immature leaves at the growing point). In some plants, the first sign of potassium deficiency is a white specking or freckling of the leaf blades. With time, the symptoms become more pronounced on the older leaves, and they become mottled or yellowish between the veins and scorched at the margins. These progress inward until the entire leaf blade is scorched. If sodium cations are present and taken up in place of K+1, leaf flecking (necrotic spots scattered on leaf surface) and reduced growth occur. Seed or fruit is shriveled. Potassium is phloem retranslocated from old leaves to new growth.

b. Tips and edges of leaves exhibit necrotic spots coalescing into a marginal scorch. Symptom from the plant's base upwards with older leaves being affected first. In advanced, severe toxicity, necrotic spots with a pale brown center also appear in the inner parts of the leaf blade . . . Boron excess

c. Mottling and necrotic spots primarily on margin and interveinally may affect leaves due to excessive amounts of fertilizers or pesticides applied either as foliar sprays . . . Direct-contact of toxic chemical with shoot & foliage

- Examples of shoot direct-contact toxic chemicals include *the shoot-foliage applied herbicides paraquat, acifluorfen, dinoseb and the herbicidal oils produce this type of symptom*.

3. Reduced growth and wilting of older leaves with development of chlorotic and necrotic spots. Roots become stunted in length and thickened, or club-shaped, near the tips: The shoots remain normal but may show nutrient and moisture stress. Under severe conditions, root tips may be killed causing general stunting of the plant, wilting followed by marginal drying of the lower leaves first . . . Direct-contact injury by toxic chemicals or other factors in the root

zone, i.e., low temperatures; nematodes; root weevils.

- Examples of root direct-contact toxic chemicals include *excess salts or presence of toxic chemical such as the herbicides DCPA, dinitroanilines, diphenamid.*

Leaves often eventually become bronze colored . . . Chloride deficiency

4. Marginal scorching that may progress to general leaf scorching. Generally no spotting . . . Excess salt or sodium excess

5. Intense yellow or purple color in leaves. Molybdenum excess or toxicity in field-grown plants is rarely observed. Plants appear to tolerate relatively high tissue concentrations of molybdenum. Isolated reports of symptoms from excess molybdenum include development of intense yellow color in tomato leaves and intense purple color in cauliflower leaves . . . Molybdenum excess

XI. References, Laboratory Analyses

If you have identified the plant and have narrowed the probable cause down through the various categories (i.e., distinguished between living and nonliving - then if living, distinguished between pathogens and animal factors - then if pathogen, distinguished between fungal and bacterial organisms), you will probably need assistance in identifying the specific responsible organism or nonliving factor. Collect a sample and submit it to our Plant Lab. Reference books would also provide further assistance in narrowing down the search for the specific factor causing the observed plant damage.

XII. Synthesis to Determine Probable Causes of the Plant Damage

The detective work to find the "signs" (residues of the living, damaging organism or nonliving factor, records, etc.) is time consuming and methodical. But, without this process of elimination and synthesis, probability of making a correct diagnosis is low.

ENFORCEMENT **SECTION 2**

Nursery Violations - Wis. Stats. 93.07(12), 94.01 to 94.11 and Chapter ATCP 21

Department Duties; Plant Pests - s. 93.07

(12) Plant Pests. To conduct surveys and inspections for the detection and control of pests injurious to plants, make, modify, and enforce reasonable rules needed to prevent the dissemination of pests, declare and manage emergencies relating to the detection and control of pests injurious to plants, provided that such declaration does not supersede the authority of the chief state forester under s. 23.114 or the department of natural resources under s. 26.30, and suggest methods of control.

Plant Inspection and Pest Control Authority - s. 94.01

(1) In the conduct of survey and inspectional programs for the detection, prevention and control of pests, the department may impose quarantines or such other restrictions on the importation into or movement of plants or other material within this state as necessary to prevent or control the dissemination or spread of injurious pests.

(2) In accordance with sub. (1), the department, by summary order, may prohibit the removal of any plant, host plant, or other pest-harboring material from any private or public property, or any area of the state which in its judgment contains or is exposed to injurious pests, except under such conditions as in its judgment are necessary to prevent the dissemination or spread of pests, giving written notice thereof to the owner or person in charge of the property. While such order is in effect no person with knowledge thereof shall cause or permit the removal of any such plant, host plant or other pest-harboring material from such property or area, unless it is in compliance with the conditions of such order. Orders issued under this subsection shall be in writing, have the force and effect of an order issued under s. 93.18, and are subject to right of hearing before the department, if requested within 10 days after date of service. Any party affected by the order may request a preliminary or informal hearing pending the scheduling and conduct of a full hearing.

[…]

(8) Department Inspection. The department may inspect nurseries and premises at which nursery stock is held for sale or distribution. The department may inspect premises at which evergreen trees are grown for eventual sale as Christmas trees and premises at which Christmas trees are held for sale or distribution.

Inspection Report - s. 93.07(12)

Inspection Reports should be used to document all pest and disease finds at the time of inspection. Pests/pathogens requiring treatment/disposal (*based on the HIS Regulatory Action Guidelines*) for 9 or fewer plants can be documented on an Inspection Report. Other minor violations for 9 or fewer plants can also simply be documented on the Inspection Report (examples: non-viable stock, unlabeled or mislabeled stock). Violations involving 10+ plants would require a Pest Abatement Order or an Order Prohibiting Sale or Movement (and accompanying Release)

Activity Report - s. 93.07(12, 13), 94.01

Activity Reports are used for **Level 1 - Compliance Assistance**. Use an Activity Report to document any initial compliance or outreach/education discussions had with a customer. You can also use an Activity Report to document minor violations the inspector trusts the customer will rectify, without question, in a timely manner.

Warning Notice - s. 93.06(1), 94.01

Warning Notices are used for **Level 2 Compliance - Warning.** Use a Warning Notice when the customer has prior history/documented knowledge of PIB rules and regulations or the violation is serious in nature. A Warning Notice documents a formal notice given to responsible persons that observed violations are serious, or represent previously observed violations that were not corrected, and require prompt action.

