A PRACTICAL RESEARCH DIGEST FOR TURF MANAGERS

TURFGRASS TRENDS

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TURF DISEASE MANAGEMENT

Remote diagnostics in turfgrass

By Dr. Ed A. Brown

An education project at the University of Georgia, College of Agricultural and Environmental Sciences is using technology to save turf managers and agricultural producers millions of dollars from damage and crop loss by providing a more efficient and effective mechanism for plant problem diagnostics.

The Distance Diagnostics through Digital Imaging Project, a joint venture implemented by the College's Plant Pathology Department & Office of Information Technology, developed a Internet based program and equipped county Extension faculty in Georgia with computers, digital cameras, and microscopes and trains these faculty to use these tools in assessing factors leading to crop losses due to plant disease and pest infestations.

920 turf samples

Each year, Georgia turf managers and farmers through county Extension faculty submit more than 3,000 plant problem samples to the Plant Pathology Plant Disease Clinics for diagnosis. Of those, 920 were turfgrass samples in 2000. Traditionally, plant samples are mailed or hand-delivered for analysis.

Distance Diagnostics through Digital Imaging saved Georgia growers over $17.7 million.

The samples are catalogued and examined by plant pathologists, who then communicate back the diagnosis and educational recommendations to the county Extension office. This process typically could take from two to four days. A large number of the samples are destroyed or deteriorate en-route, making an accurate diagnosis sometimes difficult.

Computer equipment was provided by the private foundation -funded project. Extension county faculty at these agricultural imaging stations can take digital images of the diseased or pest-infested plant sample, and transmit those images along with grower information through the Internet to UGA scientists who can make an assessment and recommend treatment in a timely manner.

The decrease in diagnostic turnaround time alone potentially saves millions of dollars for Georgia agriculture. Turfgrass diseases on fine turf can cause damage in a short period of time and an expedient diagnosis can be the difference between success and failure. At the time of discovery, early detection and confirmation of a turf disease or pest infestation can be localized.

With the traditional turnaround time of three or four days, plant disease can spread quickly. Treatment may have escalated to a curative chemical remedy sprayed over a large area. This new program not only saves money and time to turf managers, but also has a positive environmental effect as a result. This is "prescription agriculture," diagnosing the problem so a control manage-

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ment program can be targeted to the precise situation.

In 2000, crop disease loss cost Georgia agriculture more than $654 million, or about 20 percent of the $3.25 billion total crop value. A survey was conducted in 1999 and during the first two years of implementation Distance Diagnostics through Digital Imaging saved Georgia growers over $17.7 million. The success is attributed to the quick diagnostic turnaround and timely implementation of control practices.

The Project represents a crosscutting initiative between Extension Plant Pathology and the Office of Information Technology. This project achieves several objectives. The positive impact it has on the agriculture economy of the state is quite evident. But other substantial benefits include the building of a plant disease database accessible over the Internet and the use of this data in the education of growers and instruction of our students at the University of Georgia.

County faculty use a digital camera and a dissecting microscope to take images of affected plants. They also use a compound microscope, which can magnify images up to 600-1000x their original size. These images are then uploaded via a standard World Wide Web browser to a database along with notes about the situation and information based on the grower's observations.

Over 600 samples consisting of over 1,800 images are submitted annually for disease diagnosis through the system. The college is using these images and data to develop a disease image library accessible over the Internet. A number of the best images are currently online now for use by students, professors and researchers making them more familiar with plant disease recognition. As samples are received, the library will be expanded.

Project funding

The project, funded by a three-year private gift from an Atlanta-based foundation and matching funds from the Georgia state lottery for an investment of more than $1 million, not only equipped 94 College of Agricultural and Environmental Sciences county Extension offices across the state, but also supported training faculty in all county offices on the techniques and benefits of Distance Diagnostics.

Images are uploaded via a standard World Wide Web browser to a database along with notes about the situation and grower observations.

The project goal is to produce an Internet Imaging System that is easy to use, supportable, facilitates diagnostics, and is easily replicated.

The success of implementing the project is based on several factors. First, the project coordinators, through extensive development and testing, ensured that the system worked and that images were usable. That is the key to giving the scientist accurate samples from which to make a diagnosis. It was also important that the digital library have the best possible images from the field that could be provided. To do so, it was ensured that the hardware, software, and database interfaces were sound. Then a systematic plan was developed to train College academic and county faculty. There is an online tutorial on using the equipment available on the College's Distance Diagnostics project Website.

The right equipment

The hand held digital camera can take images of field problems and give the diagnostic faculty a feel of the problem in the field. This component is often not available when a physical sample is submitted to the Plant Disease Clinic. The stereoscope is used for observing insects, weed identification characteristics and can be used to image these characteristics for sample submission. The compound microscope is essential to magnify fungus spores and fruiting bodies for an accurate disease diagnosis because some symptoms are common to many different diseases.

An important aspect of the project is the collaboration of different disciplines to develop a low-cost, reliable product that proves to be a tremendous economic asset to Georgia's agriculture economy and also an effective tool for teaching our plant growers and students diagnostic techniques.

Many disciplines at the University of Georgia have been incorporated into this program. They include Plant Pathology, Entomology, Crop & Soil Sciences (weed identification, water problem evaluation, general crop problem determination), Horticulture, Aquaculture (Forestry), Agricultural and Biological Engineering and the College of Veterinary Medicine.

Other state contracts

The scope of the project is not limited to Georgia agriculture applications. Illinois, Louisiana, Alabama and Texas have contracted with Georgia to customize programs for their Cooperative Extension Systems. University faculty at those states Land Grant Universities are diagnosing problems submitted through their Distance Diagnostic programs developed by the University of Georgia. Inquires from six New England States (Massachusetts, Maine, Connecticut, New Hampshire, Vermont, and Rhode Island) and other states have been made. Private industry and agriculturalists doing research in other countries have also expressed interest.

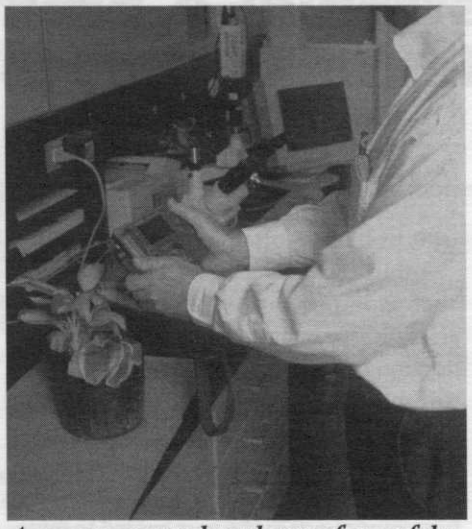
Distance Diagnostics will not completely replace the submission of physical samples for evaluation, but could replace about 60 percent of physical samples diagnosed in the Georgia Plant Disease Clinic by simple compound microscopic examination.

