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THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION NEW HAVEN

Bluegrasses for green lawns

By Raymond J. Lukens

Kentucky bluegrass, which carpets our lawns and feeds our cows and horses, thrives on well-drained soils in cool, humid climates. Bluegrass was brought from its native northern Europe by early explorers and was scattered throughout America in horse feed. By the time settlers came to live on the land, the grass was already established in clearings and in open areas.

Bluegrass is well suited for turf. It produces many runners that form dense sod with a vigorous rhizome system, has a rich deep green color, and can withstand mowing heights of 1 to 2 inches on fertile soil.

However, Kentucky bluegrass has its problems. Seeds germinate slowly, and initial ground covering takes from 6 to 10 weeks in favorable weather. Fertilization to encourage the grass to crowd out weeds can cause rank growth and heavy thatch. This luxurious turf growth can attract fungal disease and insect pests.

Moreover, Kentucky bluegrass succumbs to melting-out disease during extended periods of cool, overcast weather. Melting-out is caused by a fungus commonly found in most soils. Susceptibility to melting-out makes it risky to use common Kentucky bluegrass in shady areas.

For a number of years, plant scientists have been selecting varieties of Kentucky bluegrass having deeper color, improved tillering, slower growth, or disease resistance. Of these, Merion is one of the best known.

To examine these newer varieties for turf qualities favorable for Connecticut lawns, 39 varieties were planted at Lockwood Farm, grown under a low maintenance program (1 to 2 lb nitrogen per 1,000 sq ft per season),

The author stands among his bluegrass plots at Lockwood Farm.

and cut at a mowing height of 1½ inches. Seeds came from many sources. Samples of the same varieties were tested in similar trials by other scientists in New England.

Ground covering ability was examined during the first season. Color, persistence of turf density, resistance to weed invasion, and incidence of disease were examined during the next five growing seasons.

Differences in the rate of seedling emergence following fall planting seemed to be caused by differences in seed quality rather than variety. However, the amount of ground covered in the season following germination can indicate the rate at which a variety is able to establish turf. Varieties that had covered the most ground in May of the first full season were Jacklin S-21, Kenblue, Geary, Delta, and Park. Kenblue is a selection from the State of Kentucky that most closely resembles common Kentucky bluegrass.

Sixteen varieties maintained high turf densities after 5 years (see the table). At that time thatch was from 2 to 3½ inches thick. Thatch is organic matter in the upper layer of sod consisting of plant debris, live runners, and roots. Excessive thatch can interfere with water movement in soil, especially if irrigated, and thatch has been associated with loss of turf following epidemics of Fusarium blight. Because thatch density is associated with depth of the thatch, densities greater than 0.5 grams per cc would indicate the need for dethatching measures.

Turf color is highly influenced by available moisture and nutrients. Green is the deepest in spring and fall, especially following application of fertilizer. The third column lists the varieties that stayed greenest during the dry summer months and for the longest periods after fertilization.

As with many lawns, the turf plots were invaded by common weeds such as dandelion, plantains, chickweed, clover, and crabgrass. Generally fewer weeds were found in the denser turf. Warren's A-20 had the fewest weeds, but all of the varieties were able to crowd out weeds. Herbicides were applied during alternate years to allow the less aggressive bluegrass varieties to compete with weeds.

Melting-out disease attacked the plots during April to June, and dollar spot disease appeared during July and August of each year. Kenblue and 10 other varieties susceptible to melting-out were able to resist dollar spot, while Merion and five other varieties resisted melting-out but were susceptible to dollar spot. Ten varieties were found resistant to both diseases. Those of high turf densities are indicated in the fourth column. Three varieties succumbed to both diseases and produced poor turf.

The low fertility maintenance program was too drastic for Merion and other deep color varieties that are normally grown in display areas where they do best when mowed short and clippings are removed. They require as much as 6 lb nitrogen per 1,000 sq ft per season in frequent applications to maintain vigor. The high performance varieties lost out in the battle with aggressive weeds and covered less than half of the ground area at the end of 5 years. Furthermore, the medium cutting height discouraged aggressiveness of some dwarf varieties that perform best at cutting heights of 3/4 to 1 inch. The use of high performance varieties for lawn purposes is questionable in view of the extreme care and large amount of fertilizer required for their maintenance.

