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DETERMINING THE NEED FOR PHOSPHORUS AND POTASSIUM FERTILIZATION IN A NEW TURF PLANTING

*John Van Dam, Roy Branson, and Ralph Strohman**

In a recent field trial at the State Recreational Area, Lake Perris, University of California soil and tissue analysis guidelines were used to assess the phosphorus and potassium fertilization needs of a new Alta tall fescue planting.

The site, a gently sloping, formerly uncultivated area with sandy loam soil, had been seeded to Alta tall fescue in the summer of 197% Fertilization during the first year was limited to nitrogen only, applied at a relatively low rate. When the trial planting began in the spring of 1978, the turf was well established but showed signs of needing additional fertilizer. Based on past fertilization practices and appearance of the turf, nitrogen deficiency was assumed. Past experience and research with southern California soils also suggested a possible deficiency of phosphorus (P) but not of potassium (K). The trial was established to analyze the soil for available potassium and phosphorus and then double-check the findings by conducting a fertilization trial to determine the adequacy of these elements in the leaf tissue with and without soil fertilizer added.

Analyses of soil samples taken before treatment from the surface 6-inch depth in each of the trial's four blocks are shown in table 1.

TABLE 1. SOIL ANALYSES-BEFORE TREATMENT (JULY, 1978)

Element and method used	Average ppm per block* I	II	III	IV
Available P (Olsen's sodium bicarbonate)	6.5	6.4	8.0	6.7
Available K (boiling nitric acid)	1,614	1,778	1,960	1,975

*Five samples per block.

According to existing soil analysis guidelines, the available P was in the range that research has shown to be marginal for turf-grasses-that is, 5 to 8 ppm (Lunt, Branson, and Clark, 1967). From a practical standpoint, P fertilization is advisable when soil P levels fall within this range. A field test, such as the one described here is the best way to find out if and how much P is actually needed. Several rates were included in the trial to gain information on the minimum requirement, in case P fertilization was found to be necessary.

Available K levels, on the other hand, fell within the range that indicated an adequate supply of this element in the soil-that is, more than 900 ppm (Lunt et al. 1974). Since K deficiency was not to be expected, according to the analyses, only one rate was used in the trial in addition to the check.

The fertilization treatments, applied during July, 1978, in a randomized complete block design with four replicates-single superphosphate (P_2O_5) at 0,2 1/2, 5, and 10 pounds per 1,000 square feet, and potassium chloride (K_2O_5) at 0 and 10 pounds per square foot. To eliminate nitrogen as a variable, it was applied uniformly to all plots (isobutylidene-diurea, 31-0-0), at 10 pounds per 1,000 square feet).

Approximately three months later, leaf tissue samples from each of the plots were analyzed. Average P and K data for each treatment are shown in table 2.

TABLE 2. TOTAL P AND K IN ALTA TALL FESCUE LEAF TISSUE (SEPTEMBER, 1978)

Rate per 1,000 sq ft	Dry weight in leaf P (P_2O_5)	K (K_20)
pounds	*percent*	
0	0.35	2.90
2%	0.54	...
5	0.64	2.90*
10	0.65	...

*Plus P_2O_5.

The level of leaf P in the check treatment (0.35 percent) was marginal (Branson, 1966) and agreed with its predicted availability of the soil P supply as discussed earlier. Phosphorus fertilization with P at the lowest rate increased the leaf P to 0.54 percent, which was in the adequate range. Leaf P was increased further by addition of more P fertilizer until the highest application rate was reached.

In contrast with leaf P, leaf K was well within the adequate range, more than 1.0 percent (Branson, 1966), even where no K fertilizer was applied. This was due to the substantial reserve of available K in the soil. Again, as with P, the leaf level of K agreed with its predicted availability of the soil supply. Leaf K was unaffected by K fertilization-a further indication of the abundant reserve of that element in the soil.

