
Frontiers of Plant Science

A REPORT FROM THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION, NEW HAVEN

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Let's color Connecticut green: marketing our plant industry

By Susan O. Faulkner

I am honored to deliver the Samuel W. Johnson Memorial Lecture and share with you some of my thoughts on a subject that has been of concern to me for some time. However, I am a "professional volunteer," a garden designer, lecturer and conservationist. I do not take life very seriously. You can't and survive presiding over the Federation of Garden Club's 8,000 members.

What subject is of concern? Public recognition of our plant industry.

When I served on the Board of the Bartlett Arboretum, I always felt it was the best-kept secret in the State of Connecticut. Very few people even knew where it was, and when I went upstate to work with the garden clubs, I discovered that they didn't know it was their state arboretum.

I feel the same way about the plant industry as a whole in the State of Connecticut. I do not think that the people of the State of Connecticut know about, are aware of, appreciate, or care about the plant industry. Our industry is comprised of farmers, nurserymen, greenhouse growers, garden centers, and landscapers. I add those volunteers and consumers as an important part of the manpower of our industry.

Americans are spoiled. We spend considerably less of our income on food than other nations. Americans can walk into any store anywhere and see an abundance of and variety of food unknown anywhere else in the world. Plants? Flowers? Quite the same. Our citizens often don't realize that Connecticut has about 3800 farms and agricultural income of more than \$1 billion.

Five years ago I spoke to the state meeting of Garden Clubs and warned of cold winds of change—some that might not be to our liking—and that garden clubs should examine what they are and where they are, and of the need to prepare to live in the 90's and beyond. A few days ago I looked at the forecasts in the Environment 2000 report written in 1987. I thought about where we are today, and who we are today and how best to market this plant industry.

Those who prepare forecasts for the 21st Century predict that agriculture will continue to be an industry in transition; it will face difficult adjustments as market forces, not Washington, set prices. Precision agriculture technology will wring more from less and do so with greater sensitivity to the environment and natural resources. Bioengineering will bring breakthroughs in crops with built-in resistance to disease, bugs, etc. and new tolerances to adverse growing conditions.

Considering these broad changes, we must analyze the marketing needs, examine what is being done, and then suggest some additions or innovative alternative methods of marketing.

To assess the needs I sought the opinions of consumers and commercial participants in many interviews beginning at

our Connecticut Flower and Garden Show.

Consumers want more information on soil-less mixes and organic gardening and are still worried over Silent Spring. They are interested in automatic watering systems, better tools, grow lights, ways to kill the kudzu plant, hybridizing, technological advances in agriculture subsidizing farmers, environmental awareness, and the need to support our Agricultural Experiment Station.

Looking more to the future, genetic changes in plants and seeds are of great concern, with requests that 'we take it easy' putting profits before people, and that the natural integrity of seeds be protected. There are desires for increased variety in plant material. Some respondents think that more gardeners will buy plants rather than grow seeds themselves. More open space, protection of our natural heritage, as in parklands, conservation and recycling, environmental economic incentives and education in use of native plants were also wanted.

Several respondents remarked on the first evidence that pollen from a transgenic plant (*Bt* corn) can harm a non-pest species, in this case the monarch butterfly. Introduced 3 years ago, this season, between 10 and 20 million acres of *Bt* corn is being planted. One researcher asked why this study was not done before the approval of *Bt* corn, "this is 20 million acres of corn too late." While the plight of the butterfly is not a cause for alarm, some researchers viewed the study as a sign for tighter regulation.

Also under fire is the seed technology which results in sterile seed; this terminator technology will prevent seed saving and necessitate buying of new seed yearly. Are these questions for our industry? Can this affect marketing procedures?

I was in England recently and read that five outstanding horticulturists have taken on a project asking government to examine closely genetic tampering: to take time to be certain of safety before such crops are grown there. TV showed a demonstration against American products. I also talked to a nursery which is selling old fashioned seed and urging Brits to grow their own food.