Continued

Kentucky bluegrass varieties that performed well under low maintenance

Variety	High Turf Density After 5 yr	Thatch Less Than 0.5 g per cc	Deep Color	Resistance To Melting-out And Dollar Spot
Belturf	X	X		
Birka	X		X	X
Campus	X	X	X	X
Cougar	X	X		
Fylking	X			X
Geary	X	X		
Jacklin S-21	X	X		
Kenblue	X	X		
Minn-6	X	X		
Palouse	X	X		
Pennstar	X		X	X
Prato	X			
Primo	X		X	
So. Dakota Cert.	X	X		
Warren's A-20	X			X
Warren's A-34	X			X

BLUEGRASS

Our trials demonstrated that Kenblue and 15 new varieties of Kentucky bluegrass can perform satisfactorily in Connecticut with little maintenance. Nine varieties produced little thatch, while seven produced high levels of thatch. The latter varieties may need dethatching for proper maintenance.

Six of the varieties resisted both melting-out and dollar spot, while the remaining ten were resistant to only one of these diseases. Four varieties remained deep green even when there was little moisture or fertilizer.

Of the 39 varieties of Kentucky bluegrass tested in our trials at Lockwood Farm, the three varieties that performed the best were Birka, Campus, and Pennstar.

With the increased costs of fertilizer and water for sprinkling, many property owners may decide to reduce their present level of lawn care. The results from these tests will serve as a guide to the varieties of Kentucky bluegrass that do best in Connecticut with minimum maintenance.

New Publications

Three new and two revised publications have been prepared by the Connecticut Station staff since the last issue of *Frontiers*. Requests for copies should be addressed to Publications, Box 1106, New Haven, Conn. 06504. The results of many other scientific investigations carried out by Station scientists are published in scientific journals. During the past six months 62 such articles have been submitted for publication.

- B 695 Termites in Buildings, R. Beard (Revision of 1968 edition)
- B 747 Longevity of Septic Systems in Connecticut Soils, D. E. Hill and C. R. Frink
- B 748 Termite Biology and Bait-block Method of Control, R. Beard
- B 749 Defoliation in Connecticut 1969-1974, Tabulated by Use of the Geo-Code, J. F. Anderson and S. W. Gould
- LP List of Publications (1975 edition)

A special issue of *Frontiers of Plant Science* will be published in late February to commemorate the centennial of The Connecticut Agricultural Experiment Station. This issue will highlight the discoveries of some of the famous scientists who have worked at the Station during her first 100 years.

The two-lined chestn killer of oaks in Con

By Dennis Dunbar and George Stephens

Growing concern over the increasing numbers of dying oaks in the State in recent years has led us to investigate the role of a small beetle called the two-lined chestnut borer, *Agrilus bilineatus* (Weber). We have been studying the biology, life history, and control of this insect since the summer of 1972, when oak mortality became most noticeable.

The two-lined chestnut borer, which is native to eastern oak forests, derives its name from the prominent brown line on each of its wing covers (Fig. 1). Its hosts include American chestnut, oak, and beech. Trees weakened by drought or defoliation are more subject to attack than are healthy trees. Thus, the widespread defoliation of Connecticut forests by the gypsy moth and elm spanworm over the past few years has allowed the borer to attack many weakened trees and to build its numbers to a high level.

Adult beetles, $\frac{1}{4}$ to $\frac{1}{2}$ inch long, are black with a greenish tinge. In Connecticut most adults emerge from infested trees in mid-June, although some emerge as late as August. Adults live approximately two weeks. Females search out likely spots on the bark of large limbs and the main trunk of trees where they lay their eggs.

Upon hatching, the tiny larvae burrow through the bark and begin to cut their characteristic zig-zag feeding galleries between the bark and wood. (Cover photo) In July, newly-hatched larvae can barely be seen, but by October the slender, flattened larvae may be more than an inch long (Fig. 2).

In the fall, larvae cease to feed and instead burrow outward to the bark. Pupal chambers are constructed just beneath the surface where the larvae, doubled back upon themselves, remain throughout the winter. Pupation, the transformation to adulthood, begins in late April or May. Beginning in June adults chew away the thin covering of bark and emerge through characteristic D-shaped holes ready to begin the cycle anew.

The adults feed upon oak foliage. Laboratory tests show that the leaves of scarlet and chestnut oaks are preferred over other species. However, the real damage results from larval feeding in the phloem and cambium.

The phloem, a narrow band of living cells beneath the bark, is the pathway by which materials assimilated in the leaves are transported to the roots. When this

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An adult two-lined chestnut borer, below, ranges in size from ¼ to ½ inch in length. The larva, right, may be more than an inch long.