Department Orders Authority - s. 94.01

Order Prohibiting Sale or Movement - s. 94.10(9), 94.76 & ATCP 21.03 (1)

This is a department order having the full force and effect of law, restraining the sale, use, disposition, or movement of stock, or any other plant product. An authorized employee or agent of the department may, by written notice--using the Order Prohibiting Sale or Movement form--order a nursery grower or nursery dealer to do any of the following:

1. Temporarily hold nursery stock pending inspection by the department
2. Remedy violations of this section
3. Refrain from importing weeds or pests that threaten agricultural production or the environment in this state
4. Permanently withhold nursery stock from sale or distribution, if the sale or distribution would violate this section or an order issued under this section and the violation cannot be adequately remedied in another manner
5. Destroy or return, without compensation from the department, nursery stock that is sold or distributed in violation of this section, or an order issued under this section, if the violation cannot be adequately remedied in another manner. In order for a business to remedy a violation documented on an above Order, a Release form must also be issued.

The department may also issue this order if, in the department's judgment, the order is necessary to prevent or control the spread of suspected pests/virus/pathogens. This order may prohibit the movement of any pest, or any plant, pest host or pest-harboring material which may transmit or harbor a pest. This order issued under the ATCP 21.03(1) subsection can also be used to prohibit the movement of bees, bee colonies or bee apparatus.

By prohibiting movement, the material is under Quarantine until released. "Quarantine" means an order of the department requiring isolation of the material named and prohibiting its movement or disposition except as authorized by the department. "Pest" has the meaning specified in s. 93.01 (10) and includes any living stage of insects, mites, nematodes, slugs, snails, other invertebrates injurious to plants or plant products; any host upon which a plant pest is dependent upon to complete life cycle; any other living organism classified as pest under 94.69 (1) (a) (The department may promulgate rules to declare as a pest any form of plant or animal life or virus which is injurious to plants, persons, animals, or substances)

Pest Abatement Order – s. 94.02 (1) & ATCP 21.03 (2)

Pest Abatement Order. The department may issue a Pest Abatement Order under s. 94.02 (1), Stats. And ATCP 21.03(2), if, in the department's judgment, the order is necessary to prevent or control a hazard to plant or animal life in this state. A pest abatement order may require the destruction or

removal of pests, plants, pest hosts or pest-harboring materials within **10 days**. A pest abatement order under this section may require the destruction or removal of bees, bee colonies or bee apparatus.

Release (Conditional or Complete) Form:

Within **30 days** after service of an Order Prohibiting Sale or Movement, the stock either has to be brought into compliance or the department directs by written notice the disposition of the stock. A release form allows the Order Prohibiting Sale or Movement to be released by Conditional Release or Complete Release.

- **Conditional Releases** specify condition(s) identified by an inspector, Program Manager or Section Chief which must be met prior to sale, movement or disposition of the stock. If the condition specified is not met, the order remains in effect. The party holding the material is directed to notify the department in writing when the conditions specified are completed.

- **Complete Releases** terminate the order thereby releasing the product. Complete releases are issued when the material is brought into compliance, test results are negative, or other disposition has been agreed upon.

Uniform Action Table for Violations

Wis. Adm. Statute Section	Violation Description	Recommended Action
s. 94.10(3)(a)	Operating without a nursery grower license	No history: Activity Report Prior license/history: Warning Notice
s. 94.10(2)(a)	Operating without a nursery dealer license	No history: Activity Report Prior license/history: Warning Notice
s. 94.10(3g)(a)	Operating without a Christmas tree grower license	No history: Activity Report Prior license/history: Warning Notice
s. 94.10(5)(c)	A person selling nursery stock at retail shall ensure that the nursery stock is labeled with the common or botanical name of the nursery stock.	<10 plants: Inspection Report 10+ plants/prior history: Activity Report or Compliance form TBD by inspector
s. 94.10(7)(a)(2)	No nursery dealer may misrepresent that the nursery dealer is a nursery grower.	No history: Activity Report Prior history: Warning Notice
s. 94.10(7)(b)(1)	Sell, offer to sell or distribute any nursery stock that the nursery grower or dealer knows, or has reason to know, is infested with plant pests or infected with plant diseases that may be spread by the sale or distribution of that nursery stock.	<10 plants: Inspection Report 10+ plants/prior history: Activity Report or Compliance form TBD by inspector *(must immediately remove from sale)*
s. 94.10(7)(b)(1m)	Obtain, hold, sell, offer to sell or distribute nursery stock from any source other than an officially inspected source.	Order Prohibiting Sale or Movement w/Conditional Release
s. 94.10(7)(b)(2)	Sell, offer to sell or distribute any nursery stock that the nursery grower or nursery dealer knows, or has reason to know, will not survive or grow.	<10 plants: Inspection Report 10+ plants/prior history: Compliance form TBD by inspector *(must immediately remove from sale)*
s. 94.10(7)(b)(3)	Misrepresent the name, origin, grade, variety, quality or hardiness of any nursery stock or make any other false or misleading representations in the advertising or sale of nursery stock.	<10 plants: Inspection Report 10+ plants/prior history: Order Prohibiting Sale or Movement w/Conditional Release
s. 94.10(7)(b)(4)	Conceal nursery stock to avoid inspection by the department, falsify any record required under this section or make any false or misleading statement to the department.	No history: Warning Notice Prior history: Warning Notice or other Compliance form TBD by inspector
s. 94.10(3m)	Notice of new locations. a) The holder of a nursery dealer license shall notify the department in writing before adding, during a license year, any new location at which the license holder will hold nursery stock for sale. The license holder shall specify the address of the new location in the notice. b) The holder of a nursery grower license shall notify the department in writing before adding, during the license year, any new location at which the license holder will operate a nursery or hold nursery stock for sale. The license holder shall specify the address of the new location in the notice. c) The holder of a Christmas tree grower license shall notify the department in writing before adding, during the license year, any new location at which the license holder will grow evergreen trees for eventual sale as Christmas trees or hold Christmas trees for sale.	No history: Activity Report Prior history: Warning Notice or other Compliance form TBD by inspector *(do not sell/dig stock until field has been inspected)*