For more information about Distance Diagnostics Through Digital Imaging, visit the project website at *www.dddi.org*.

The system does not support individuals submitting images for evaluation and diagnosis. For the same reason that there are Medical Imaging Centers, it takes trained, technical support to process the samples correctly for the highest quality images for diagnostic purposes. The Cooperative Extension Service is the Land Grant affiliated system that is responsible for diagnostic education in most states and is a key component in the states that are participating in the program.

Tool box for diagnostics

The Distance Diagnostics Team is developing a Tool Box for the Distance Diagnostics through Digital Imaging System. This toolbox will be marketed to consultants to provide them with a system for them to use to receive images from their clients.



A county agent takes photos of one of the 920 turf samples submitted each year by Georgia turf managers. In all, extension faculty submit more than 3,000 plant problem samples to the Plant Pathology Plant Disease Clinics for diagnosis.

Another related project that is being developed and is in Beta testing is a wireless system to compliment Distance Diagnostics through Digital Imaging. Samples of images can be submitted from the field using a lap top computer and the accompanying mini microscopes. The data is submitted using a wireless packet data digital phone.

Both these projects support LG Media, which is being developed to store images of faculty as an archival system. These images will be available to the general public as well as used by research and teaching faculty.

The Internet Imaging System at the University of Georgia supports the development and maintenance of the above databases and Internet based systems. These programs use the technology available to support the grass roots diagnostic and educational programs that are the foundation of a successful agricultural plant production program.

Dr. Edward A. Brown is professor of plant pathology (retired) at the University of Georgia. He received his BS in general agriculture, his MS and his Ph.D. in plant pathology, all from the University of Georgia.

This is "prescription agriculture," diagnosing the problem so a control management program can be targeted to the precise situation.

Pyraclostrobin: A promising new fungicide for turfgrass professionals

By Wakar Uddin

Results from trials in the Northeast show that Insignia is highly effective in controlling gray leaf spot (blast), anthracnose basal rot, Pythium foliar blight, brown patch, gray snow mold, pink snow mold, red thread, rusts, take-all patch, leaf spot and summer patch.

Strobilurin, often referred to as "Strobie" by turf managers, continues to be an important fungicide type in turfgrass disease management, since the introduction of azoxystrobin (Heritage) to the turf market. More recently, trifloxystrobin (Compass) added another dimension to the spectrum of fungicides in the turfgrass industry. Tremendous success with these two compounds in the past has led to intensive search for new strobies in the fungicide industry.

Most recently, the discovery of pyraclostrobin by BASF has added yet another component to the turf fungicide market. Pyraclostrobin has generated tremendous interests in both the turf and fungicide industries. Registration of pyraclostrobin, tested as BAS 500 F, with the proposed trade name Insignia - is currently pending. It should soon become available in the U.S. market once it is approved by the U.S. Environmental Protection Agency (EPA) and state regulators in certain regions.

Although this new strobilurin is not yet available in the market, the name Insignia is not new to turf managers. The product has been extensively tested in demonstration trials across the country. Despite all the research and demonstration trials in the U. S. and Europe, information on the property and efficacy of this new strobilurin is still scanty in literature, as one would expect.

Traditionally, in the turf industry, a variety of questions are often posed by curious superintendents with regard to a new compound, after its discovery becomes public or the product is about to be registered. There is no exception in the case with Insignia, which has apparently received widespread attention from turf managers during the past few years. Based on questions that are most frequently asked by turf managers and the technical information available at this point, this article is compiled for turf managers' reference in turfgrass disease management programs. This hopefully will aid in reduction of the time a turf manager will spend in making phone calls or sending emails.

How pyraclostrobin works

Pyraclostrobin - a carbamic acid - reportedly has activities against fifteen major turfgrass pathogens with a wide range of efficacy from moderate to extremely high. Like the other strobilurins available in the market, one of the positive attributes of this compound is the low rate of use and relatively longer application intervals. This ulti-

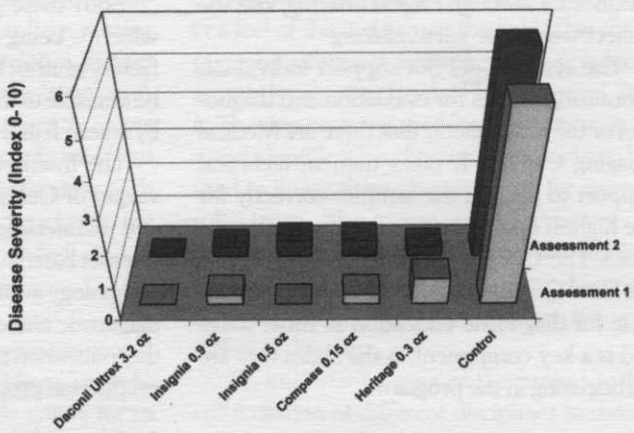


Fig. 1. Control of gray leaf spot in perennial ryegrass turf by three strobilurin fungicides and chlorothalonil applied at 14-day intervals. Disease severity (Index 0-10; 0=none;10=>90% turf area necrotic) was assessed twenty (Assessment 1) and twenty-eight (Assessment 2) days after inoculation.

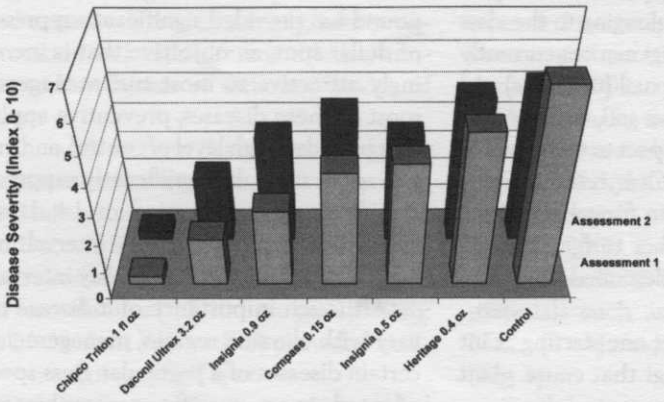


Fig. 2. Control of anthracnose basal rot of Poa in Poa-Bent mix green by fungicide applied at 14-day intervals. Disease severity (Index 0-10; 0=none, 10=>90 % turf area symptomatic) was assessed eighteen (Assessment 1) and thirty-three (Assessment 2) days after inoculation with Colletotrichum graminicola.

mately lead to the development of a sound fungicide program that is cost-effective.