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These trials at Lake Perris demonstrated the usefulness of both soil analysis and plant leaf analysis in providing guidance for developing the correct program of K and P fertilization of turf at this location. It also showed that the soil P supply was inadequate and that a single surface application of P at a modest rate was effective in correcting this condition. K fertilization of turf at this location was not found to be necessary.

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DICHONDRA RUST CONTROL: RESEARCH PROGRESS REPORT

*Gary W Hickman and Jan Holcomb**

Rust, caused by *Puccinia* species of fungus, is a commonly recognized turf disease. Symptoms include yellow-orange, red, or brown pustules which develop on leaves and stems. The spores are easily seen by running a cloth over the infected leaves. In dichondra, these pustules more commonly occur on the underside of the leaf. Infected leaves often have elongated petioles. Badly infected leaves cup, exposing the underside of the leaf, and may be chlorotic. The rust fungus, *Puccinia dichondrae,* that infects dichondra produces only the teliospore stage in California, and it has no alternate hosts.

There are very few technical references to I? *dichondrae* and no published reports on control of the disease. *The Index of Plant Diseases in the United States, Agricultural Handbook* No. 165, does list this disease as occurring on *Dichondra repe* in California.

A replicated trial was conducted in the spring of 1979 to find an effective chemical control for the disease. Zineb, oxycarboxin (Plantvax), chlorothalonil (Daconil 2787), and an untreated check were included in the trial. The test site was a solid stand of mature dichondra, uniformly infected with rust. A completely randomized design was used with experimental units of 1.5 square meters replicated four times.

Active ingredient rates for the test, expressed as grams per square meter, were zineb, 2.6; oxycarboxin, 0.6; and chlorothalonil, 0.2. Each test unit was sprayed with approximately 1 liter of material using a pressurized hand pump applicator until all plants were wet.

The first application was made on April 24, 1979, and a second one on May 5, 1979, with a 14 -day interval between treatments. A replicated phytoxicity trial was also conducted in July of 1979. Oxycarboxin was tested at four different rates on an established dichondra area. The rates of active ingredient, expressed as grams per square meter, were 0.6 g (efficacy trial rate); 2.6 g (4 lb/lOOgal/A label rate for bluegrass); 5.2 g (2 x label rate); and 10.4 g (4 x label rate). An untreated control was included in this trial.

Results and Conclusions

Visual ratings made May 18, 1979, showed satisfactory disease control by the oxycarboxin. The zineb, chlorothalonil, and untreated check plots were equal. No phytotoxic effects were seen using these application rates. In the phytotoxicity trial, no damage was recorded to dichondra using up to the label rate for bluegrass (2.6 g/sq m), which is equivalent to four times the effective trial rate for dichondra. The 2 xlabel rate (5.2 g/sq m) showed slight marginal burning of the leaves but was judged acceptable. The 4xlabel rate for bluegrass (10.4 g/sq m) was moderately phytotoxic and was not acceptable. Repeated applications were not tested for their possible phytotoxic effects.

VISUAL RATING* OF TREATMENTS FOR DICHONDRA RUST CONTROL

Treatment	Active ingredient per square meter	Rating†
	grams	
zineb	2.6	6.ob
oxycarboxin	0.6	2.0,
chlorothalonil	0.2	7.5b
control	· ·	7.01,

*Rating: 0 = complete control; 10 = no control.

†All means followed by the same letter are not significantly different from each other at P = 0.05 using Duncan's multiple range test.

This progress report gives experimental data that should not be considered as University of California recommendations for use. Until the products and the uses given appear on a registered pesticide label or other legal, supplementary directions for use, it is illegal to use the chemicals, as described.

Additional studies are anticipated using other chemical and cultural controls. Future studies should include testing of shorter time intervals between treatments. Results will be presented as they become available.

Acknowledgements: Appreciation is extended to Rosetta Isaak, S. Hironaka..and Arthur McCain.

*Environmental Horticulture Advisor and Farm Advisor Intern, San Joaquin County, Cooperative Extension, respectively.