Wis. Adm. Code Section	Violation Description	Recommended Actions
ATCP 21.10	Gypsy moth; import controls and quarantine	Order Prohibiting Sale or Movement w/ Release
ATCP 21.12	Pine shoot beetle; import controls and quarantine	Order Prohibiting Sale or Movement w/ Release
ATCP 21.16	Hemlock woolly adelgid; import controls	Order Prohibiting Sale or Movement w/ Release
ATCP 21.17	Emerald ash borer; import controls and quarantine	Order Prohibiting Sale or Movement w/ Release
ATCP 21.18	Asian longhorned beetle; import controls and quarantine	Order Prohibiting Sale or Movement w/ Release
ATCP 21.19	Phytophthora ramorum; import controls and quarantine	Order Prohibiting Sale or Movement w/ Release
ATCP 21.21	Thousand cankers disease of walnut trees	Order Prohibiting Sale or Movement w/ Release
DNR Ch. NR 40.04	Cannot possess, transport, transfer, or introduce **prohibited plants** without a permit. *Any viable part of the species is covered by these regulations	Warning Notice *(remove stock from sale immediately)*
DNR Ch. NR 40.05	Cannot transport, transfer, or introduce **restricted plants** without a permit. *Any viable part of the species is covered by these regulations	No history: Activity Report Prior history: Warning Notice *(remove stock from sale immediately)*
DNR Ch. NR 40.05 (3)(p)	Restricted plants not split-listed that were located in WI prior to May 1, 2015 may be transported, transferred and introduced without a permit for a period not to exceed 3 years for herbaceous plants and woody vines, or 5 years for trees and shrubs.	Inspection Report: Document phase-out deadline/ plant/cultivar/quantity *(Phase-out period does not apply to stock brought in from out of state after 5/1/15 and must be removed & destroyed)*

EXAMPLE COMPLIANCE SCENARIOS

Scenario 1: Failure to Renew Nursery/Xmas License

- No response by February 20 Renewal Deadline, Owes Late Fee, License Fee
- Program lead sends email reminder mid-March
- LPPAs send Final Notice letter by March 31
- Follow-Up calls from LPPAs to non-responsive, starting April 17
- **Notice of Noncompliance letter** sent by Section Chief to non-responsive, starting May 15 (w/renewal application, lockbox envelopes)
- **Notice of Mandatory Compliance Conference letter** to non-responsive sent by Section Chief, June 15 (w/renewal application, lockbox envelopes)
- **Order Prohibiting Sale or Movement (ARM-PI-302)** issued to Nursery by Inspector and Section Chief if no-show at conference, final opportunity to become licensed without incurring severe fines and court costs
- Refer to law enforcement / DA if holding order is violated

Scenario 2: Potential unlicensed nursery identified through inspector tip, internet search, or cross-listing licensees with WLNA /WGIF/WCTPA members.

- **LPPA sends "you may need a license" letter** with application or statement that they sign affirming that they do not need a license.
- If non-responsive, LPPA refers case to inspector to visit site, determine if license is needed; if a license is needed, conduct compliance outreach through an **Activity Report** or **Warning Notice** (inspector discretion based on intent and extent of violation; compliance history) and provide them with an application and envelope**.**
- **Notice of Noncompliance letter** sent by Section Chief to non-responsive (w/renewal application, lockbox envelopes)
- **Notice of Mandatory Compliance Conference letter** to non-responsive sent by Section Chief, (w/renewal application, lockbox envelopes)
- **Order Prohibiting Sale or Movement (ARM-PI-302)** issued to Nursery by Inspector and Section Chief if no-show at conference, final opportunity to become licensed without potentially incurring civil forfeitures or criminal penalties.
- Refer to law enforcement / DA if holding order is violated

Scenario 3: Chronic Unlicensed Offender, Never responded to past Compliance Outreach or failed to renew after past compliance history

- **Notice of Noncompliance letter** sent by Section Chief to business along with a license application and explanation of 20% late fee / surcharge for operating previous year if applicable. If no response after 30 days, proceed.
- **Notice of Mandatory Compliance Conference letter** to non-responsive sent by Section Chief, May 20 (w/renewal application, lockbox envelopes)
- **Order Prohibiting Sale or Movement (ARM-PI-302)** issued to Nursery by Inspector and Section Chief if no-show at conference, final opportunity to become licensed without potentially incurring civil forfeitures or criminal penalties.
- Refer to law enforcement / DA if holding order is violated

Scenario 4: Selling stock that is suspected to be infected with virus, pests, disease

- Inspector visits nursery grower or dealer, finds >10 plants with symptoms of virus or infested with insects or disease, asks staff to take off sales floor and continue to water/maintain the health of the plants while test results or treatments are pending, issues **Order Prohibiting Sale or Movement (ARM-PI-302)**.
- If test results are positive, inspector issues a written **Release (Conditional)** spelling out disposition instructions (i.e., return to supplier, destroy via dumpster in sealed black garbage bags, etc.) **(ARM-PI-507)**
- If test results are negative, issue them a written **Release (Complete)** authorizing them to return material to sale floor. **(ARM-PI-507)**

Scenario 5: Selling NR 40 Restricted or Prohibited Invasive Species

- For Phase-out plants, determine source. If from WI = OK to sell through phase out period, document the plant/cultivar/# of plants/phase out deadline on the **Inspection Report**.
- For Phase-out plants if source is out of state and was brought in after 5/1/2015, phase out period does not apply = Remove & Destroy or return to supplier. Document compliance action on **Activity Report or Warning Notice** as determined by the inspector.
- Selling **Restricted** plants; first time offense issue an **Activity Report**
- Selling **Prohibited** plants and/or Repeated violation use a **Warning Notice**

Scenario 6: ATCP 21 Violations are discovered for a regulated or non-regulated pest: gypsy moth or EAB quarantine (i.e. firewood from quarantine sold or moved to non-quarantined county); honeybees imported that have extensive Varroa or American Foulbrood infestation, may lack import paperwork; potato rot nematode, potato late blight, HWA on nursery stock, TCD on walnut log