The mode of action of this strobilurin is noteworthy especially for those turf managers who often think along the technical line beyond the practical value or effectiveness of a chemistry. Studies have indicated that pyraclostrobin has preventive and curative properties against a number of diseases. It is inhibitory to a target fungal pathogen virtually at all major stages of the life cycle such as spore germination, germ tube elongation, mycelial growth, and sporulation.

More technically, these molecules inhibit mitochondrial respiration within fungal cells. Within the cells it blocks the electron transport at the cytochrome bc-1 complex. In cells which are exposed to these molecules, the level of ATP (adenosine triphosphate) in the target fungi are not sufficient for disease development.

The primary benefit of using pyraclostrobin might be most likely from a preventive use, as in most of the existing major fungicides. This will not only be relevant to increased efficacy but also to the long-term resistance management as preventive application provides reduction of initial inoculum; therefore, less disease severity and decreased selection pressure for development of possible mutant strains of the pathogen over time and space.

Turfgrass pathogens

As a foliar spray, Insignia controls several turfgrass diseases caused by fungi from the classes *Ascomycete*, *Basidiomycete*, *Deuteromycete*, and *Oomycete*. The causal agent of take-all patch, *Gaeumannomyces graminis* var. *avenae*, is an important pathogen from the *Ascomycete* fungi. Take-all is one of the serious root and crown diseases of creeping bentgrass that is often difficult to control by fungicides. *Rhizoctonia solani*, a commonly known *Basidiomycete*, is a serious pathogen that attacks almost every species of turfgrass under warm and humid conditions. It is a non-spore-producer in a typical brown patch pathosystem in turf, and it rapidly spreads through mycelia and/or bulbils (a structure produced by the fungus to withstand adverse conditions).

There are several fungi among turfgrass pathogens that fall into the class *Deuteromycete*. These fungi are most commonly known as fungi imperfecti which implies the imperfect ones; they are not considered *perfect* because the phase of reproduction involves non-sexual structures. When sexual reproduction of a fungus in this group is discovered, they are given a different name referring to sexual stage. In some cases, the sexual reproduction stage of a fungus is only found in cultures in the laboratory.

One good example is the gray leaf spot fungus or more widely known as blast fungus worldwide, *Pyricularia grisea*. The sexual stage of the blast fungus has not been found in nature, but is produced in the laboratory and known as *Magnaporthe grisea*. An example of a fungus from Oomycete is *Pythium*

apanidermatum. The unique nature of turfgrass pathogenic fungi belonging to the class *Oomycete* is that the fungi can concurrently produce both types of sexual (oospores) and asexual (zoospores) spores and, therefore, no alternative name with respect to the sexual or asexual spores is given. *Oomycete* is a highly controversial class in the fungal kingdom. Biology of these and other turfgrass fungal pathogens is extensively described in selected references.

For interested readers, one starting point for information on fungi that cause plant disease is *www.apsnet.org*.

The efficacy

Results from research trials in the Northeast and several other regions of the United States have shown that Insignia is highly effective in controlling a number of diseases of turfgrass. These include gray leaf spot (blast), anthracnose basal rot, Pythium foliar blight, brown patch (Rhizoctonia blight), gray snow mold (Typhula blight), pink snow mold (Microdochium patch), red thread, rusts, take-all patch, leaf spot (Helminthosporium leaf spot) and summer patch.

In addition to these diseases, this compound has provided significant suppression of dollar spot, an objective that is increasingly attractive to most turf managers. In most of these diseases, preventive application provided high level of control, and curative application also significantly suppressed the disease over a period of 14 days or longer. In many cases, 28-day intervals have been as effective as 14 or 21-day intervals.

Although importance of a disease may vary with climatic regions, management of certain diseases of a particular grass species adapted to a specific geographic area remains a top priority for turf managers. Devastating effects of gray leaf spot (blast disease) in certain regions is a good example. This disease is a serious problem in ryegrass turf in the Northeast and most of the Mid-west, and to a lesser extent in tall fescue and St. Augustine grass in the South. Fungicidal control of the disease remains a strong component of a disease management program in the turfgrass industry.

Strobilurins have traditionally been a good choice of systemic fungicide that is effectively integrated into a sound fungicide

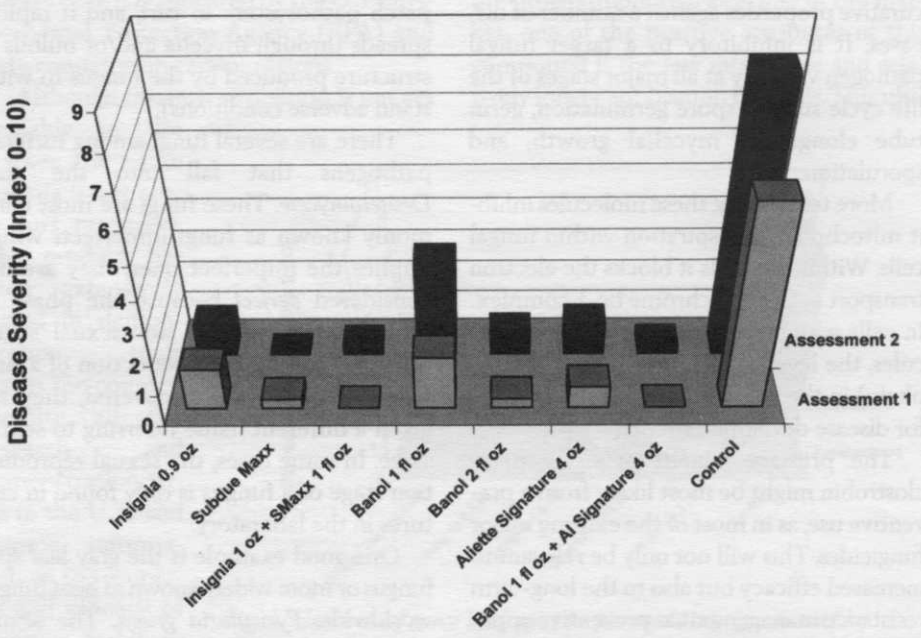


Fig. 3. Preventive control of Pythium foliar blight in perennial ryegrass turf. Disease severity (Index 0-10; 0=none;10=>90% turf area necrotic) was assessed three (Assessment 1) and four (Assessment 2) days after inoculation with Pythium aphanidermatum. SMaxx=Subdue Maxx; Al Signature=Aliette Signature

program. Heritage and Compass have been used extensively, but cautiously, with proper rotation and tank-mixes with other contact and systemics of different modes of action.