Commercial growers feel that in the new century, marketing should aid in dealing with chain stores whose lack of care for their plants is a detriment to the industry. They also suggest education, and use of the internet. Nurseries are "constantly working against the guy in the truck," i.e. there should be licensing as with arborists. One grower emphasized that we would get somewhere if we all pulled together as an industry.

Examined from the consumer's viewpoint and from inside the industry, we can see that our agriculture is evolving, growing and making great contributions to the life of

The annual Samuel W. Johnson Memorial Lecture during Plant Science Day at Lockwood Farm on August 4, 1999.

Connecticut citizens. However, there are substantial concerns that might be answered by more effective marketing.

What is marketing? Not only selling, but also advertising, promotion, public relations, education to gain public recognition, and public recognition and understanding. What is being done now, and does our industry need new approaches to marketing?

Some years ago I met Peter Berle, President of National Audubon and an expert in use of public relations and use of media. He taught us that in working with the media you must use constant pressure, consistently applied. Marketing is not a one-time thing; it goes on and on. It changes with the world and the times.

There is evidence that we are now recognizing the need for “pulling together.” In the fall of ’97 some of the best minds of the industry gathered together to get agriculture more focused—to become more of a force in the state. In ’98 a steering committee was formed and last February a conference, “Focus on the Future,” brought together the various parts of the industry.

Last August, the Florists, Greenhouse Growers and Nurserymen organizations joined together to form Green Industries. They will have a large exhibit of 1200 square feet at the February 2000 Connecticut Flower and Garden Show.

An outstanding example of good marketing practice is the State Department of Agriculture’s “Ag Expo.” Last October marked its third year. It attracted over 12,000 people.

Another example is the Farmer’s Markets. Ten years ago there were nine; today there are 61. No better market procedure exists than the eye to eye contact between producer and consumer.

Through all this, our Agricultural Station has served as a support system and continued its usual forward-looking research work. In addition it participated in two public events, the Hartford Ag Expo and the New Haven County Conservation Fair, which was held at the Lockwood Farm.

Also keeping us consumers healthy was the Station’s collaboration with maple syrup producers to reduce the amount of lead in maple syrup. Equipment replacement will eliminate lead solder. A second example of consumer protection by the Station was the detection of the fungicide Vinclozolin in peas processed in Belgium. A voluntary nationwide recall resulted.

All the above can be listed under Marketing Practices if proper information is made public. We know that our industry is well, thriving, and making a better Connecticut, but does the average citizen? We are well aware that each group, business and organization has basic marketing techniques already at work. Can we also make use of nonprofit organizations and create some “backdoor” marketing procedures to fill the requests we got from our research? Some suggested ideas for marketing and promotion are:

A speakers list. From the commercial side, are there growers who are willing to share information on new plant material? Consumers are hungry to hear of new plants. Are there horticulturists who would visit a school, garden club, nature center or other center to share knowledge on soil-less mixtures, seeding and transplanting?

Education. Some farms and farm centers have pumpkin

hunts, wagon rides, etc. in the fall for children. We know that the Agricultural Station has welcomed 6,000 children as part of its two-year’s of Farm-City Expo. Many nurseries and garden centers hold classes...yet more education was a number 1 request in our interviews. Are there other members of the industry, such as nurserymen greenhouse growers, who would once during a year welcome consumers to their business? Could you demonstrate what you do in your business for young children?

Publications. Some day it would be wonderful if we could have a publication for plants such as *Wildlife Conservation* has for animals. For over 100 years this magazine has been published by the zoos in America. *Hort-Impact* has been replaced by *Yankee Grower*, and we have targeted newsletters. This broader-scope publication responds to those who requested more education, particularly use of native plants, and organic gardening.