- Inspector would issue an **Order Prohibiting Sale or Movement (ARM-PI-302)**. Order may prohibit movement of any pest, any plant, pest host, or pest-harboring material which may *transmit or harbor a pest*. By prohibiting movement, the material is under Quarantine until released. “Quarantine” means an order of the department requiring isolation of the material named and prohibiting its movement or disposition except as authorized by the department. “Pest” has the meaning specified in s. 93.01 (10) and includes any living stage of insects, mites, nematodes, slugs, snails, other invertebrates injurious to plants or plant products; any host *upon which a plant pest is dependent* upon to complete life cycle; any other living organism classified as pest under 94.69 (1) (a) (The department may promulgate rules to declare as a pest any form of plant or animal life or virus which is injurious to plants, persons, animals, or substances)
- Inspector must issue a **Pest Abatement Order (ARM-PI-225)** or **Release (ARM-PI-507) (Conditional** or **Complete)** before the item(s) can be moved or destroyed.

Scenario 7: ATCP 21 Serious infestation of a regulated or non-regulated pest (i.e., balsam fir trees from North Carolina found to be infested with live elongate hemlock scale; late blight in a potato field; velvet longhorned beetle in furniture).

- Inspector would issue a **Pest Abatement Order (ARM-PI-225).** The department may issue a summary pest abatement order under 94.02 (1) if, in the department’s judgement, the order is necessary to prevent or control a hazard plant or animal life in this state. A pest abatement order may require the destruction or removal of pests, plants, hosts, or pest-harboring materials within 10 days.

Seed Policy & Procedures ***Table Of Contents***

Notes

INTRODUCTION **SECTION 1**

Objective and Authority of the Department

The objective of seed inspection is to determine if seed being marketed is truthfully labeled or otherwise in compliance with requirements of State and Federal seed laws. Consumer protection is a primary purpose of seed law enforcement. In obtaining the maximum protection for the consumer, the Wisconsin Department of Agriculture, Trade and Consumer Protection (WDATCP) must work within the available funds, personnel and. time available.

Seed inspection is the very first step to be taken in the enforcement of seed laws and is, therefore, one of the most important activities. The degree of effectiveness with which any seed law is enforced depends entirely on how well this initial inspection activity is carried out. With uniform and impartial enforcement of the seed law, a predictable business climate is produced in which the seedsman and the entire seed industry can operate to advantage. When a seed dealer has the assurance that their competitors are operating within the framework established by the seed laws, then they know the limits available to themselves and the entire industry in which to develop their business to the maximum. Seed dealers operating within the law are the means by which the WDATCP secures the protection for the consumer, which is provided in the seed laws.

WDATCP is charged by legislative act to enforce Chapters 94.38 to 94.46 and ATCP 20. Section 94.45(1), Stats., authorizes WDATCP employees, (Specialist(s)), to discharge this responsibility, by performing a minimum of four tasks:

A. Inspect seed products offered for sale or distribution in their area. The inspections should reflect the consumer usage of the products. To accomplish this, the specialist must have a working knowledge of the sampling techniques, inspection methods, and steps that must be taken with regard to violations. The specialist, as liaison between a labeler/distributor and the WDATCP, is charged with the responsibility of assisting them with any problem involving violative products. This may encompass removing seed from channels of trade.

B. Assure that all seed offered for sale or distribution is properly labeled and the distributor/labeler licensed.

C. Serves as the principal contact between the consumer and the WDATCP. The consumer should be made aware of the service and product assurance available. Understanding investigative procedures is vital to conducting effective inquiries into consumer complaints.

D. Assist the administrative program section of WDATCP through personal contact with firms and individuals with regard to seed, licensing or meeting the requirements of a Special Order or Voluntary Compliance Agreements.

State-Federal Cooperation under the Federal Seed Act (FSA)

"State-Federal cooperation" is the keystone of enforcement of the interstate provisions of the FSA. Without enforcement activity and cooperation at the State level, there is virtually no enforcement of the FSA with respect to shipments into a State. Without the FSA, the State ordinarily has no direct legal recourse against an out-of-state shipper.

Nearly all seed marketed is subject to the State seed law and is exposed to inspection by the State. It is estimated that about one-half of all seed marketed moves in interstate commerce and is therefore

subject to the FSA. This means that about half of the time the State Specialist can serve a dual role by inspecting seed for the enforcement of both laws. The State and Federal governments have historically cooperated in seed enforcement work rather than duplicating efforts or going separate ways.

When authorized by the U.S. Department of Agriculture, Specialists may perform the same functions under the FSA. Specialists should be thoroughly familiar with federal authority and be able to refer to it in case this authority is questioned. Authority for seed inspection is contained in Section 202 of the FSA and Section 201.37 of the rules and regulation under the Act.

A. State and Federal Jurisdiction

These cooperative efforts require recognition of a delicate line that separates the jurisdiction and responsibilities of the State and Federal agencies. Interstate commerce is the responsibility of the Federal agency and intrastate commerce is in the jurisdiction of the State agency. The dividing line of responsibility is usually that point at which seed in interstate commerce comes to rest within the State.

The State agency may take action to prevent further sale of seed within the State in violation of State seed law. It is the jurisdiction of the Federal agency to take action against the interstate shipper who violates the FSA.

B. Memorandum of Understanding And Cooperative Agreements

The Memorandum of Understanding or Cooperative Agreement provides for mutual assistance and cooperation between the State Agency and the Agricultural Marketing Service (AMS) in the enforcement of the interstate provisions of the FSA. The agreements provide that the State agencies will do initial sampling and testing of seeds offered for sale in the state and will forward to the Federal agency evidence of apparent violations of the FSA.

1. Section 201.37 Authorization. When authorized by the Administrator of the Agricultural Marketing Service, or by such other person as may be designated for the purpose, Federal employees and qualified State officials, for the purposes of the Act, may draw samples of, secure information, and I inspect records pertaining to, and otherwise inspect seeds and screenings subject to the Act.