Research at Penn State has shown that Insignia is extremely effective in controlling gray leaf spot as seen with other strobilurins and Daconil Ultrex (Fig. 1). The study further revealed that different rates, intervals, and formulations (0.5 - 0.9 oz. per 1,000 sq. ft.; 14-28 days; WG or EC) provided similar control of gray leaf spot.

Despite the excellent controls provided by the strobilurins, turf managers must exercise caution in choosing this class of chemistry because their modes of action are the same or very similar. Because of the risk of cross-resistance problems, only one strobilurin must be chosen for rotation or tank-mix, and the instruction in the label must be followed.

Based on regional observations, one of the reasons for Insignia apparently becoming a hot topic is the new challenges in fungicidal control of anthracnose basal rot, which is a major concern in the industry. Anthracnose basal rot has been prevalent in Poa and/or bentgrasses in Poa/bentgrass greens. In recent years, this disease has been reported to occur almost all year round. It has been diagnosed in turf under snow cover in January in some locations in the Northeast, and it is unlikely that these structures were remnants of fall infection as supported by the viability and spore/acervuli counts per symptomatic plant.

Frustration is mounting in the golf industry as superintendents cannot find a good answer for chemical control of this disease. The wide range of efficacy in strobilurin fungicides, particularly, azoxystrobin has been reported from various regions in the past. It is unclear whether this will also be true for Insignia as the population biology of the anthracnose fungus in U.S. is not well understood.

Studies conducted at Penn State in the summer of 2001 indicated that Insignia provided satisfactory control at high (0.9 oz) and low (0.5 oz) rates at 14 days (Fig 2.). It also provided similar control at 21 days when used at high rate. Further tests on extended intervals and tank-mixes for preventive and curative controls will be conducted in 2002.

Additionally, the broad-spectrum nature of Insignia is evident from significant suppression of Pythium foliar blight and dollar spot diseases. In a study conducted at Penn State in 2000, Insignia (0.9 oz) provided control similar to that of standard Pythium materials such as Banol (2 oz), Subdue Maxx (1 oz), and Aliette Signature (4 oz) (Fig. 3).

Strobilurins, in the past, have not been effective in controlling dollar spot. Further, resistance development in *Sclerotinia* populations especially to Demethylation Inhibitor (DMI) fungicides often causes serious problems in dollar spot management. However, significant reduction of dollar spot by Insignia has been reported.

Control of a wide range of turfgrass diseases caused by fungi from various classes is a major strength of pyraclostrobin, and such an extraordinary broad-spectrum nature of this new strobilurin will undoubtedly become a strong component in an integrated disease management program when the product becomes available in the market.

Wakar Uddin is an Assistant Professor of Plant Pathology at the Pennsylvania State University. His degrees in plant pathology are a B.S. and M.S. from the University of Nevada and a Ph.D. from the University of Georgia. His specialties are the epidemiology of turfgrass diseases and biology of the pathogens; fungicide efficacy and integrated turfgrass disease management. His research involves management of gray leaf spot of perennial ryegrass turf caused by Pyricularia grisea. A second component of his research encompasses biology of Colletotrichum geminicola and management of anthracnose basal rot in Poa and creeping bentgrass greens. He teaches two resident courses in turfgrass pathology at Penn State and also offers an on-line course, "Diagnosis and Management of Turfgrass Diseases," as part of Penn State's World Campus distance education program.

Louisiana smooth cordgrass:

Genetic evaluation based on DNA fingerprinting

By Herry S. Utomo, Ida Wenefrida, Timothy P. Croughan, and Mike Materne

Advancement in plant biotechnology research has created powerful DNA-based molecular markers, small fragments of DNA that can be visualized following separation according to their molecular size by electrophoresis.

These markers can be utilized to precisely identify organisms, distinguish between apparently similar individuals, determine hybrid purity, estimate genetic variation among genotypes of any organism, or monitor diversity within plant populations (William *et al.*, 1990; Dawson *et al.*, 1993, Hu and Quiros 1991).

On the mark

One place are where these markers promise to be of value is in work being done with Louisiana smooth cordgrass.

The work was born in the on-going efforts to re-vegetate land to combat coastal erosion and wetlands deterioration in Louisiana. Coastal marshland losses in Louisiana are estimated to be 16,000 to 20,000 acres a year (USGS, 1985). Because the state's coastal marshes cover more than four million acres, Louisiana alone contributes more than 80 percent of the coastal wetlands loss in the U.S. annually, and continuing losses will have devastating impacts.

Louisiana's coastal marshlands and water bodies are a prodigiously productive estuarine system that support an abundant population of fish, shellfish, and wildlife. Currently, Louisiana provides 30 percent of the country's annual commercial harvest of fish and shellfish and 40 percent of its furs. Louisiana's estuarine system overwinters 66 percent of the migratory birds that use the Mississippi Flyway.

The main advantage of RAPD analysis is that it does not require prior knowledge of the organisms under investigation.

Constructing physical barriers and building riprap structures using donated Christmas trees have been used to rebuild Louisiana's eroding coastal marshes in limited areas. Despite their effectiveness, they are expensive to build and require continuous maintenance. Their impact is considered too small to compensate for such a high rate of current coast-wide land loss.

Smooth cordgrass (*Spartina alterniflora*) can work well, especially at receding shorelines, on barrier islands, and in deteriorating marshes that give away to open shallow water. It is a highly productive species, palatable to fish, wildlife, and livestock. This species is capable of trapping sediment, and can tolerate a wide