Metrics*

*James F. Thompson***

The metric system of measurement is becoming more and more a part of our daily lives. Food containers already are labeled both with the customary (or English) units of ounces, quarts, or pounds and with the metric units of milliliters, liters, or grams. Outdoor temperature is often reported in degrees Celsius, and speedometers in new cars show figures for kilometers per hour.

The modern metric system-also known as International System of Units (SI)-is based on units of 10, like the U.S. money system. For that reason, multiplication and division in the metric system is easier to use than the English system.

The Language of Metrics

Prefixes are added to metric words gram, liter, meter, and the like, to indicate their multiple or fractional values. For instance, 191 kilometers is less cumbersome to express the distance between Los Angeles and San Diego than 191,000 meters.

Following are metric prefixes (with abbreviations) and their multiple or fractional values. Note how spaces separate the three-number groups of whole values; commas are not used at all. (However, in some non English-speaking countries, commas are used as we use decimal points.)

giga (G) = 1 000000000 (10^9)
mega(M) = 1000000 (10^6)
kilo(k) = 1000 (10^3)
hecto(h) = l00 (10^2)
deka(da) = 10 (10^1)
deci(d) = l/l0 (10^{-1})
centi = l/l00 (10^{-2})
milli = l/10000 (10^{-3})
micro (μ) = l/l000000 (10^{-6})
nano(n) = l/l000000000 (10^{-9})
pico(p) = l/l000000000000 (10^{-12})

Exact Equivalents

To convert unit left of equal sign (=) to unit right of equal sign, multiply by constant on right. For example, 40 kilometers = 40 x .6214 = 24.86 miles. (A formula is provided to convert degrees Fahrenheit to degrees Celsius and vice versa.)

Length

1 kilometer (km) = 0.6214 mile
1 meter(m) = 3.281 feet
1 meter = 39.37 inches
1 centimeter (cm) = 0.3937 inch
1 millimeter (mm) = 0.03937 inch
. . . .
1 mile = 1.609 kilometers
1 chain (66 feet) = 20.12 meters
1 rod (16.5 feet) = 5.092 meters
1 foot (12 inches) = 0.3048 meter
1 inch = 2.540 centimers

Area

1 square kilometer
(100 hectares) = 0.3861 square mile
1 hectare
(10000 square meters) = 107,640.O square feet
1 hectare (ha) = 2.471 acres
1 square meter = 10.76 square feet
1 square centimeter = 0.1549 square inch
. . . .
1 square mile (640 acres) = 259.0 hectares
1 square mile = 2.590 square kilometers
1 acre (43,560 square feet) = 0.4047 hectare
1 square foot = 0.929 square meter
1 square inch = 6.452 square centimers

Weight‡

1 metric ton (tonne, t) = 1.102 U.S. tons
1 quintal (q. l/l0 metric ton) = 220.5 pounds
1 kilogram (kg) = 2.205 pounds
1 gram(g) = 0.03527 ounce
. . . .
1 U.S. ton = 0.9072 metric ton
1 pound = 0.4536 kilogram
1 ounce = 28.35 grams
1 grain (l/7,000 pound) = .0648 gram

Yield

1 metric ton per hectare = 0.446 U.S. ton per acre
1 kilogram per hectare = 0.892 pound per acre
1 quintal per hectare = 0.892 hundred weight per acre
1 cubic meter per hectare = 11.48 bushels per acre
. . . .
1 U.S. ton per acre = 2.242 metric tons per hectare
1 pound per acre = 1.121 kilograms per hectare
1 hundredweight per acre = 1.121 quintal per hectare
1 bushel per acre = .08708 cubic meter per hectare

Temperature

degrees Celsius (°C x 1.8) + 32 = degrees Fahrenheit (°F)
degrees Fahrenheit (°F – 32) x .555 = degrees Celsius (°C)

Pressure

1 Pascal (Pa, equivalent to
1 newton/meter*) = 0.0001450 pound per square inch
1 Pascal = 0.004019 inch water (60°F)
. . . .
1 inch water (60°F) = 248.8 pascals
1 pound per square inch = 6894.0 pascals

Volume

1 hectare centimeter = 0.9728 acre-inch

*From *Metrics,* Leaflet 21098, Division of Agricultural Sciences, University of California, Berkeley, California.
**Extension Agricultural Engineer, University of California, Davis.