2. Section 202.6 Records. All persons transporting, or delivering for transportation, in interstate commerce, agricultural seeds shall keep for a period of three years, a complete record of origin, treatment, germination, and purity of each lot of such agricultural seeds, and all persons transporting, or delivering for transportation, in interstate commerce, vegetable seeds shall keep, for a period of three years, a complete record of treatment, germination, and variety of such vegetable seeds. The Secretary of Agriculture, or his duly authorized agents, shall have the right to inspect such records for the purpose of the effective administration of this Act. (7 U.S.C. 1572.) Section 203.7-Exemptions

The FSA requires that seed shall be completely and correctly labeled at the time it is shipped in interstate commerce. The interstate shipper is not obligated to see that the seed continues to be correctly labeled indefinitely. Inspection of seed in intrastate commerce may indicate that the seed was falsely labeled at the time of interstate shipment. The State agency may take whatever action is appropriate under its law to prevent the seed from being further sold or offered for sale in violation of the State law.

A seed specialist should exercise care to determine that the seed being inspected is actually subject to the seed law under which they are authorized to act. In most cases, seed will be subject to either the State seed law or the FSA and perhaps both.

Plant Variety Protection (PVP) & Title V of the Federal Seed Act

The PVP, in force since December 24, 1970 provides 18 years of legal protection, much like a patent, to developers of new varieties of all flowers, agricultural, and vegetable plants which reproduce sexually, by seed (first generation hybrids are excluded).

Any individual, public institution, or corporation who is the owner, breeder, developer, or discoverer of a "novel" variety of sexually reproduced plants (excluding bacteria and fungi) may apply for plant protection. A certificate of protection is awarded to an owner of a variety after an examination by a Plant Variety Protection Office (PVPO) examiner shows the variety has distinct (novel), uniform, and stable characteristics.

After being notified that the application has been accepted by the PVPO, before the issuance of a PVP certificate, an applicant may label the seed of a novel variety with words such as "Unauthorized Propagation Prohibited (Unauthorized Seed Multiplication Prohibited)—U.S. Variety Protection Applied For." An owner who contemplates filing an application and releases a variety for testing or increase may label the seed with words such as "Unauthorized Propagation Prohibited—For Testing (or increase) Only." After a PVP certificate has been issued, the seed may be labeled "U.S. Protected Variety." The label gives notice to the consumer that the owner of the variety has certain rights. Improper use of the labeling is a violation of the law. The owner is responsible for enforcement for any infringement of its civil rights. Also, courts may issue injunctions to prevent others from violating the rights of the owner.

The owner of a PVP variety has the right to exclude others from selling, offering for sale, reproducing, importing, exporting or using the protected variety in the production of a hybrid or different variety (as distinguished from developing) during this time. There are two exemptions to the law explained below.

General knowledge of the PVP Act is essential to a better understanding of Title V of the Federal Seed Act (FSA). Title V was added to the FSA in late 1970 when the PVP Act was signed into law. Title V (sometimes referred to as the certified seed option) grants additional protection to the owner of a protected variety. PVP certificates issued without the Title V option can be amended, however, once chosen this option is an irrevocable restriction enforced through Title V of the FSA. A variety is not protected under Title V of the FSA as long as the application is pending and the PVP certificate has not been issued. Sale of uncertified seed by variety name prior to issuance of a certificate does not violate Title V, whether or not a PVP certificate has been issued. Such sale may however be an infringement or violation of the owner's civil rights. Once the PVP certificate specifies that "seed of this variety is to be sold by variety name only as a class of certified seed", it becomes subject to the provisions under Title V of the FSA. Federal enforcement under Title V of the FSA only applies when the seed of a protected variety is advertised, offered for sale, or sold by variety name. (Legislation now in Congress may change this.)

Noteworthy features of Title V are that all persons, including the owner of the variety, are subject to the requirements of the FSA. Any person who sells, offers for sale, or advertises for sale, by variety name, uncertified seed of a PVP protected variety (with exceptions) violates Title V of the FSA. Unlike

the PVP Act protection, which is enforceable in the form of regulatory actions, initiated by the Seed Regulatory and Testing Branch of USDA. The kind of seed is not limited to those kinds of agricultural or vegetable seeds specified in the FSA. Title V protected seed does not have to be in interstate commerce to be subject to FSA enforcement.

Exemptions, which apply to the Title V protected varieties, are the "fanners exemption" and that for "certified lots sold in uncertified seed mixtures." Authority for the farmers exemption is gained through purchase of the seed, allowing the farmer to use and sell his reproduced or multiplied seed to another grower, provided neither is in the seed business and the seed sale complies with applicable State laws. However, the second grower has no right to sell his reproduced seed without authorization from the owner of the variety. Title V of the FSA was implemented simultaneously with the PVP Act to provide for both civil and criminal sanctions for infringements of the PVP certificates. It is, therefore, an integral part and complements the PVP Act when enforced within the framework of that Act. The farmers exemption does not permit uncertified seed with Title V protection to be advertised for sale by variety name. The prohibited sales are illegal under Title V whether occurring entirely within a particular State or in interstate or foreign commerce. The second exemption, which applies to Title V protection is seed from certified lots of specially protected varieties, can be sold by variety name in uncertified seed mixtures, as long as the approval of the owner of the variety has been obtained.

Enforcement of the FSA is not dependent on ownership of the seed. Firms who only condition and bag seed for a fee, wholesalers, brokers, and other persons who advertise, transport, or deliver for transportation ("brown bag") seed of Title V protected varieties are not entitled to the farmers exemption. To accord exempt status to extensive sales made on behalf of farmers by such entities would frustrate the basic purpose of providing protection to the owner. Any person who makes verbal representation or implies variety by reference or any other means for uncertified seed of a Title V protected variety is in violation of Title V of the FSA.

Section 102 of the FSA imposes a restriction on the certification of "Title V" protected varieties. This section requires that "Seed of a variety for which a certificate of plant variety protection under the PVP Act specifies sale only as a class of certified seed shall be certified only when (1) the basic seed from which the variety was produced was furnished by authority of the owner of the variety if certification is made during the term of protection, and (2) it conforms to the number of generations designated by the certificate, if the certificate contains such a designation."