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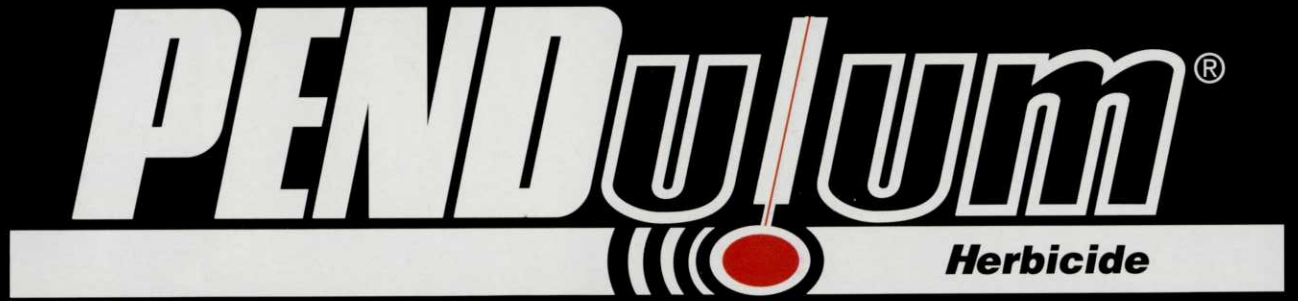
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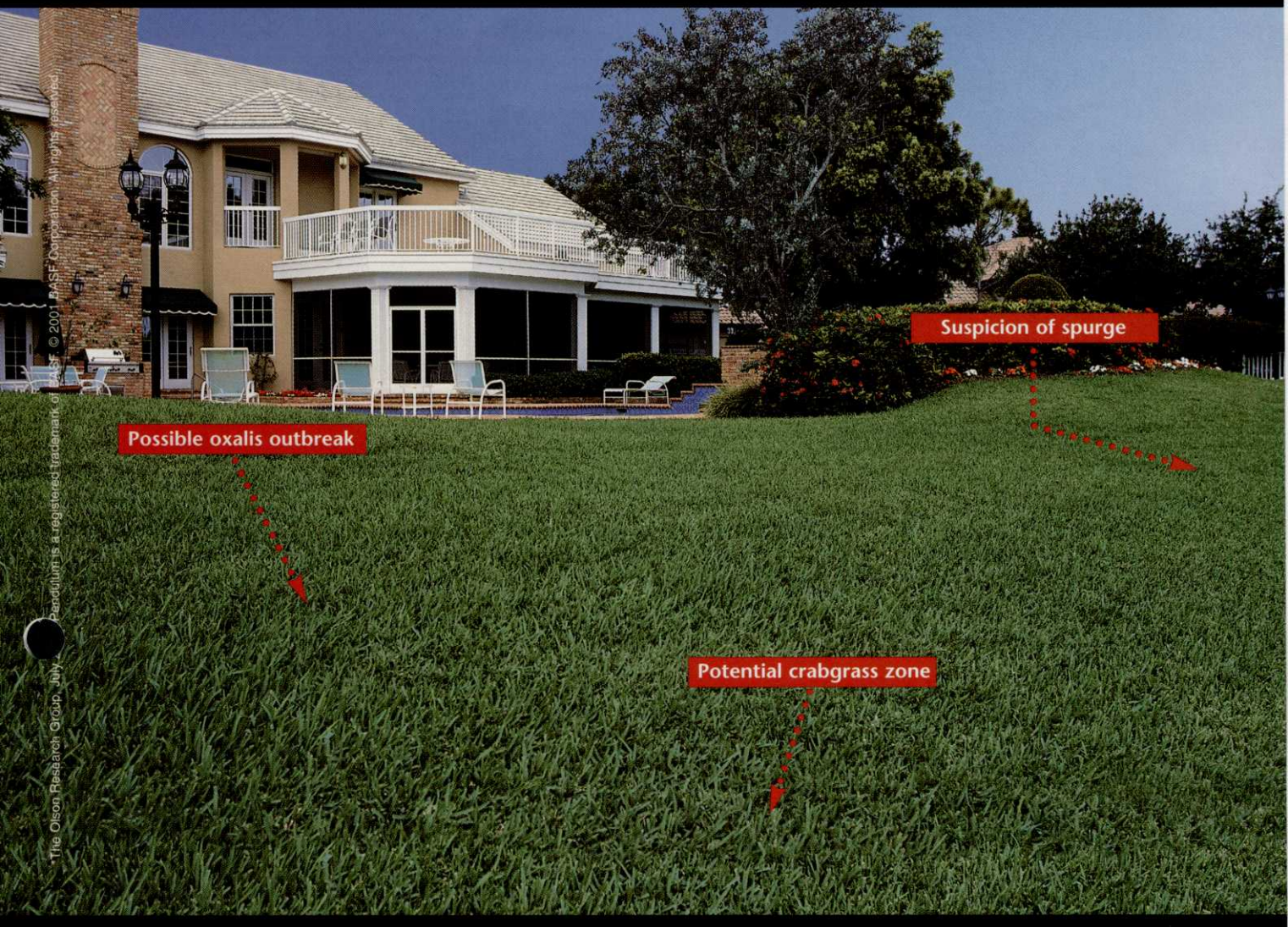

*The Olson Research Group, July

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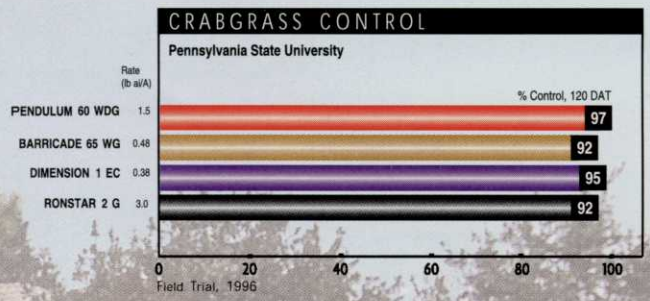

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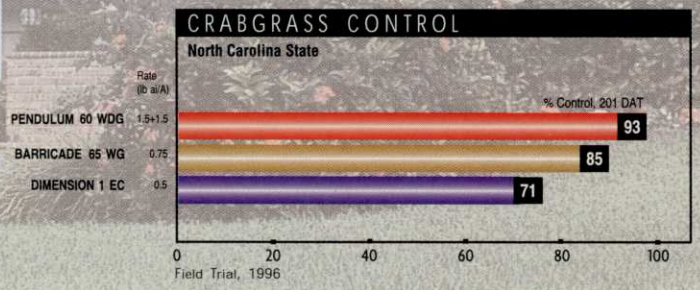