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Memberships. Be a joiner! Investigate organizations which represent your personal interests and join. It might be a plant society, Connecticut Horticultural Society, Westchester-Fairfield Hort Society, the Natural Resources Council of Connecticut, the Experiment Station Associates or any of a myriad of interesting organizations. Why???? You might belong to a professional group of some kind, but you should expand your interests and, believe it or not, it will help market your industry. These non-profits often represent the consumer—remember “public recognition.”

Reverse Membership. Does your professional organization have an Associates or Friends category? Many dedicated gardeners might join and swell the ranks of your group and be another “marketing opportunity,” if invited.

Internet. If you have a computer program and web site, personalized plots for plantings plus plant lists are always popular. Plus, if you select plants and advise on garden practices carefully, you may alleviate some of the “Silent Spring” worries, the number 1 request from the interviews.

Joint Projects. Non-profits, particularly garden clubs, abound in projects, whether it be cleaning a hiking trail or refurbishing a civic planting. Find one in your area: It should cost you little money, but it will take some time and dedication...and give you another press release opportunity. The ideal for this year is joining with the Committee on Invasive Plants. This is an outstanding opportunity to educate re: invasives, and professionals are ideal to suggest substitute plant materials. Invasives are listed in our Federated Garden Clubs booklet and by the DEP.

Plant Protection in Retail Stores. Study whether improved packaging can protect the plants and their moisture supply from chain store abuse.

Communications. And finally, as you successfully test new promotional ideas and approaches, share them with others, so that they may join in making a more effective and respected plant industry.

Drought has major impact during 1999

Although rain that fell during the fall helped replenish water supplies, the precipitation came too late for many growers and homeowners in the state. Both the numbers and casual observations showed that drought occurred in Connecticut during the Summer of 1999. Rainfall during June, July, and August, totaled only 3.69 inches at Lockwood Farm in Hamden, 7.74 inches less than the average for the years 1931-1960. Stated another way, the rainfall in these three crucial months of the growing season was equal to the average for only one month. Although the causes are not certain, the effects of this drought were painfully obvious: wilting plants, fields of crops abandoned by farmers, brown and possibly dead lawns, early color changes and wilting of leaves on trees and shrubs. Station scientists from the Departments of Entomology, Forestry and Horticulture, Plant Pathology and Ecology, Soil and Water, and the Valley Laboratory in Windsor were asked to present their observations. The following is an attempt to put drought into perspective and show some of the effects observed during 1999. It begins with a climatological discussion by Paul E. Waggoner and is followed by a discussion of effects on plants and insects in Connecticut.

The key to drought is in the soil pores

By Paul E. Waggoner

Normally, or at least on average for the past century, about 45 inches of precipitation falls each year on Connecticut. A variation in the annual precipitation did not, however, cause the drought of 1999. Rather light rainfall during April-July caused the trouble. During those 4 months, only 7.33 inches fell in Bridgeport, 7.02 at the Experiment Station's Lockwood Farm in Hamden and 7.64 inches at Bradley Field.

Four questions need answering. What did the landscape need during the four months? How exceptional was April-July 1999? Were some regions hurt especially? And, what caused the drought?

What did plants need? In warm weather well-watered plants can transpire about an inch a week or 4 inches in a month. So the landscape needs or at least can use some 16 inches during April-July. Although exactly an inch a week rarely falls, plants draw on the reservoir or bank account of water in soil pores to even out the supply. Six inches of productive soil can store or bank about 1 inch of water, allowing the surplus to drain away. Because the precipitation during the winter of 1998-9 was not deficient, the soil pores were filled at the beginning of April, giving, say, a lawn with 18-inch deep roots, 3 inches in the bank. Crops had similar accounts, and trees with some 48 inches of roots, 8 inches. Thus by the beginning of August, a lawn would have used its 3 inches in the bank and needed 13 inches deposited by rain to evaporate happily. Even with the 13 inches, it would have drawn down its account. A tree beginning with more in the bank would still have needed rain to deposit 8 inches. My examples are rough and simplified but still impart the nature of the landscape's need. As the examples suggest and the landscape testified, 7 inches deposited by rain was short.