Seed Laboratory

WDATCP contracts with other State or commercial laboratories to do the official testing. The contracted laboratory must be adequately staffed to promptly test samples taken during the rush season, which is usually proceeding the planting season for the crops. In addition to the traditional testing for purity, germination, and noxious-weed seeds, the laboratory is generally responsible for testing seed for treatment and trueness-to-variety testing in the greenhouse or field. Wisconsin Crop Improvement Association's laboratory does service- testing for farmers and seedsmen on a fee basis when official duties permit, preferably outside the rush season.

SEED SAMPLING & INSPECTION **SECTION 2**

Recommended Steps and Procedures

A. Each Specialist will be provided with a license list of entities that have obtained a seed license from the department. Along with the list, a 3-year compliance record will be provided that indicates the number of samples taken within the state from respective labelers and any violation associated with the sample.

B. Specialist(s) should initiate the inspection by making themselves known to the owner, manager, or other appropriate personnel of the company. The Specialist(s) should always show credentials and make known the purpose of the visit.

C. Upon entering the facility, observe all seeds offered for sale, looking for obvious violations and expediting enforcement. Shortcuts described here are methods of reducing time consumed by some tasks, without seriously reducing the accuracy of the work.

D. Analysis of data, experience, or good judgment, may indicate which kinds of seed are most often mislabeled or which seed dealers are most often in violation. Also, you may visually spot-check many lots on hand, but only sample those that look off-grade, have old test dates, are labeled to contain near the maximum noxious- weed seeds, or are otherwise most suspicious. Sampling large unbroken lots may prevent duplicate sampling later.

1. Most seed inspected is good seed and is correctly labeled. "Selective sampling" concentrates effort on lots most likely to be mislabeled. "Screening techniques" serve to identify in the least possible time those lots that are mislabeled.

2. Violations always need to be verified by a test from a sample taken to support actions

by WDATCP. The rationale for sampling seed as a definable "lot" is to insure that deficiencies can be clearly traced to the seed and any legal sanctions are clearly supported.

3. Annual -program evaluation places a focus on problematic seed. Follow the plan choosing lots not sampled on the weekly office publication.

4. Sample seed from new companies supplying dealers in your area.

E. After selecting a lot of seed for sampling, completely fill out all information requested on the sample envelopes or sample bag.

1. TREATED SEED - means seed which has received an application of a substance, or has been subjected to a process in such a way as to reduce, control or repel certain disease organisms, insects or other pests attacking seeds or seedlings growing therefrom.

2. Seed treatment was developed because a real need existed. It is known that diseases of grains were injurious in ancient times resulting in throwing diseased grain through an open fire, salt water treatment, the use of copper washes, copper sulphate, formaldehyde, hot water or mercuric chloride. Since then the spectrum of seed treatments has extended to bactericides, growth regulators, insecticides and repellents.

3. FARMER'S SEED - Many of the State seed laws provide an exemption from the seed labeling requirements for farmers who sell their own seed on the farm where grown. Other States

exempt farmers selling their own seed from license fee, but requires them to meet labeling requirements. Many feel the farmer has the right to market his own produce in his own way unaffected by the laws governing the retail merchant. With the limited funds and personnel of the WDATCP, it is unlikely that labeling requirements of the seed law could be strictly enforced in the case of the farmer's seed.

F. ATCP 29.57, Wis. ADM. CODE - SEED APPLICATIONS.

1 DEFINITION. In this section, "pesticide-treated seed" means seed, intended for planting or propagation that is treated with a pesticide for the purpose of providing post-planting protection to the seed or seedling.

2 PLANTING PESTICIDE-TREATED SEED. Planting of pesticide-treated seed is not a pesticide application. The pesticide application is made when the seed is treated. After treatment, the seed is not regulated under the authority of pesticide laws, but regulated under the seed laws. There are provisions in ATCP 29 on treated seed, but they are there under our authority to adopt rules related to seed.

Pesticide-treated seeds shall be incorporated into the soil when planted to prevent access by birds and other animals. This requirement does not apply to seed that is normally planted on the soil surface and poses no significant risk to birds or other animals.

3 PESTICIDE-TREATED SEED; PROHIBITED USES. No person may do any of the following:

(a) Use pesticide-treated seed for food, feed or oil, or mix it with food, feed or oil.

(b) Expose pesticide-treated seed to access by birds or other animals.

4 WARNING SIGNS POSTED ON SEED STORAGE BINS.

(a) A person who stores pesticide-treated seed in bulk shall post a warning sign on every bin or storage area where that seed is stored. This paragraph does not apply to seed, stored on the property of an agricultural producer that is not intended for sale.

(b) A warning sign under par. (a) shall remain posted as long as the pesticide-treated seed remains in storage. The warning sign shall be at least 8 1/2 inches by 11 inches, and shall conspicuously disclose the following statement or its equivalent: "DANGER. THE SEED IN THIS STORAGE AREA HAS BEEN TREATED WITH THE PESTICIDE [name of pesticide] ON [date]."

5 SEED DISPOSAL. Pesticide-treated seed shall be disposed of in a manner that does not pose a risk to persons, property or the environment.

Seed Sampling

A. Fill out the Seed Sample Collection Record form ARM-PI-152(8/95).

B. A label should be removed from one of the containers and attached to the Sample Collection Form as evidence of the labeling. An official replacement label is attached in its place. These two documents constitute the basic evidence in any seed law action. Most certifying agencies recognize a State Specialist(s) replacement label as an official certification label.

1. TAGS AND SEALS - Certified seed is packaged in various kinds of containers, but on each one an appropriate sealing device, is used. Field seeds may be packaged in cloth or paper bags.

The certification tag is sealed to the twine with which they are sewn with a metal seal that cannot be removed and used again. The certification label may be sewn to the bag, glued on, or preprinted on the bag. The seal is the property of the certification agency, and its use by any other agency is illegal. The seal protects the bag from being opened and may also prevent the official certification tag from being removed.

2. All States use a blue tag for certified seed, generally a purple tag for registered seed, and a white tag for foundation seed. The tag usually carries a statement that the seed is certified. It tells which State has performed the certification, gives the crop and variety name, and includes a number which identifies the grower and the lot of seed or a serial number by which the certification records can be traced.