1 cubic meter = 35.314 cubic feet
1 cubic meter = 1.308 cubic yards
1 cubic meter = 1000.0 liters
1 liter(L) = 0.0353 cubic foot
1 liter = 0.2642 U.S. gallon
1 liter = 1.057 quarts
1 liter = 4.227 cups
1 cubic centimer = 0.061 cubic inch
1 milliliter = 0.06667 tablespoon
1 milliliter = 0.03333 fluid ounce

....

1 quart = 0.9464 liter
1 cup = 0.2366 liter
1 fluid ounce = = 30.0 milliliters
1 tablespoon (3 teaspoons) = 15.0 milliliters
1 acre-foot (43,560 cubic feet) = 1233.5 cubic meters
1 acre-inch (3,630 cubic feet) = 102.8 cubic meters
1 cubic yard = 0.7645 cubic meter
1 cubic foot = 0.0283 cubic meter
1 cubic foot = 28.32 liters
1 cubic inch = 16.39 cubic centimeters
1 U.S. gallon = 3.785 liters

Flow

1 cubic meter per second (m^3/s) = 15,850 gallons per minute
1 cubic meter per second (1000 L/s) = 35.31 cubic feet per second

....

1 gallon per minute = 0.00006309 cubic meter per second
1 gallon per minute = 0.06309 liter per second (L/s)
1 cubic foot per second = 0.02832 cubic meter per second
1 cubic foot per second = 28.32 liters per second
1 miner's inch (No. Calif. 1/40 cfs) = 0.0007079 cubic meter per second
1 miner's inch (So. Calif. 1/50 cfs) = 0.0005663 cubic meter per second

Light

1 lux (lumen/m^2) = 0.0929 foot-candle
1 foot-candle = 10.74 lux

Energy

1 megajoule (MJ) = 0.3725 horsepower-hour
1 megajoule = 0.2778 kilowatt-hour
1 joule (J, equivalent to 1 newton-meter) = 0.0009478 British thermal unit
1 ioule = 0.2388 gram calorie

....

1 horsepower-hour = 2.685 megajoules
1 kilowatt-hour = 3.600 megajoules
1 British thermal unit (Btu) = 1055.0 joules
1 gram calorie = 4.187 joules

‡**Weight** is the commonly, although incorrectly, used term for mass in the English system. Mass is a measure of the amount of material that an object contains. In science and engineering, weight is used as a measure of the force of Earth's gravity on the mass of an object. Weight differs as a result of gravity, whereas mass is constant. It is necessary to know whether mass or force is intended and to use the proper SI unit-kilogram for mass and newton for force.

UC TURF CORNER

*Victor A. Gibeault and Forrest D. Cress**

UC Turf Corner contains summaries of recently reported research results, abstracts of certain conference presentations; and announcements of new turf management publications. The source of each summary is given for the purpose of further reference.

ACTIVATED CHARCOAL CAN NULLIFY HARMFUL CHEMICAL RESIDUES

During the past 10 years, some 25 field tests have been conducted at the Rhode Island Agricultural Experiment Station to determine if activated charcoal can absorb and nullify the harmful effects of chemicals and herbicides used on turfgrass.

The activated charcoal used in most of the tests was a dry, finely divided form called Gro-Safe. Some chemicals were found not to inhibit seedlings. Others that inhibited grass seedlings could be deactivated by charcoal, resulting in improved grass stands, the Rhode Island researcher who conducted the studies reports. (The chemicals are listed in the publication referred to below.) "Our studies," he says, "demonstrate that activated charcoal can absorb and deactivate most of the herbicides used for weed control in turfgrass. In soils that are contaminated with harmful chemical residues, improved grass stands can be obtained by using charcoal in the seedbed. Use of charcoal in contaminated soils before sodding can improve rooting and reduce grass injury."