Fig. 1

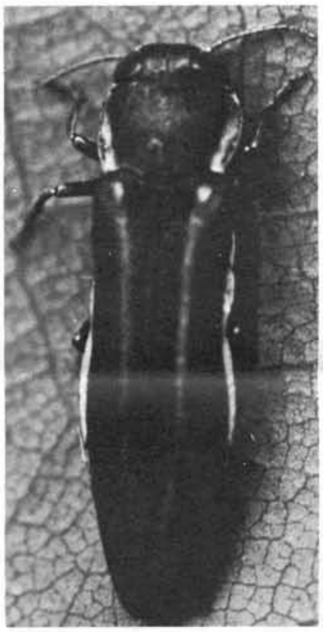
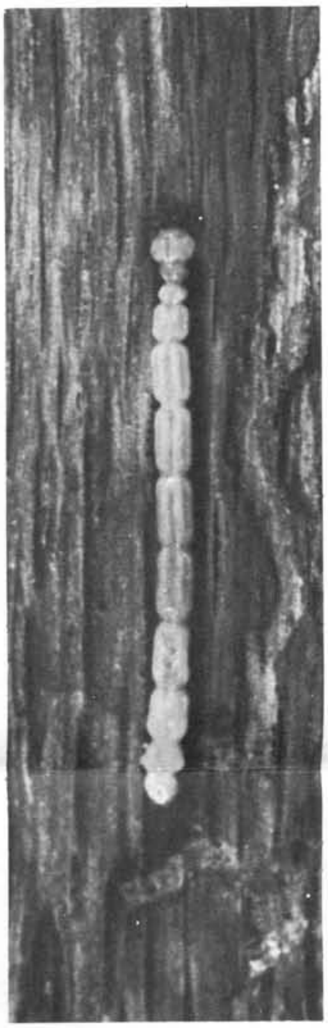


Fig. 2



pathway is interrupted by larval feeding galleries, the roots are soon unable to grow and function. Uptake of water is impeded and severe water deficit, usually in late July or August, is accompanied by sudden wilting and browning of the foliage in the tree tops. Although some trees succumb after a single season, most are infested for two years before death occurs. Our field samples showed that chestnut and white oaks are most susceptible, but all oak species found in our woodlands are attacked.

Examination of almost any woodland in Connecticut will reveal some oaks killed by the two-lined chestnut borer. However, until recently, despite previous repeated heavy defoliations, loss of oak has generally been slight. But by 1971 increasing numbers of dead oak were seen in many localities. During the summer and fall of 1972, 11 sites in 9 towns that showed oak mortality were examined. Most sites were on dry ridge tops with thin, rocky soils and had been defoliated one or more times since 1969.

Oak mortality during the period 1969-73 ranged from 18 to 79 percent. Mortality was least in areas like Cornwall and Watertown where there was either no defoliation or a single defoliation in 1972 or 1973. The most mortality occurred in Bethany where there was heavy defoliation in both 1970 and 1971. From 50 to 100 percent of the oaks dead at least a year contained evidence of being attacked by the two-lined chestnut borer.

Some sites had few living chestnut oaks remaining. In all of the areas, mortality of birch and maple has been negligible.

Large trees killed by the two-lined chestnut borer can be salvaged for timber and firewood. Experiments were conducted in 1972 to determine if larvae could complete their development in cut logs or firewood. If this is possible, then there is great potential for transporting and concentrating large numbers of two-lined chestnut borers into areas where there are valuable oak shade trees.

We found that survival of insects in logs stored over the winter on a rack in an open shed was 99 percent compared to 75 percent in logs stored on a rack and placed outdoors. However, chipping of infested logs killed all beetles.

Infested logs may also be treated with insecticides. We found that the insecticides Dursban, lindane and Cygon sprayed on infested logs in May held adult emergence below 10 percent. Logs receiving no treatment had 95 percent emergence.

Because adult beetles feed on oak leaves, control by conventional foliage spraying was attempted. Sprays of Imidan, Orthene, methoxychlor and Sevin applied to oak leaves and fed to caged beetles in the laboratory killed all beetles up to one week after application.

The total acreage of forest severely infested has not yet been determined, but the rocky highlands adjacent to the Naugatuck River Valley appear to be the hardest hit. Barring abundant regeneration of oak, the future composition of these stands may be mainly red maple and black birch.

