CALIFORNIA TURFGRASS CULTURE
FORMERLY, SOUTHERN CALIFORNIA TURFGRASS CULTURE

VOLUME 27, NO. 1 WINTER, 1977

PROGRESS REPORT
RECENT RESEARCH RESULTS AT U.C. SOUTH COAST FIELD STATION

V. A. Gibeault, V. B. Youngner, S. Spaulding, R. Autio, M. Henry, J. Van Dam*

Several studies were established at the U.C. South Coast Field Station in September 1975. Periodically, results from these trials will be presented in this publication as Progress Reports so the turfgrass community can keep abreast of the findings. These results will be released as tables; discussion of the results will occur at the completion of the study. These studies were made possible because of annual financial contributions from the Southern California' Turfgrass Council

Perennial Ryegrass Variety Study

Twelve varieties of perennial ryegrass were each separately seeded at the rate of 6 lbs. per 1000 sq. ft. to 150 sq. ft. plots. The varieties, which were replicated four times, are presented in Table 1. Seeding, occurred on September 25, 1976. Plots were thereafter mowed at 1 1/2 inch&, fertilized with nitrogen at the 1/2 pound per 1000 sq. ft. per month rate, and irrigated as needed. to avoid moisture stress. Ratings that were taken included turf scores and visual measurements of color, texture, cuttability, smog susceptibility and rust susceptibility. The average ratings are presented in Tables 1 and 2.

TABLE 1. Turfgrass quality scores for 12 perennial ryegrass varieties. (0-10 with 10 best)

Variety	12-I-75	l-5-76	2-2-76	7-12-78	g-2-76	11-I-76	Avg.
Yorktown	7.8	7.4	7.3	5.5	5.5	5.9	6.5
Manhattan	7.9	7.3	7.5	6.5	6.9	6.4	7.1
Diplomat	7.9	7.6	7.8	6.5	7.7	6.9	7.4
Wendy	6.4	6.3	6.9	5.0	4.7	5.2	5.8
Esporta	7.4	6.8	7.8	5.0	4.6	4.5	6.0
Pennfine	7.0	7.4	7.0	7.0	7.1	7.0	7.2
Derby	a.5	0.0	7.8	7.0	7.5	7.5	7.0
Citation	7.1	6.6	5.8	5.5	5.7	5.9	6.1
S-321	5.4	6.3	6.4	5.5	5.2	4.9	5.6
Common	6.8	5.5	6.1	5.0	5.2	5.2	5.6
Clipper	6.4	6.0	6.3	5.8	6.4	6.7	6.3
Lamora	7.1	6.0	6.6	4.5	3.7	3.2	5.2

TABLE 2. Various characteristics of 12. perennial ryegrass varieties.

Variety	Smog Damage' 11-6-75	Color² 3-5-76	Texture" 3-5-76	Cuttability⁴ 4-6-76	Rust' 4-6-76
Yorktown	2.0	6.5	9	8.0	5.7
Manhattan	3.0	6.0	9	6.7	3.2
Diplomat	1.7	6.5	9	8.7	1.0
Wendy	5.0	4.2	6	3.2	1.0
Ensporta	3.7	5.0	9	6.7	1.0
Pennfine	1.7	6.7	9	7.7	1.5
Derby	2.0	8.0	9	8.0	4.5
Citation	1.0	9.0	9	8.2	2.7
S-321	3.7	4.2	6	4.7	1.0
Common	6.5	4.2	3	1.7	1.7
Clipper	3.3	5.7	9	7.5	3.2
Lamora	.5.3	3.0	3	5.5	1.0

10, complete damage; 0, no damage.
[2] 10, dark green; 1, light green.
[3] 3, coarse; 6, intermediate; 9, fine texture.
[4] 10, mowes clean; 0, shredded leaf blades,
[5] 10, most rust; 0, no rust.