3. Certification Classes - For seed certification purposes, Wisconsin recognizes only the Breeder, Foundation, and Certified classes. The / Certified class of seed cannot be produced from the Registered class of seed in Wisconsin. See pages 1 through 12 in Section 7 (WI Seed Certification Standards).

4. Quality Classes

   - First Quality - seed is labeled with a blue colored certification tag with the red "W" logo. (See page 7-2 for example).
   - Second Quality - seed is labeled with a blue colored certification tag with a black outline of Wisconsin insignia and the words Certified No. 2. (See page 7-2 for example).

C. Sample the seed using proper methods indicated herein.

D. Obtain shipping information from the office of each lot sampled and complete the Activity Report form ARM-ACM-150(Rev 2-00). Too often the essential information is not available if the Specialist(s) go back for it at a later date.

1. Examine each record carefully to be sure that it pertains to the lot of the seed sampled. Check for multiple shipments of the same lot to make sure the proper information is recorded. When violative, make copies of invoices and bills of lading to document the intrastate or interstate shipment.

2. If a sample had to be taken from open bags, the owner should initial a statement that the seed has not been commingled with other seed.

3. The State and Federal Seed Act require that seed dealers keep certain records. The purpose of keeping records if not only for the effective enforcement of the seed laws, but also for the dealer's own guidance and defense. The laws authorize inspection of these records by enforcement officers. The records shall be kept in such a manner that they can be related to records required to be kept by others and so that origin, variety and treatment of the seed can be traced from the ultimate consumer back to the grower, if necessary.

E. Advise the firm's personnel of any records not available or any apparent discrepancy in the records or in labeling. If the Specialist finds (upon reviewing the firm's records), that seed lots have been falsely labeled, this should be brought to the attention to appropriate personnel. An opportunity to explain the matter or take corrective action should be given and noted on the Activity Report.

The Sample

A. OFFICIAL SAMPLES MUST BE:

1. Collected, identified and sealed, BEFORE taking another sample.
2. Documented completely, accurately and legibly to be able to withstand legal scrutiny.
3. Large enough to permit laboratory examination and analysis. Sample splitting or reduction should be performed in the laboratory.
4. Identified and handled by you, in a manner that maintains sample integrity for a proper chain-of-custody by being:
    a. In your possession,
    b. Within sight,
    C. Locked up, or
    d. Sealed.
5. Marked to inform those handling the sample of any hazards or special precautions associated with it, such as "pesticide treated seed.

ENFORCEMENT **SECTION 3**

Seed Violations - ss. 94.41 to 94.46, Stats.

Stop Sale (SS) Authority- s. 94.46(1)

A stop sale is a department order, having full force and effect of law, restraining the sale, use, disposition, or movement of seed. Stop Sales can be placed on any lot of agricultural or vegetable seed not in compliance with the seed law and rule. Unless the seed is brought into compliance or other disposition is agreed upon within 30 days, the department will direct the disposal by written notice. A stop sale order may be served in person or by mail and the owner or custodian of the seed is entitled to a hearing on the stop sale by filing a request with the department within 10 days after the order is issued.
Two opportunities arise to issue stop sale orders. The first opportunity is during an initial inspection and the second is after laboratory analysis of a sample. The decision to issue a stop sale is based on several factors including the significance of the violation, violation history of the labeler, size of the lot analyzed and timeliness of lab analysis.

Stop Sale Release: Within 30 days after service of a stop sale, the lot of seed either has to be brought into compliance or the department directs by written notice the disposition of the seed A release form allows a stop sale to be released by conditional release or complete release. **The Program Specialist will be the lead person in tracking the disposition of a stop sale. The Program Specialist and Inspector consult with each other before a release is issued.**

- **Conditional Releases** specify condition(s) identified by an Inspector or program specialist which must be met prior to sale, movement or disposition of the seed. If the condition specified is not met, the stop sale order remains in effect. The party holding the seed is directed to notify the department in writing when the conditions specified are completed.
- **Complete Releases** terminate the stop sale order releasing the product. Complete releases are issued when the product is brought into compliance or other disposition has been agreed upon.

"Voluntary Removal" (VR)- Authority s. 94.46(1): The seed law provides a voluntary signing of a disposal agreement without the issuance of a stop sale. This voluntary agreement is the Voluntary Removal From Sale document. The Inspector issues the Voluntary Removal From Sale to the entity holding the product, specifying the conditions that must be met before a seed product is withdrawn from sale. A conditional release is NOT used after issuance of a voluntary removal.

Seed Seizures and Orders of Condemnation of Seed or Temporary or Permanent Injunction s. 94.46(2): Any lot of agricultural or vegetable seed not in compliance with ss. 94.38 to 94.46, ATCP 20 or not disposed of according with any disposal agreement or order is subject to seizure on complaint of the department to a court. The department may also apply to the court for a temporary or permanent injunction to prevent, restrain or enjoin a person from violating the law, rules or order issued. These actions will only be performed by the department's central office.

Violation Definitions

A. Technical violations do not involve the quality of the seed. For example, incomplete labeling, date of test expired, although the germination is still truthfully labeled, kind and variety names garbled, or false and misleading description on the containers. Technical violations may be minor or serious:

   1. Minor violations involve false labeling of one or more factors only slightly beyond the tolerance. Generally the seed could be relabeled and be saleable.

   2. Serious violations are flagrant enough to warrant consideration of legal action. The seed is falsely labeled (or unlabeled) and is unfit or of such poor quality that any person planting it would likely be damaged. Some officials consider excesses or deficiencies of twice the tolerance, with some exceptions, as a "rule of thumb" to distinguish minor from serious violations. Excessive noxious-weed seeds are always serious violations. False labeling of weed seeds is more serious than false labeling of inert matter. The kind of seed involved makes some difference.

B. Controllable violations could be prevented by taking reasonable precautions or first determining the facts. False labeling without testing or other reasonable precautions labeling contrary to test records, failure to label, failure to keep and make accessible required records, and failure to blend a lot to uniformity are all considered controllable violations.