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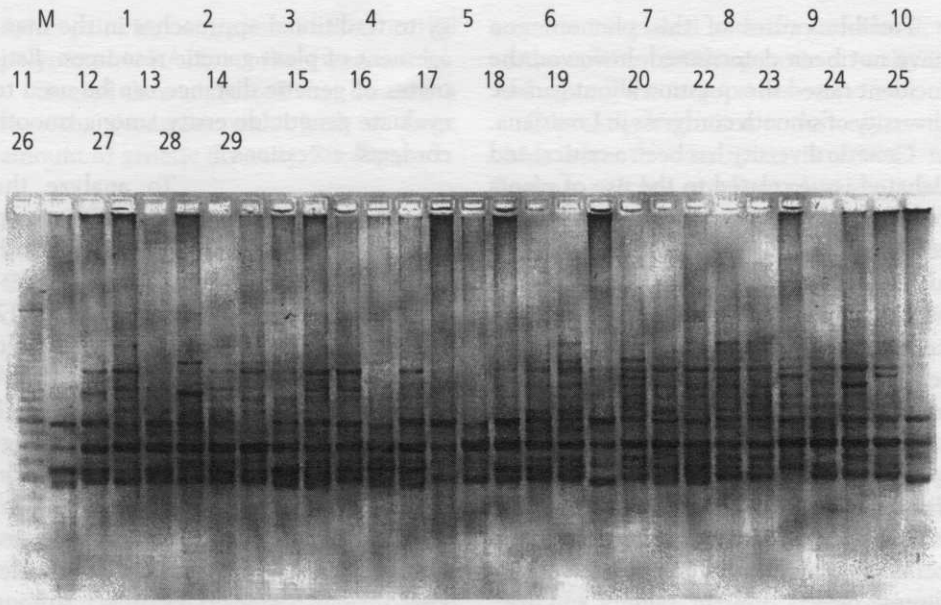

Figure 1. Electrophoretic analysis of DNA amplification products on 29 smooth cordgrass accessions. M=size marker

range of environmental conditions, including submersion for 12 hours a day, pH 4.5 to 8.5, and salinity from 10 to 60 ppt (parts per thousand).

It colonizes mudflats and sandflats in saline or brackish water. Smooth cordgrass is, therefore, highly suitable for erosion control and estuarine reclamation.

Molecular markers

Molecular markers may provide specific types of ecological indicators for monitoring the integrity of natural ecosystems and the sustainability of ecosystems that are affected by external factors.

Markers are not affected by a plant's age or the environment.

Molecular markers can be generated from various molecular procedures, including random amplified polymorphic DNAs (RAPD). RAPD utilizes short, random DNA primers to hybridize with complementary DNA strands anywhere in the genome. The resulting intervening DNA is amplified by polymerase chain reaction (PCR).

The amount of DNA needed for PCR amplification is very small, and the procedure is simple, rapid, inexpensive, and reproducible. The main advantage of RAPD analysis is that it does not require prior knowledge of the organisms under investigation. This is ideal for smooth cordgrass in which genetic information is very limited.

The objective of this study was to utilize RAPD analysis to evaluate the genetics of Louisiana smooth cordgrass. The genetic evaluation includes characterization of genetic diversity, spatial distribution based on closely related grouping, and potential use of marker-based identification.

Cordgrass genetic diversity

Recent incidence known as "brown marsh" or "marsh dieback", first noticed in the spring of 2000, affected extensive coastal marsh regions in Louisiana where smooth cordgrass is the predominant species. The brown marsh has occurred several times in the past, but the size of the last incidence was unprecedented. The most affected areas were the salt marshes between the Mississippi and Atchafalaya Rivers.

Possible causes of this phenomenon have not been determined, however, the incident raised the question about genetic diversity of smooth cordgrass in Louisiana.

Genetic diversity has been a critical and debated issue related to the use of plants for coastal stabilization and wetlands reclamation.

The use of a single cultivar over large areas for erosion control could have serious consequences in the future. Loss of genetic diversity has been widely recognized as a major threat for adaptive potential and the maintenance of species. Populations with low genetic diversity could be more vulnerable to a sudden change in macro/micro climate or other irregularly occurring environmental stresses such as disease, insects, drought, salinity, and fire.

To effectively manage genetic diversity requires the ability to identify genetic variation. Genetic diversity is measured traditionally based on the differences in morphological, physiological, and agronomic characters or can be determined based on pedigree information. A similar objective can be obtained using DNA fingerprinting techniques.

The random amplification of DNA polymorphisms (RAPD) provides an unbiased method of quantifying genetic diversity. This molecular technique therefore can be applied as a complementary strategy to traditional approaches in the management of plant genetic resources. Estimates of genetic distance can be used to evaluate genetic diversity among smooth cordgrass accessions

Since there are no distinctive genetic patterns associated with any region, there is no apparent need to develop cultivars for specific locations.

To analyze the genetic relationship among 95 smooth cordgrass accessions, a total of 12 primers were used to generate DNA fragments. Figure 1 shows DNA fragments of accession 1 to 29. A total of 225 fragments were obtained with the 12 primers. Among these, 136 fragments (60 percent) were polymorphic. The size of fragments ranged from approximately 180 to 2,300 base pairs.

The proportion of smooth cordgrass accessions with polymorphic RAPD fragments ranged from one percent to 88 percent (representing fragments that were rare to those that were common) with a mean frequency of 40 percent. A total of

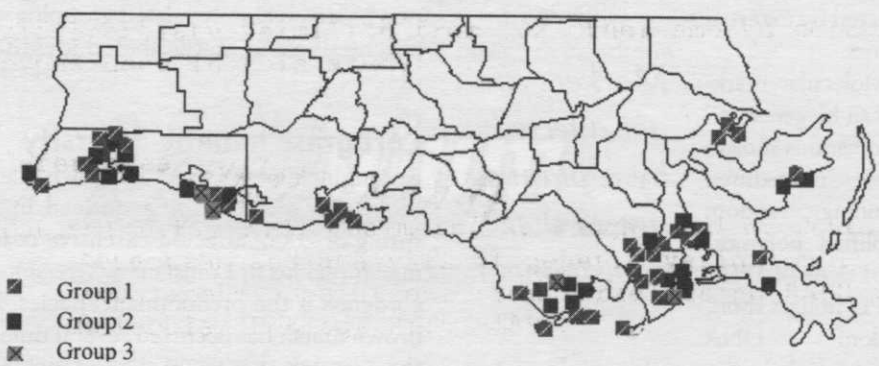

Figure 2. Distributions of smooth cordgrass accessions based on their genetic groups

4,465 pairwise comparisons based on 136 polymorphic RAPD markers were made.

Overall data suggested that Louisiana smooth cordgrass exhibited a large amount of genetic diversity. See Figure 1.

Genetic distribution of Louisiana smooth cordgrass

Cluster analysis revealed that 95 smooth cordgrass accessions used in this study felt into three genetic groups, each of which is separated by genetic distance of more than 0.90.

Plotting the members of each group according to their origins indicated that there was no apparent specific genetic pattern associated with geographical location (Figure 2). Each group occupied a large area and was well-dispersed across coastal region. This finding suggests that seed may play a significant role in smooth cordgrass colonization of salt marshes along Louisiana's coast.