When chemical spill, overapplication, or misuse occurs, charcoal, applied as soon as possible, can alleviate damage to established turfgrass from some chemicals. Success often depends on getting the charcoal in contact with the chemical before it gets into the plant. The researcher suggests keeping a bag of charcoal handy for immediate, emergency use.

("Activated Charcoal Nullifies Harmful Chemical Residues," by J.A. Jagschitz, Turfgrass Research Review, Cooperative Extension Service, University of Rhode Island, Vol. 2, No. 4, August 1977)

*Environmental Horticulturist and Communications Specialist, respectively, Cooperative Extension, University of California, Riverside.

STUDIES POINT WAY TO IMPROVING TURFGRASS BREEDING PROGRAMS

Studies at the University of California, Riverside, show that it may be possible to develop Kentucky bluegrass cultivars with higher rates of leaf and tiller emergence and greater tolerance to mowing. The UCR findings point out the need for exploring the potential for breeding strains more tolerant of mowing by selection of genotypes with higher leaf sheath photosynthesis.

The studies were conducted in the greenhouse on individual plants of Kentucky bluegrass cultivars Merion, Newport, and Windsor to precisely describe leaf and tiller growth and the effects of defoliation upon them. In the first study, six plants of each cultivar, grown under uniform controlled conditions, were examined daily for 60 days for leaf, tiller, and rhizome emergence. In the second study, five plants of each cultivar were defoliated, and five plants were left intact. To provide uniform defoliation of all cultivars, entire leaf blades were removed at the time they reached full expansion. In the third study, CO2 exchange as a measure of net photosynthesis was determined for all leaf surfaces, and for leaf blade surfaces only, by coating leaf sheaths with grease.

Leaf and tiller emergence on the main shoot proceeded at constant rates characteristic of each cultivar. On all cultivars the first leaf of the main shoot was dead before the sixth leaf had emerged. Thereafter, leaf senescence and leaf emergence proceeded at the same rate so that each shoot had a maximum of five functioning leaves. The same growth patterns were observed on primary and secondary tillers until affected by intertiller competition.

Defoliation didn't affect leaf emergence rates on any cultivar. It did reduce the rate of tiller emergence on Newport and Windsor but not on Merion.

Merion had a higher rate of net photosynthesis than Newport. Leaf blade photosynthesis rate did not differ significantly between them. Thus, the higher rate for Merion was attributed to a higher rate for leaf sheaths. The UCR researchers who conducted the studies noted that the greater tolerance to defoliation displayed by Merion could be due to the greater photosynthetic activity of its leaf sheaths.

("Growth of Kentucky Bluegrass Leaves and Tillers with and without Defoliation," by V.B. Youngner, F. Nudge, and R. Ackerson, *Crop Science,* Vol. 16, January-February 1976)

SEASONAL CHANGES IN NONSTRUCTURAL CARBOHYDRATE LEVELS AND DENSITY OF KENTUCKY BLUEGRASS IN THREE CLIMATIC AREAS

Temperature is known to be one of the most important factors controlling nonstructural carbohydrate levels and density of Kentucky bluegrass turf. A study at the University of California, Riverside, focused on determining how nonstructural carbohydrate levels and density of Kentucky bulegrass turf differ among climatic areas and from season to season within an area. Total nonstructural carbohydrates (TNC) and innovation development were studied in five field-grown Kentucky bluegrass cultivars in three distinct California climatic areas: a maritime climate of coastal southern California, a southern California interior valley thermal belt, and a temperate mountain valley. The respective soils of the areas were a San Emigdio sandy loam, an Arlington fine sandy loam, and a Havala sandy loam.