How abnormal was April-July 1999? The National

Historical Climatological Network includes three stations in Connecticut with records for 1889-1994 (Falls Village, Groton and Storrs). Groton received somewhat less and Storrs somewhat more than Falls Village during that sample of 106 April-June periods. Rather than averages, however, we need the frequencies of rainfall amounts to judge how abnormal 1999 was.

The frequencies depicted in Figure 1 show that the needed 13 to 8 inches of rain generally fall into the bank account of water kept by the landscape. The range of 6-9 inches in the frequency diagram is rare. In the past the scant 6-9 inches bracketing the 7 inches of 1999 did occur 12% of the time in Groton, but at Falls Village and Storrs, such a dry April-July only occurred 1% of the time. Although only 6.02 inches fell on Groton during April-July 1894, Falls Village and Storrs have never received less than 8 inches. No doubt that the mere 7 inches of 1999 were exceptional.

Which localities suffered? During the summer when showers rather than widespread frontal rain predominate, localities differ and envy. Rain deposited an average exceeding 11 inches in the northwestern region but only 8 to 9 inches in the central and costal regions of Connecticut. Only 7 to 8 inches fell on Burlington, Bradley Field, Bridgeport, and Lockwood Farm in Hamden. Norwich was driest, receiving only 6.55 inches, while nearby Mansfield Hollow received 10.53 inches during the four months. There was no justice.

What caused the drought? One answer is clear, another is uncertain. The clear answer, evident daily during the drought was a ridge of high pressure persisting over the eastern United States beneath a ridge in the jet stream blowing far above. These both stabilized the air that might have lifted to release showers and kept the weather hot, speeding

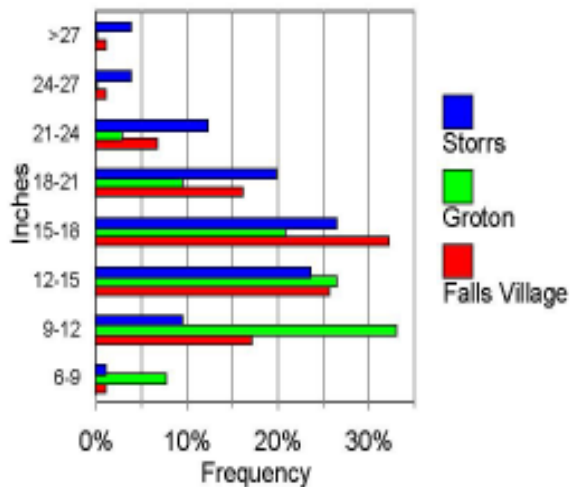


Figure 1. The frequency of inches of rainfall during 106 years at three Connecticut localities during April to July.

evaporation. The lack of showers meant less was deposited in the bank account of water in soil pores at the same time that the hot weather speeded withdrawals.

The specter of global warming leads to the less certain answer. Wide publicity has by now spread the news that combustion of fossil fuel has certainly increased the amount of carbon dioxide in the atmosphere. Theoretically more

carbon dioxide and other so-called greenhouse gases in the atmospheric greenhouse overhead should warm the planet. Although the average world temperature has risen a few degrees recently, the increase of the gases since the beginning of the Industrial Revolution should theoretically have warmed it even more. This mismatch of theory and fact plus other uncertainties make attributing the April-July 1999 drought in Connecticut to greenhouse gases and global warming 'iffy'.

To compound the uncertainty, the main driver of the drought was a lack of rain, which models of global climate project with even less certainty than they project a general warming. Because evaporation does speed up 3% per degree Fahrenheit (other things being equal), the hydrologic cycle of evaporation into the atmosphere and then precipitation would turn faster in a warmer world. Where the precipitation would fall is, of course, the great question with an uncertain answer. So the drought of April-July 1999 is consistent with global warming—but whether global warming caused it is very uncertain. The cause could as well be the random fluctuations of the atmosphere that during April-July delivered both a scant 6.02 inches to Groton in 1894 and fully 27.45 inches to Falls Village in 1945. To farmers and gardeners, sufferers from the bites of mosquitoes, and homeowners with wells, consequences overshadow the statistics and causes of the drought. So, in the following pages, Station scientists discuss the extraordinary drought of April-July 1999.