Even though Louisiana smooth cordgrass has been known to be generally sterile with little or no seed production, careful searching eventually yielded a few exceptionally fertile plants that produce viable seeds. Smooth cordgrass seed has some degrees of dormancy. Since the seed is light and remains dormant during winter, it could potentially spread by floating significant distances.

Utilization of a single smooth cordgrass cultivar for salt marsh reclamation and erosion control has raised concern. The main concern is related to the genetic of the cultivar used and possible negative impacts associated with the introduction of the cultivar on the genetic diversity in and around the target areas.

Currently, Vermilion is the only available smooth cordgrass cultivar in Louisiana. It has excellent plant vigor and other growth characteristics.

Results from cluster analysis indicate that Vermilion belongs to group 2. In order to maintain genetic diversity, it appears that the use of Vermilion for erosion control over large areas should be accompanied by other cultivars that represent groups 1 and 3. See Figure 2.

Currently, Vermilion is the only available smooth cordgrass cultivar in Louisiana.

Distribution of each genetic group across marsh coastal regions provides information on how future smooth cordgrass cultivars might be developed with regards to genetic diversity. Since there are no distinctive genetic patterns associated with any region, there is no apparent need to develop cultivars for specific locations.

A finer genotype map, however, might be needed to facilitate a better design for developing new cultivars that will maintain existing genetic diversity in the target areas. The map can be also used for monitoring the integrity of smooth cordgrass

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under its natural ecosystem and suitability of the ecosystems as affected by the introduction of new cultivars.

Addressing questions of identity

Molecular markers can be used to resolve a dispute over plant identity. They involve identification of DNA segments unique to a particular individual or cultivar. Once the markers have been identified, genetic identification is relatively fast and reliable. The procedure requires only a small amount of plant tissues that can be taken at any plant growth stage. In addition, markers can also be used to confirm the purity of cultivars being used.

In many cases, the use of the cultivar Vermilion is required in contracts to revegetate with smooth cordgrass. To differentiate cultivar Vermilion from non-Vermilion genotypes based on physical characteristics at early growth stages can be challenging. Molecular markers can be used to solve this problem. Evaluation of 66 RAPD primers yielded three primers that produce unique DNA bands that differentiate Vermilion from 102 other smooth cordgrass types used in this study.

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Do "drift retardant" chemicals work?

If used properly (at appropriate rates), these products indeed reduce spray drift by hindering formation of small, drift-prone droplets

By Erdal Ozkan

At Ohio State, we conducted experiments to determine effect of using drift retardant chemicals on spray pattern, droplet size and spray drift.

Results of these tests indicate that if used properly (at appropriate rates), these products indeed reduce spray drift by hindering formation of small, drift-prone droplets.

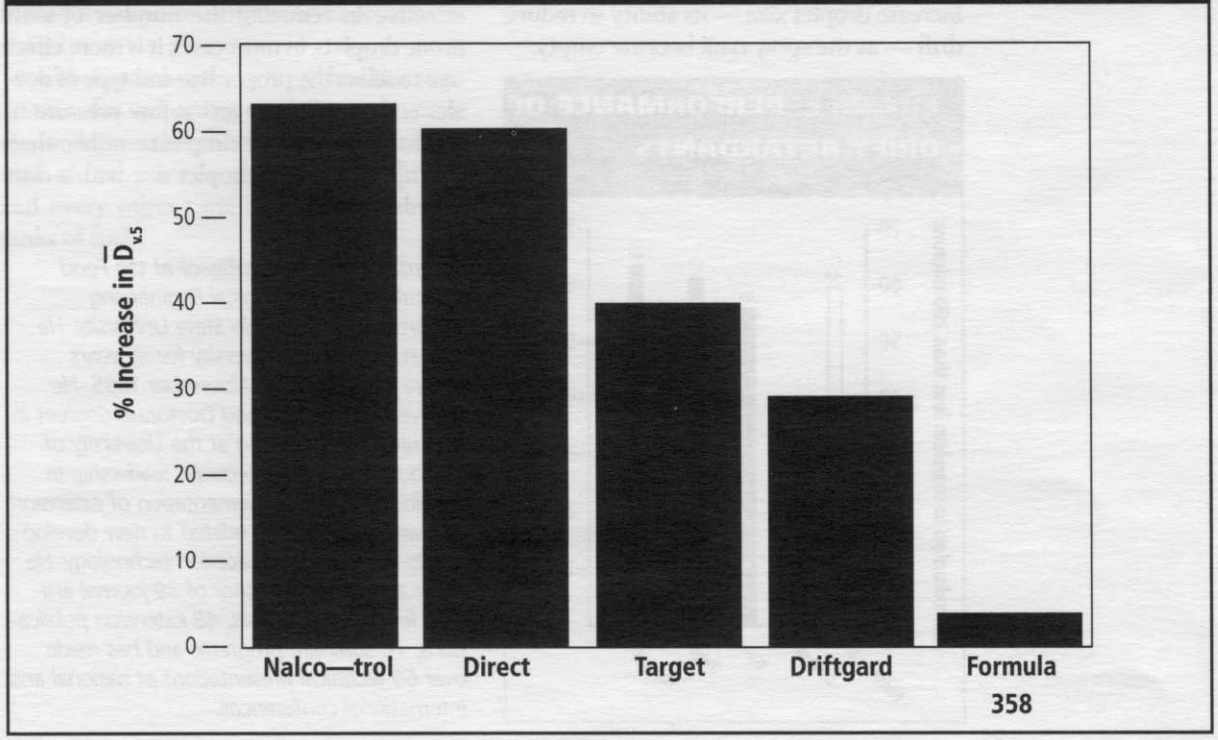
There are many "drift retardant" chemicals commercially available to pesticide applicators (there are over 30 of them). These products are normally some type of long chain polymer or gum that increases the viscosity of the spray mixture which result in a courser spray. Unfortunately, the information related to performance of these products is limited.

Results of a study conducted by USDA-ARS Engineers in Texas indicated that the effect of polymer concentration on droplet size is dependent on polymer type. For example, polyvinyl and polyacrylamide polymers were found to be more effective than linear alkyl epoxide or polymide copolymers in increasing volume median diameter and reducing the percentage of spray volume composed of small droplets subject to spray drift.

At Ohio State we have tested five drift retardant chemicals to determine their effects on droplet size, spray pattern, and spray drift reduction. In comparison to spraying water only, all drift retardants tested reduced volume of portion of small droplets in the spray but at varying magnitudes.