Results showed that changes in TNC levels and numbers of irinovations followed seasonal patterns closely associated with the prevailing temperatures of each specific location. Consistently high summer temperatures reduced TNC stores, but moderate temperatures did not affect them. Brief periods of exceptionally high temperature also reduced TNC levels.

Accumulation of TNC occurred at each location at the time when temperatures were well below optimum for growth at that location. In the cold winter location, TNC levels decreased during the winter. Flushes of growth occurring in spring depleted TNC. Density-the number of innovations per unit area-decreased throughout the summer at the high temperature location but increased during the cool winter. In moderate summer and winter temperatures, the number of innovations remained high and showed less seasonal fluctuation.

Temperature rather than day length appeared to be the primary factor affecting innovation development.

("Seasonal Changes in Nonstructural Carbohydrate Levels and Innovation Number of Kentucky Bluegrass Turf Growing in Three Plant-Climate Areas," by V.B. Youngner, F.J. Nudge, and S. Spaulding, *Agronomy Journal*, Vol., 70, May-June 1978)

EFFECT OF FERTILIZATION ON PENNCROSS CREEPING BENTGRASS

Effects of phosphorus, potassium, and five nitrogen sources on soil nutrient levels and 'Penncross' creeping bentgrass maintained as putting green turf were studied at Pennsylvania State University. Researchers also investigated whether turf growth and quality were affected within the obtained range of nutrients in the soil and tissue.

This field study was conducted on Hagerstown soil. Nitrogen sources were Agrinite, Milorganite, urea, Uramite, and Nitroform. Wilting, disease, chlorosis, and annual bluegrass infestation were used to assess quality.

Fertilization with Milorganite increased available soil phosphorus and magnesium, which ranged from 11 to 94 ppm and 0.06 to 0.28 meq/l00 g, respectively. All treatments affected elemental content of the clippings sampled.

When potassium was applied at 0.76 kg/l00 m^2, both tissue and available potassium increased. When the potassium rate was increased to 1.52 kg/100 m^2, the additional increment of potassium caused a greater increase in soil potassium and a smaller increase in tissue potassium than was obtained.with the first increment of added potassium.

The greatest change in tissue phosphorus occurred with the first incremental addition. Tissue phosphorus was not greatly affected by soil phosphorus above 24 ppm.

Phosphorus fertilization had little effect on clipping yield; however, potassium fertilization tended to increase growth as well as decrease chlorosis noted in early spring. Less severe summer wilting was observed with Agrinite, Milorganite, and potassium treatments. Less dollar spot infection was noted with urea fertilization. Annual bluegrass invasion was favored by phosphorus and potassium fertilization, and the effect of one was enhanced by the other. Milorganite, which increased soil phosphorus, also favored annual bluegrass.

("Effect of Fertilization on Penncross Creeping Bentgrass," by D.V. Waddington, T.R. Turner, J.M. Duich, and E.L. Moberg, Agronomy Journal, Vol. 70, No. 5, September-October 1978)

POTASSIUM FOR TURFGRASS NUTRITION

Knowledgeable use of potassium is relatively sophisticated, because the striking responses in turfgrass shoot growth, density, and color typically seen from nitrogen fertilization do not necessarily occur after potassium fertilization. Nevertheless, it can be just as important in the science of turfgrass culture. In some cases, the effects of potassium fertilization, with respect to the ability of a turfgrass to survive stress conditions, can be more important than striking responses in shoot growth, color, or density.

Increasing potassium levels cause a corresponding increase in overall root growth, as exhibited by greater total root numbers, a higher root growth rate, and stimulation in transplant rooting of newly sodded turfs.

Research has shown that the hardiness level of turfgrasses increases with higher rates of potassium fertilization. The tendency toward wilting also is reduced. It is particularly important to ensure that adequate soil potassium levels exist before anticipated periods of drought, heat, or cold stress.