LANDSCAPE TREES AND SHRUBS

Symptoms of drought stress were evident on many woody plants in the landscape, in natural woodlots, and in forests throughout Connecticut. One important aspect of drought is the fact that the symptoms are often not evident in the top of the tree or shrub until some time after the event has occurred—even as much as one to two years later! Symptoms include loss of turgor in needles and leaves, drooping, wilting, yellowing, premature leaf or needle drop, bark cracks, and twig and branch dieback. During 1999, leaves on deciduous trees often developed a marginal scorch and interveinal necrosis, whereas needles on evergreens turned brown at the tips. Trees and shrubs also exhibited general thinning of the canopy, poor growth, and stunting. In extreme cases, drought resulted in plant death. Among the trees and shrubs most affected were ashes, maples, dogwoods, birches, hemlocks, rhododendrons, mountain laurels, and hollies.

The primary physical effect of drought or dry soil is direct damage to the roots and root death. Non-woody feeder roots, usually located in the top 15 inches of soil, are particularly sensitive and are the first affected. When these roots dry, shrivel, and become nonfunctional, a water deficit develops since the roots cannot provide water to the top of the plant.

In addition, drought triggers numerous metabolic changes which substantially alter the physiology of drought-stressed woody plants. Among these are changes in hormone levels

and other physiological factors (e.g., factors that influence the number of leaf initials in buds for the next year or that are responsible for the closing of stomates).

A significant secondary effect of drought is that it weakens and predisposes woody plants to secondary invaders and opportunistic pests. As a consequence of this predisposition, an unusually high number of problems such as fungal tip blights (*Diplodia* tip blight of pine, *Phomopsis* and *Kabatina* tip blights of junipers) and vascular wilts (*Verticillium* wilt of maple, Dutch elm disease) were observed. Numerous cankers and diebacks were associated with the fungi *Botryosphaeria*, *Phomopsis*, and *Cytospora*, as were increased incidences of root problems associated with *Armillaria* and *Phytophthora*. It is also documented that many drought-stressed plants also show increased sensitivity to de-icing salts, air pollutants, and pesticides to which they are exposed.

Despite the dry conditions during most of the growing season, a surprising number of foliar diseases were observed on woody plants. Most of these could be attributed to early spring conditions when day-night temperature fluctuations resulted in significant dew formation and allowed infections to occur. Among these were *Gymnosporium* rusts of crabapple, scab of crabapple, anthracnoses on oak and maple, and tar spot of maple.

Leaf size was reduced, resulting in the appearance of a thinner than usual canopy in many trees, ranging from



Figure 1. Ridgetops appeared more like fall in August due to drought stress.

smaller trees such as dogwoods and Japanese maples, to larger trees such as oaks and sugar maples. Late season diseases, such as powdery mildew, were severe due to stress suffered during the drought. In addition, many trees, especially those on high dry ridges or in thin soils, basically “shut down” in early August; leaves became brown, dry, and premature defoliation resulted. The early cessation of photosynthesis may result in a weakened tree next summer.

Newly transplanted shrubs especially suffered from the drought, hot days, and dry air that prevailed throughout the summer months. Many transplants simply did not survive, in spite of proper planting and supplementary watering.