Kentucky Bluegrass Variety Study

Thirty-three varieties of Kentucky bluegrass were seeded at the rate of 2 lbs. per 1000 sq. ft. on September 24, 1975, to 6' by 6' plots. Each variety was replicated three times. The tolerance of the varieties to an experimental herbicide was examined in the summer of 1976. The herbicide was applied at the recommended rate in June and the data presented in Table 3 was recorded on August 18, 1976.

The data presented is the percent *Fusarium roseum* that was observed on the varieties with and without herbicide treatment. The message to bc learned from this presentation is:

1. Varieties differ in their susceptibility to *Fusarium roseum.*

2. Some bluegrass varieties will increase in *F. roseum* susceptibility if stressed in the summer months by chemical treatments. Note particularly the increased incidence of the disease when Sydsport, Enprima, Fylking, Glade, Pennstar and Nugget were treated with the herbicide.

*Environmental Horticulturist, U.C. Riverside; Agronomist, Plant Sci. Dept., UC. Riverside; Staff Research Associates, UC. Riverside; Farm Advisor, Orange County; Farm Advisor, Los Angeles County 'respectively.

TABLE 3. **Percent Fusarium roseum incidence on 33 Kentucky bluegrass varieties with and without herbicide treatment. Data recorded on August 18.1976.**

Variety	No Herbicide		Herbicide Treated	
Touchdown	0.0	Z*	3.0	Z
IS 28	0.3	YZ	9.0	XYZ
Enmundi	0.3	YZ	4.7	YZ
Rugby	0.7	YZ	2.7	Z
Enoble	1.0	YZ	2.7	Z
Geronimo	1.3	YZ	3.7	YZ
Parade	1.7	YZ	2.7	Z
Bonnieblue	1.7	YZ	1.3	Z
Majestic	1.7	XYZ	5.0	YZ
EM 15	2.0	XYZ	4.3	YZ
Adelphi	20	XYZ	2.3	Z
Glade	2.0	XYZ	34.0	VW
Merion	2.0	XYZ	5.3	Z
Newport	2.0	XYZ	5.0	XYZ
BM 10	2.3	XYZ	3.0	Z
Victa	2.3	XYZ	8.3	XYZ
Baron	2.7	XYZ	6.0	XYZ
CT 14374	3.0	XYZ	6.3	XYZ
Vantage	3.3	XYZ	7.7	WXYZ
Sydsport	3.7	XYZ	26.7	WXY
Aquila	3.7	XYZ	15.7	WXYZ
A34	3.7	XYZ	15.7	WXYZ
Ram I	4.0	XYZ	4.0	YZ
Pennstar	4.0	XYZ	29.3	WX
Arista	4.3	XYZ	13.3	WXYZ
Ca 24	5.0	XYZ	11.7	WXYZ
BM 14	5.3	XYZ	9.0	WXYZ
Windsor	6.3	XYZ	12.0	WXYZ
Common	9.3	XYZ	16.3	WXYZ
Nugget	13.3	XY	66.7	U
Fylking	14.0	XY	53.3	UV
Enprima	16.0	XY	56.3	UV
Park	20.3	X	20.7	WXYZ

*Values followed by the same letter are not significantly different at the 5% level of probability.

CONSERVING WATER INTHELANDSCAPE

*Richard Baldwin**

The available water in California is becoming scarce as our population and varied needs for water increase. The current drought underscores the need to conserve water both now and in the future. Some thoughts on conserving water in irrigation of landscape plants were put together for use in Ventura County and are presented here.

Irrigate only when the plants need water. Irrigation schedules are usually compromises involving times when play areas are not in use, capacity of the irrigation system, convenience, and plant needs. Frequency of irrigation should be flexible because plant needs vary with temperature, wind, rooting depth, leaf surface, and amount of water in the soil still available to the plants.

Most turf would be improved by applying water when the grass shows a subtle change in color or footprints remain impressed for a period of time, indicating the grass is getting dry. Water should then be applied at a slow enough rate that the soil absorbs it as fast as it goes on, without runoff. Apply sufficient water to wet the soil to the depth of the major portion of roots. This is normally 6-8 inches deep for the common cool season grasses.