Wear tolerance improves as the potassium level of turfgrasses is increased, with the degree of response varying among turfgrass species. Turfgrasses also are less prone to several diseases when grown at higher potassium levels.

Thus, it is apparent that potassium has important effects on turfgrass survival and performance, which may not be easily seen in day-to-day growth and development but which can be critical during periods of stress.

("Potassium for Turfgrass Nutrition," by James B. Beard, Grounds Maintenance, March 1978)

NETTING IMPROVES TALL FESCUE SOD PRODUCTION

A researcher at Kansas State University recently evaluated the potential of using open-mesh garden netting to improve tall fescue sod production in his state.

(When tall fescue sod is produced, Kentucky bluegrass often is included to provide knitting strength necessary for sod cutting, delivery, and laying, Frequently, strength sufficient to lift the sod is not attained for 1 to 1 1/2 years. Also, the resulting sod is a mixture of tall fescue and Kentucky bluegrass; if the bluegrass predominates, the tall fescue appears as a weed problem.)

In the Kansas study, four nitrogen fertility treatments, netted and unnetted, were included. Quality ratings were somewhat better for treatments with netting (Vexar garden utility netting) because of less seed washing after a heavy rainstorm a week after seeding. Only minor differences among fertility treatments were noted.

The netting improved sod tensile strength fivefold, the Kansas researcher reports. Sod pieces containing the netting were handled easily without tearing. In general, netting improved transplant sod quality. Netting enhanced transplant sod rooting by 22 percent for all netted treatments. A quality tall fescue sod that could be handled easily without tearing was produced in 10 months.

In a subsequent study, netting improved sod quality and enhanced its tensile strength fivefold to sixfold. Transplant sod strength was not affected. A quality tall fescue sod was produced in 5 months.

("Tall Fescue Sod Production with Netting," by R.N. Carrow, *Central Plains Turfgrass Foundation Newsletter,* February 1979)

SOD HARVESTING: A SOIL MINING OPERATION?

In many areas where commercial sod is produced, certainly in New England, an increasing number of people have expressed concern about soil losses due to sod harvesting. Here and there across the nation a few growers have claimed soil depletion allowances, which have been allowed by the Internal Revenue Service. These precedents have not served to improve the image of sod production as an agricultural enterprise.

Because of rapid growth of the New England sod industry and the growing public concern there about resulting soil losses, University of Rhode Island researchers decided that measurements should be made to obtain soil loss data.

In summary, the results of their study show that sod farming is not a soil-depleting enterprise when compared with other accepted, routine enterprises. Some soil losses through wind and water erosion occur with almost all agricultural crop production, a fact not recognized or acknowledged by many people. Soil erosion from sod production should be minimal, the University of Rhode Island researchers point out.

Their measurements indicate that the age of a sod stand and the harvesting method used significantly influence what soil losses do occur. Losses resulting from two harvesting techniques for 2- and 3-year production cycles were compared. The two harvesters studied were those most frequently used in Rhode Island in commercial sod production: the Brouwer and the Beck. The Brouwer harvester is usually set to cut strips about 6 feet long and 16 to 18 inches wide. The Beck harvester cuts three strips at one time in lengths of 50 to 60 feet with a 16-inch width. Cutting depth is adjusted for both machines to remove as little soil as possible but also to ensure that entire sod pieces are cut. In the Rhode Island study, the Beck harvester in the 2-year production cycle removed the most soil; the Brouwer harvester in the 3-year cycle removed the least.

Data obtained from the study also reaffirmed that grass production improves soils, because large amounts of organic matter are incorporated.

The researchers who conducted the study concluded: "Sod production need not be detrimental to our land resources. In addition, if this high-value crop can be grown to keep land in agricultural production adjacent to our large urban population, it is a great benefit."

("Are We Mining the Soil as We Harvest Turf?" by B.B. Hesseltine and C.R. Skogley, *Turfgrass Research Review,* Cooperative Extension Service, University of Rhode Island, Kingston)

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