LAWNS AND TURF

The hot, humid, dry summer caused significant stress and dieback of many lawns throughout the state. Damage began in June and continued into early September as cool-season turfgrasses went beyond their normal summer dormancy to completely dead. As a consequence of these stressful conditions of prolonged heat and high humidity, many disease and weed problems plagued lawns and golf greens and fairways. The key disease problems diagnosed were Pythium blight, summer patch, brown patch, and anthracnose, especially the more atypical basal or crown-rot stage of this disease. Among the weeds, nutsedge, crabgrass, and ground ivy gained predominance in many lawns by late summer, having taken advantage of the stressed cool-season turfgrass species.

If brown patches persisted after the September rains, the grass had died. The first step to successful reseeding is a soil test, which will give information on improving soil fertility. Reseeding should occur in April.

GROUND COVERS

By mid- to late summer, pachysandra weakened by drought stress or growing in marginal sites (e.g., full sun) developed symptoms of Volutella blight. This disease was diagnosed with great frequency and caused significant problems and extensive dieback in established plantings throughout the state. Although the typical diagnostic, concentric lesions were present on leaves, stem cankers

posed the most important problem since they resulted in sudden collapse of plants in large patches.

WEEDS

Weedy plant species tend to be highly adaptable to weather extremes. Thus, weed populations usually do not shift from year to year. However, in 1999 the severe heat and drought favored some weeds while hurting most others. Based on observations and homeowner calls, drought-tolerant weeds such as crabgrass, purslane, and prostrate spurge were more prevalent than usual in 1999. In unwatered lawns where the grasses went dormant and turned brown, bare patches were created, allowing drought-tolerant weeds to emerge. These weeds were even common in lawns treated in the spring with preemergence herbicides such as pendimethalin or benefin. These herbicides have low solubility in water, and under dry conditions they are tightly bound to soil particles until abundant moisture frees them in solution for uptake by roots of weed seedlings. Thus, some crabgrass and other weeds escaped herbicide treatments in 1999. Similarly, many commercial growers witnessed poor performance of preemergence herbicides in their fields.

CHRISTMAS TREES AND CONIFERS

Effects of drought were particularly severe on seedlings and new transplants, and many Christmas tree growers throughout the state reported losses ranging from 20% to as high as 95% with average losses of 50%. Drought stress was also noticeable in many older, established trees by midsummer, especially those in sandy soils, on gravel sites, or where roots were located in the top layers of heavily compacted soils. Symptoms developed on individual trees or in groups of trees which were growing under common soil conditions.

Rhizosphaera needlecast of Colorado and white spruce, generally a plantation problem, occurred in both plantations and landscapes, especially on drought-stressed trees. This disease caused substantial drop of one- and sometimes two-year-old needles, and infected trees showed considerable thinning. Many pines and true firs also exhibited tip and branch dieback and needle browning and drop.



Figure 2. Newly-planted Christmas trees dead from drought.



Figure 3. Sparse growth of corn can be seen in experimental plot. Inset, small ear harvested in late August.

FRUITS

Apples, peaches, and pears without irrigation exhibited some twig and branch dieback, occasionally produced undersized fruit, and exhibited early fruit drop in many locations. Prolonged periods of drought stress have been known to influence flower bud formation and flower development for the subsequent year. Additionally, weakened trees are also prone to secondary problems such as cankers and root rots. Several growers had concerns about uneven ripening of raspberries under drought and heat stress. Blueberries without irrigation showed evidence of twig and branch dieback and uneven cropping.

VEGETABLES AND FLOWERS

Yields of many vegetables from sweet corn to pumpkins were a small fraction of normal. The direct effects of drought were evident as vegetables without irrigation were stunted, wilted, produced undersized and smaller numbers of fruit, and often whole plants died. Other more subtle effects of drought included delayed flowering, poor pollination, and reduced fruit quality. Many cucurbits were reported to exhibit a change in sex expression as the ratio of flowers reverted to predominantly male.