Uniform Action Tables for Violations (for reference to Recommended Actions see Overview…Section 1 of Uniform Enforcement Guide)

Law 94.38-94.46	Rule ATCP 20	Violation Description	Recommended Actions
94.385(1), 94.41(b)	20.14(1)	Container of agricultural or vegetable seed sold, distributed, offered or exposed for sale without a label.	2 SS
94.385(2)	20.14(1) 20.04(2)	Failure to furnish a label with the invoice or shipping document, for each bulk lot of agriculture or vegetable seed sold, except as in 94.43(2).	1*
94.41(1)(a)	20.04(1)(j) 20.06(2)	Offer, distribute or expose for sale agricultural seed not germination tested within a 12-month period or hermetically sealed containers of seed not germination tested Within a 36-month period.	Off-Season - 1* In-Season – 2/SS
94.41(1)(b)	**20.04 (1)**	**Not labeled in accordance with s. 94.41 in that: 2 or more missing elements – SS**	
94.41(1), 94.43(1),(2)	20.04 (1)(a)	The label omitted the name and address of the licensed labeler	2
94.41(1)(b)	20.04 (1)(b)	The label omitted net quantity declaration that complies with ss.98.07 and 98.08	1*
94.41(1)(b)	20.04 (1)(c)	The label omitted the lot number or other identification s. 94.41(1)(b)	1*
94.41(1)(b)	20.04 (1)(d)	The label omitted the origin by state	1*
94.41(1)(b)	20.04 (1)(e)1	*The label omitted the commonly accepted name of the kind or kind and variety.	2
94.41(1)(b)	20.04 (1)(e)2	"The label omitted the percent of pure seed s. 94.41(1)(a)	2
94.41(1)(b)	20.04 (1)(f)	The label omitted percentage by weight of all weed seeds s.94.41(1)(d)	1*
94.41(1)(b)	20.04 (1)(f)	The label omitted the name and rate of occurrence per pound of each kind of restricted noxious weed seed s. 94.41(1)(e)*	2 WN SS
94.41(1)(b)	20.04 (1)(g)	The label omitted the percentage by weight of all other crop seeds	1*
94.41(1)(b)	20.04 (1)(h)	The label omitted the percentage by weight of inert matter	1*
94.41(1)(b)	20.04 (1)(i)	The label percentage does not equal 100%	1*
Law 94.38-94.46	**Rule ATCP 20**	**Violation Description**	**Recommended Actions**
94.41(1)(b)	20.04 (1)(j)	The label omitted the percentage of germination	2
94.41(1)(b)	20.04 (1)(k)	The label omitted (for any of the seed is treated, inoculated or coated seed) information required under s. ATCP 20.08	2
94.41(1)(b)	20.04 (1)(l)	The label omitted information required under s. ATCP 20.10 if the label identifies any of the seed as hybrid seed.	1*
94.41(1)(b)	**20.04 (1)**	**Being false or misleading in that: Typically based on lab report, final actions based on history**	

94.41(1)(b)	20.04 (1)(e)	The percent of pure seed was below label claim.	1* / 2 – O
94.41(1)(b)	20.04 (1)(f)	The percentage by weight of all weed seeds exceeded label claim.	1* / 2 – O
94.41(1)(b)	20.04 (1)(f)	The name and rate of occurrence per pound of each kind of restricted noxious weed seed was above label claim.	1* / 2 – O
94.41(1)(b)	20.04 (1)(g)	The percentage by weight of all other crop seeds exceeded label claim.	1* / 2 – O
94.41(1)(b)	20.04 (1)(h)	The percentage by weight of inert matter exceeded label claim.	1* / 2 – O
94.41(1)(b)	20.04 (1)(j)	The percentage of germination was below label claim	1* / 2 – O
94.41(1)(c)	20.14(3)	Having false or misleading advertisement, claim or representation.	2 - O or 1*
94.41(1)(d)	20.14(4)(a)	Containing prohibited noxious weed seeds in excess of the rule tolerances.	2
94.41(1)(d)	20.14(4)(b)	Containing weed seeds in excess of .5 percent.	2
94.41(1)(d)	20.14(4)(a),(b)	Consisting in whole or in part in excess of prohibited or restricted noxious weed seeds.	2
94.41(1)(h)	20.14(1),(3)	Misrepresented through labeling or advertising of certified seed without official certification.	2
Law 94.38-94.46	**Rule ATCP 20**	**Violation Description**	**Recommended Actions**
94.41(1)(i)	20.14(1),(3)	With an unofficial blue label not authorized by a certifying agency.	2
94.41(1)(j)		In which inoculum applied to preinoculated seed does not meet rule standards.	1*
94.41(1)(k)	20.04(e)(2)	That does include the variety name of a plant protected variety under the federal seed act.	2 SS/WN
94.41(2)(a)		Detach, alter, deface, substitute, or destroy any label attached or accompanying seed.	2
94.41(2)(b)	20.14(1),(3)	Disseminate or make false or misleading claims or advertisement.	2
94.41(2)(c)		To hinder or obstruct enforcement of ss. 94.38 to 94.46.	2/3
94.41(2)(d)		Failure to comply with a "Stop Sale" or other disposition of seed.	2/3
94.41(2)(e)		To use the word "trace" as a substitute of seed 1 composition	1
94.41(2)(f)		To use the word "type" in connection with a seed variety	1*
94.41(2)(g)		To make false declaration of gross sales or fail to maintain accurate records for inspection.	2 - O
94.43(1)	20.18(1)	Sell, distribute or offer or expose for sale any seed without a license.	No History – 2 Prior License History – 2/3
94.43(2)	20.04(2)	Dispensing retail seed from bulk without displaying a label (unless each seed package has a complete label)	1
94.44		Failure to keep records for 2 years or make accessible for inspection of quantities sold over 40 lbs.	2

	20.04(1)(c)	Failure to provide identifying lot numbers on each container sold to wholesaler or distributor.	1*
94.41(1)(a)	20.06(2)	Failure of a seed dealer to withdraw expired seed from sale	Off-Season - 1* In-Season - 2SS