Observations of unmanaged woodlands in Connecticut have shown a steady decrease in oak and an increase of maple and birch since 1927. Perhaps this present abundance of two-lined chestnut borer will further speed oak decline and a change in our forests.

SEPTIC SYSTEMS --- HOW LONG DO THEY LAST?

By David E. Hill and Charles R. Frink

Four out of 10 of Connecticut's homeowners must dispose of sewage wastes on their own property because they live beyond sewers. Although sewers are being extended into many areas of moderate population density, the number of homeowners using septic systems is not likely to decline because development will occur in more remote areas.

If a septic system fails, causing sewage to back up into household fixtures or to erupt onto well-manicured lawns, it is an expensive annoyance. Local health officials become concerned because failing systems may jeopardize health. This concern enlarges if town and state officials must decide if centralized treatment is necessary.

Many questions are raised, but the foremost are:

- How long do septic systems last?
- Do the kinds of soils in which they are installed affect their life span?
- How effective are repairs of failing systems?
- What effect do changes in design have on performance?
- Does weather affect performance?
- How can systems be improved?

To answer these questions, the Experiment Station, with the help of five honors students from Glastonbury High School, surveyed all septic systems in the town.

To calculate the longevity of these systems we determined the date of initial use of all those in operation, and the date of repair for those that were repaired. We found the soil type on each lot by overlaying a transparent soil map on the town map showing lot boundaries, and we recorded the percolation test rates that had determined the design capacity of each leaching field. All data were transferred to punch cards for evaluation.

All systems were tabulated according to age and the calendar year when they began operating. Comparisons were made between systems that failed and those that succeeded. Although the records only went back to 1961, we were able to estimate statistically the number of systems that had failed earlier. Thus a 26-year record was constructed for our longevity predictions.

Many soil types are found in Glastonbury. The town straddles the boundary between the Connecticut River Lowlands with its dominantly sandy terrace soils, and the Eastern Highlands with its soils derived from glacial debris (till) covering bedrock. Since few systems were installed in many of the soil types, we combined soil types into five groups. These groups and their percent cumulative failure rates over a 20-year span are shown in the table. Overall, we found that 493 of 2,845 systems had failed since 1961. The table reveals that 6 percent of Glastonbury's septic systems failed within 5 years, 11 percent failed within 10 years and so on. The half-life (the time it took for half of the systems to fail) was 27 years.

Looking at individual soil groups, only 3 percent of the systems installed in stratified sand and gravel failed within 5 years. In contrast, 12 percent of the systems installed in compact glacial till with hardpan at shallow depths failed early. Surprisingly, however, these systems had the longest half-life, 38 years. We attribute this to the fact that systems installed in compact till generally have larger design capacities than those installed in stratified sand and gravel because their slower percolation rates require larger leaching areas.

The records of early failures of systems installed in compact till showed that most of the percolation tests and site evaluations had taken place in summer and early fall when water that normally perches on top of the compacted till usually dries up. Thus, where failures occurred prematurely, the perched water tables were probably undetected. Further, percolation tests performed in dry soils have faster rates than those performed in the wet soils of early spring. Hence, the indicated size of the leaching field was often smaller than would normally be required. Repairs on half of these premature failures increased the size of the leaching field. The other half required ground water control. Only one in 31 of these repaired systems failed a second time.

The table also reveals a surprisingly short half-life for systems installed in loose glacial till. Their 23-year half-life is 15 years shorter than for systems installed in compact till and 4 years shorter than for systems installed in stratified sand and gravel. To determine the probable cause we compared the percolation rates of systems installed in two of these soil groups. Fully 95 percent of the percolation tests for systems installed in stratified sand and gravel had fast rates that allowed the smallest leaching area. Over 80 percent of those installed in loose glacial till also had fast rates.

The distribution of soil particle sizes and the pore spaces between them probably explain the difference in long-term performance. Stratified sand and gravel has little silt and clay, and large pores predominate. Loose glacial till, although quite sandy, includes a mixture of

A more detailed treatment of this subject is in Bulletin 747, Longevity of Septic Systems in Connecticut Soils, available from Publications, Box 1106, New Haven, Conn. 06504.

silt and clay with fewer large pores. Silt and clay may become smeared on the exposed surface of leaching trenches, beds, and pits during excavation, especially if the soil is wet. This smearing of silt and clay shortens the life of the system by reducing the infiltrative capacity of the soil.