The effects of drought were seen in experimental corn plots. At Windsor meager rainfall was supplemented with several irrigations throughout the growth of sweet corn cultivars Seneca Appaloosa and Jumpstart compared to Hamden where only two irrigations were applied. Germination of seed of both varieties averaged 81 percent at Windsor compared to 68 percent at Hamden. The corn plants became more stunted at Hamden and produced 40 percent fewer marketable ears (greater than 6 inches long). The marketable ears at Hamden averaged two rows less than at Windsor, resulting in a weight loss per ear of 18 percent. The effect was similar with cut flowers having a 34 percent decrease in number of stems harvested in Hamden compared to Windsor.

The effects of drought were also seen in the production of Jilo, a tropical eggplant and peppers. Early flowers aborted

during the dry summer months and no fruit was harvested until mid-September. With more normal rainfall in 1998, harvest began in mid-July.

In tomatoes, eggplants and various cucurbits (winter squash and muskmelon), the most noticeable result of the drought was the absence of foliar pathogens (leaf blights) until August 20 when powdery mildew made an appearance. The physiological diseases, blossom-end rot, "green shoulders," white core, and uneven ripening of tomato were common. In the worst case, 20-30% of plum-shaped fruit was affected by blossom-end rot. Later, heavy rains after drought caused extensive cracking in ripe tomato fruit (10-20% damage depending on cultivar; cherries and "Boy" varieties crack easily, plums and small fruited globular tomatoes, e.g., "Marglobe" and "Heinz," are less susceptible). Eggplants experienced no problems due to the drought. The drought caused problems with germination and early growth of cucurbits grown on black plastic (June). However, once plants were established, biweekly irrigation was enough to maintain growth and reasonable yield.

INSECTS

Gypsy moth. It is unlikely that the drought had direct effects on the gypsy moth because tree leaves were still in good condition when the caterpillars were feeding in May and June. However, the weakening of trees caused by drought later in the summer may make them more susceptible to damage from future defoliation. In 1999 the incidence of the fungal pathogen *Entomophaga maimaiga* was low and caterpillars survived well. Fortunately, the numbers of gypsy moth caterpillars were low. Because the fungus spores can live for many years, several years of drought is unlikely to affect them.

White grubs. Examples of white grubs are Japanese beetle, oriental beetle, European chafer, and Asiatic garden beetle. The eggs of these "C" shaped grubs must absorb moisture from the surrounding soil to complete development and hatch. Therefore, if a drought is severe enough (as it probably was in most parts of Connecticut during 1999), enough eggs die to keep grub numbers low. The problem is that if moisture is too low for the beetles, it can be so low as to injure turf. In the northwest and northeast hills, sporadic



Figure 4. The effects of drought can be seen clearly. The lawn on the left was unwatered. The lawn on the right was watered.

summer thunderstorms may have kept soil moisture sufficient to allow egg hatch. Asiatic garden beetle adults are active early enough (early May) to allow eggs to survive.

Poor early-season rainfall may have compromised the effectiveness of insecticides applied in early summer (Merit or GrubEx [imidacloprid] or halofenozide [Mach2]), because these insecticides require precipitation to move the active ingredient into the thatch and soil. In addition, any lawns that were irrigated enough to keep them green can be expected to have a bumper crop of white grubs. Beetles (especially oriental beetle) from surrounding, non-irrigated lawns are attracted to lay eggs in a moist habitat where the eggs have a better chance to survive. This phenomenon is especially important for container-grown nurseries where plants grown in pots are always kept moist.

Black vine weevil. Although the drought may have reduced populations, the black vine weevil has amazing survival skills. During summer heat and drought, adults burrow into the soil where temperatures and humidity are moderated. When conditions permit, the weevils come out of hiding to lay their eggs.

Like the adults, the larvae, which live in soil, can travel deeper to find moisture. This may make them inaccessible to predatory ground beetles, which tend to hunt near the surface. Another of the weevil's enemies, insect pathogenic nematodes, requires a film of moisture to travel from one infected grub to another. In dry conditions, the beneficial disease should be held in check. Where plants were irrigated, such as container-grown nurseries and in watered landscape plantings, black vine weevils escaped the drought.

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