Irrigation only when the plants show the need for water and then leaving the water on long enough to supply deep roots will stretch the interval between watering and improve the vigor of grass. Since water is lost by evaporation and drift during sprinkling and by evaporation from the wet soil surface, less frequent but deep watering conserves water for plant use.

Check water distribution for uniformity of application. If individual sprinkler coverage is not reasonably even or sprinkler patterns do not overlap sufficiently, the water will be distributed unevenly. "Donuts" of vigorous grass indicate distribution problems. Elongated patterns of turf growth usually indicate the effect of wind in disrupting sprinkler patterns.

Lawn sprinkler systems vary widely but many put out about an inch of water per hour. Some soils will accept water that fast but often the soil infiltration rate is closer to 0.1 inch per hour. A series of cans set out at intervals from a sprinkler head to catch the water will show both how much water is being discharged per hour and the uniformity of application. Typically, some cans will contain ten times as much water as others, indicating poor distribution of water.

Edges are a special problem to irrigate. Either sprinklers wet the sidewalks, driveways, or unused land area or turf at the edge suffers for lack of water. Edge effects can be minimized if attention is given to planning a sprinkler installation and the system is regulated and maintained.

Runoff is a waste of water. Use of low-output sprinklers or other methods of low application of water help considerably. Lawn aeration and thatch control usually imgroves soil infiltration rate. On dry soil, use of wetting agents sometimes temporarily improves infiltration of water into the soil. Use of mulch around trees and shrubs slows water loss.

Some grasses are more drought resistant than others. Tall fescue and bermuda grasses are very hardv turfgrasses. Even dichondra, given deep watering and a light soil will develop a good root system for a foot deep and have fairly good drought tolerance. Shaded plants use less water than those in full sun.

Late winter to early spring -fertilization with nitrogen will increase root growth under moderate California climatic conditions which, in turn, will increase drought

*Farm Advisor, Ventura County.

tolerance. An extensive root system enables a plant to fully utilize available soil water. Effective weed control conserves water for other plants. Weeds flourish because they are well adapted to compete with desirable plants for water and nutrients. Even very young weeds set back the growth of desirable plants.

Consider a landscape plan with fewer plants. Designing a landscape plan for low maintenance can be a challenging and rewarding project. Small areas invite the temptation to put in too many plants with loss of open space and high maintenance and water use. Often a simple plan is much more pleasing than one with a crowded appearance. Plants with different irrigation needs should not be mixed.

So what can be done to improve irrigation efficiency? Here are some specific suggestions:

1. For new lawns, be sure to select and install an irrigation system with a low rate of application and uniform coverage.

2. Use an automatic irrigation timer or, for small areas, appropriate timer that can be attached to a hose bib.

3. If water starts to run off, shut the water off, wait an hour or so for the water to soak in then start the water again. On one golf course, runoff occurred after 6 minutes. The irrigation timer was set to activate the sprinklers periodically for 6 minutes uutil irrigation was completed. Growth of the grass improved immediately runoff was minimized and less water was used.

4. Water only when needed. For the mechanically minded, water sensing instruments such as tensiometers are available. They can be connected to a timer to automatically apply water during designated hours, as needed.

5. Whn irrigating let the system run long enough to replenish the soil water to the depth of the root system. Depth of water penetration can be checked during or after irrigation with a soil tube, irrigator's rod or a long screwdriver.

6. Shrubs and trees should be watered separately. Use of a drip or trickle system is excellent for these plant materials and conserves water, often with improved growth. Depth of water penetration in the soil can be determined with a long metal rod.

7. Use drought tolerant plants.

8. Do not fertilize during the summer. The increased growth from fertilization requires more water and reduces or restricts the root system of cool season grasses.

9. Check irrigation line connections for leaks. Check sprinkler heads to be sure they clear the grass, are upright and functioning as intended.