EFFECTIVENESS OF REPAIRS. Analysis of our data showed that of the 493 systems repaired, 24 failed a second time within the last 13 years. Treating the 493 initial repairs as a new population, we found the projected half-life of a repaired system to be 21 years. Thus, repairs that correct design and installation deficiencies or poor management by the homeowner add measurably to the life of a system.

DESIGN CHANGES. The design requirements for leaching area were essentially tripled in 1961. In an attempt to evaluate the effectiveness of this change, we divided the septic systems into two age groups. Systems installed in compact glacial till between 1944 and 1961 failed more slowly than the average, but after 1961 they failed more frequently than the average. As we have already indicated, the rate of early failure is high for systems in compact glacial till. This may account for the apparent increase in the post-1961 failure rate. Systems installed in sand and gravel showed the greatest improvement and were the only group failing less than the average rate. For all soils, we observed about a 10 percent decrease in the rate of failure, but this difference was not statistically significant. Thus, we concluded that several more years are required before we can determine the full impact of the change in design requirements on the longevity of septic systems.

WEATHER. To examine the effect of weather, we looked at failure rates during the very dry years of 1965 and 1966, and the very wet year of 1972. The failure rates during 1965 and 1966 were similar to those of the normal weather years of 1964 and 1967. The failure rates in 1972 were the same as in normal year 1971. Hence, wet weather itself seems to have little direct effect on performance.

However, the effect of weather may be more subtle. We noted that systems initially used in 1956 had, by far, the highest number of failures. We found that most of these systems had been installed during the fall of 1955 when over 22 inches of rain fell during August and October. Conversely, we noted few failures in 1958 of systems installed during the exceptionally dry year of 1957.

Thus, the weather during installation seems to affect longevity more than the weather during use because systems installed in soils saturated with water are more prone to lose their capacity to transmit water early.

IMPROVEMENT IN PERFORMANCE. Our survey of Glastonbury's septic systems suggests several corrective measures to improve performance and increase longevity.

- Percolation testing in early spring when water tables are normally highest, especially in compact till. This should reduce premature failures due to drowning of leaching fields by perched water tables.
- Larger leaching fields for systems installed in loose glacial till. This should improve their longevity.
- Delay in installation and repair of systems until soils with appreciable silt and clay drain fully. This should minimize smearing.
- Leaching field sizes based on percolation tests, deep observations, and knowledge of soil type.

Longevity of septic systems installed in different soil groups

	Sample size	% Cumulative failure				Half-life* (Yr)
		5-Yr	10-Yr	15-Yr	20-Yr	
All soils	2,845	6	11	20	31	27
Stratified sand and gravel	1,608	3	8	16	28	27
Loose glacial till	491	8	15	27	42	23
Compact glacial till	278	12	16	21	26	38
Shallow to bedrock	333	5	10	17	27	29
Poorly drained soils	129	7	14	23	36	25
Miscellaneous soils	6	—	—	—	—	—

*The number of years before 50% are expected to fail.

THE CONNECTICUT
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Paul E. Waggoner
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New Century's Eve

By Paul E. Waggoner

This is New Century's Eve for America's first and thus for all her State Agricultural Experiment Stations.

On July 20, 1875 Governor Ingersoll of Connecticut signed into law a bill establishing the first Experiment Station in the New World. A score of years before, while studying in Germany, Samuel Johnson had begun the campaign for the Station, and while teaching chemistry at Yale he had continued the campaign, aided by farmers and city folk who foresaw science could hold back the Malthusian deluge. They kept campaigning until the General Assembly passed the charter for our Station. Soon Stations sprang up in other states.

In their first century the American Stations have united theory and practice and made a regular business of discovery, as their founders planned they would. The Stations have paid regular dividends to their stockholders, the American citizens. They have performed the essential service of getting "two ears of corn, or two blades of grass to grow upon a spot of ground where only one grew before," as described in *Gulliver's Travels*.

Even the first Station has made contributions on her own. Discovering the first vitamin, learning the essentiality of amino acids in our food, inventing hybrid corn, devising a soil test, introducing shade tents to the Connecticut Valley, controlling blights, and finding the wasp that eliminated the elm spanworm.

But – so little done and so much to do.

Foreign nations starve and our grocery prices climb, while our nation must sell our grain to pay its oil bill. The farmers who transform grain into meat, milk and eggs are ground between the stones of expensive feed and prices consumers can afford. Now the Stations must make four ears and four blades grow where they made two grow before.

Station scientists may celebrate a bit on New Century's Eve and then resolve:

"But I have promises to keep,
and miles to go before I sleep."

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