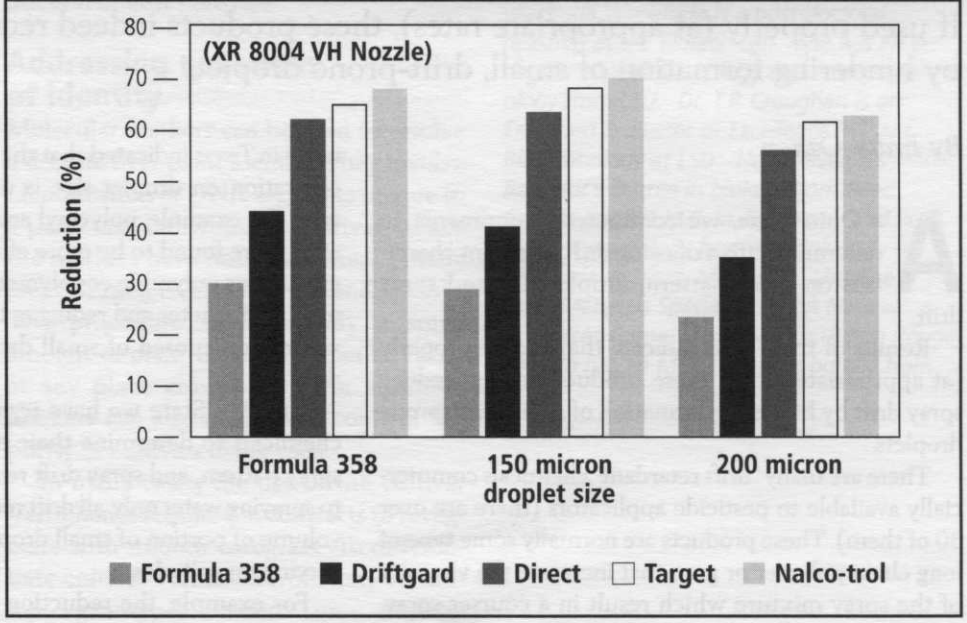
For example, the reduction of spray volume contained in droplets smaller than 100 microns ranged from 30 percent with the least effective product, to 68 percent with the most effective product.

FIGURE 1. INCREASE IN WEIGHTED VOLUME MEDIAN DIAMETER ($D_{v.5}$) WITH DIFFERENT DRIFT RETARDANTS



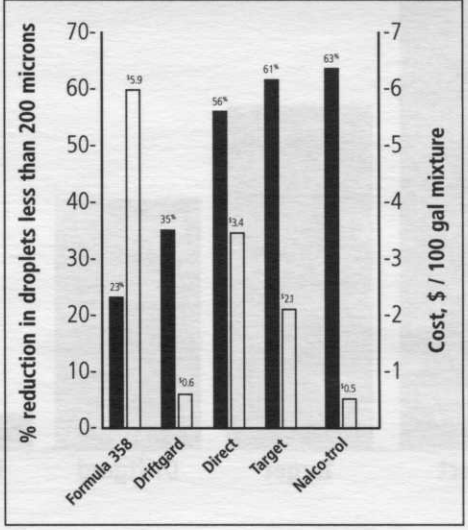
It is usually more effective to select the proper nozzles and operate sprayers at low pressure to produce desired drop size than to increase droplet size with a drift retardant chemical.

FIGURE 1. REDUCTION IN SPRAY VOLUME IN DROPLETS LESS THAN 100, 150 AND 200 MICRONS



Some studies have found that some of these polymers tend to be sheared by passing through a sprayer pump, as would occur in normal bypass, hydraulic mixing in common agricultural sprayers. This means that the drift retardant would lose its ability to increase droplet size — its ability to reduce drift — as the spray tank became empty.

FIGURE 2. PERFORMANCE OF DRIFT RETARDANTS

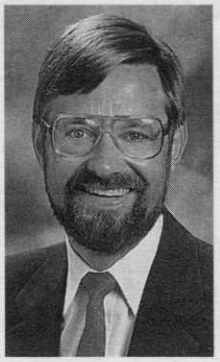


Gums are not sheared as easily as the long chain polymers, and some types of polymers (polyethylene oxide) are sheared in fewer passes through a pump than other types of polymers (polyacrylamides).

Although drift retardant chemicals are effective in reducing the number of drift prone droplets, in most cases, it is more effective to select the proper size and type of nozzles and operate sprayers at low pressure to produce the desired drop size rather than attempt to increase droplet size with a drift retardant chemical.

Dr. Erdal Ozkan is a professor at the Food Agricultural and Biological Engineering Department at the Ohio State University. He was at Iowa State University for six years before joining OSU in November 1985. He received his Master's and Doctorate degrees in agricultural engineering at the University of Missouri. In Ohio, he provides leadership in development and implementation of extension educational programs related to new developments in pesticide application technology. He is the author or co-author of 39 journal articles, four book chapters, 48 extension publications, 16 software programs and has made over 60 technical presentations at national and international conferences.

Rules of thumb



Curt Harler
Managing Editor

A basic rule of thumb says everyone remembers the rule, nobody remembers the source. That's true for one of my favorites, which says there are only two things needed to repair equipment: WD-40 and duct tape. If it won't move and it should, spray it with WD-40. If it does move and it shouldn't, use the duct tape.

While that won't earn you a degree in ag engineering, the following rule was suggested by a Penn State ag engineering professor — and I've found it holds true. If you're putting up a storage building, take your best estimate of how much space you'll need, double that, and then add 10%. That's where you'll be in five years.

Most of us who have fertilized or transplanted trees know the roots of a tree extend to the drip line of the branches above. Another good way to figure how far roots extend is to take the diameter of the tree in inches. That's roughly equal to the radius of the root system in feet.

I once had a rule for how big to dig a hole for planting a tree, but I can't find it at the moment. Anyone out there have one to share?

A chain saw brochure I read had this suggestion for adjusting tension on a new chain: Adjust the chain twice for the first tank of fuel, once on the next tank of fuel, and every other time on the next several tanks of fuel.

If you are stocking a pond with fish, Cornell University recommends putting in 300 fingerling trout per acre of pond each year.

Perhaps a more typical situation is trying to reach a fair price on a used piece of equipment. Employees have an embarrassing habit of using the boss as a referee in these disputes. A good rule of thumb is that a power tool, in decent working condition, should sell for about half of what a new one would run. At least, it'll get them out of your face and on to arguing about what a new model costs.

What works for you? Send me your favorite rules of thumb for use around the golf course, on the landscaping job, for irrigation or spreading seed. I'm at curt@curtharler.com. I will thumb through them and share them with our other readers in an upcoming issue. Oh, and a last rule of thumb: if you don't send me your favorite rule of thumb now, it'll never get done.

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