10. Raise the cutting height of mowers during the summer, especially with cool season turfgrasses. The increased height of grass helps root survival.

11. Control weeds.

Use of these suggestions will improve water application efficiency. Unfortunately, they might not reduce total water use by the plant. Irrigating according to plant needs may result in improved growth of plants rather than use of less water. Improved application of water within a given level of maintenance, however, will result in conservation of water. Certainly water lost in runoff, excessive evaporation, leaks, etc. is wasted.

Maximum water use by plants adapted to drought may not necessarily be lower than that of plants adapted to frequent irrigation. Rather, by various mechanisms, they are better able to survive periods of low water availability. While some savings in applied water may be realized from use of selected plants, the major savings must come from more efficient use of irrigation water.

It is difficult to simply plug plants with drought resistance into a landscape. Such plants need to be watered less frequently or not at all during the summer. Native plants have been disappointing in many landscapes simply because they generally will not tolerate as much water as they are given during the summer. An area set aside for such plants is good because then the whole area can be treated alike.

Junipers are a special case in that water around the base of the plant during warm weather is likely to induce rot. Junipers are able to utilize water from deep in the soil and it has been found best to water junipers infrequently in the summer. Many native plants, such as ceanothus, similarly should be watered infrequently during the summer, for the same reason.

Not all turf managers want a perfectly manicured green sward. Such a turf requires more time and effort than most sites find justifiable. Increased growth means more frequent mowing as well as other attention. Realistically, then, plantings should be planned with a level of appearance, effort, and cost of maintenance in mind. Competent professional design input at the outset of a site installation will more than pay for itself.

ESTABLISHMENT AND EARLY CARE OF TREES-Part 1*

*Richard W. Harris***

Performance of trees in the landscape depends on how well the species are' selected for the specific environment in which they are to grow, the quality of the planting stock, the care in preparing the site and planting as well as later care. This, paper will focus on establishment and early care of trees in the landscape. It is assumed that the site is fixed and quality plants of species adapted to the climate and soil have been chosen.

Practices that should be understood and used for the successful establishment and performance of landscape trees include:

Analyzing and preparing the plant site:

Protecting plants prior to the planting;

Preparing the planting hole;

Plant the tree;

Pruning and staking the tree;

Irrigating, and

Other care following planting.

In view of the space constraints, only parts of certain of these practices will be discussed. I will highlight those practices which I think are either not well understood or often not done as well as they might be.

Protecting plants to planting. Plants must be kept moist and cool (preferably at or below 45°F) so they do not become desiccated, too hot or frozen. Many deciduous trees are received bare-root during the dormant season. Care must be taken to keep the roots from drying out and the tops cool so the buds are kept from growing.

Plants can be kept in cold storage, bundled with moist packing material around their roots. The cold temperature also will assure more uniform bud break when out planted by more completely satisfying the cold requirement that many plants have. If necessary, the planting of plants from cold storage can be dclaycd two to four weeks beyond the usual time because the buds will be delayed in starting growth.

Bare-root plants also can be "heeled in" for a short period near the planting site, preferably in the shade to reduce moisture loss and to keep the buds dormant. Cover the roots 'with either moist sawdust or soil'worked down 'in around the roots to avoid air pockets. If heeled-in out in the open, set the plants in a trench so their roots can be easily covered. Lean the tops of the plants to the southwest to reduce warming of the buds during sunny days. Bare-root plants usually will do best if planted soon after delivery.

Balled-and-burlapped trees and container-grown plants can be planted almost year round, although, "b and b" plants are usually planted soon after being dug. The containers of most plants are dark-colored metal cans. If exposed to the afternoon sun, the soil on the exposed side can easily reach 120°F and remain above 100°F for six to eight hours. Temperatures of 104°F for only four hours will kill root tips of most plants and growth of black locust was reduced 75% by soil temperatures of 95°F for six hours on four consecutive days (3). Another .study showed that no roots grew in the western third of one-gallon containers exposed daily to the afternoon sun (2). Yet, the tops of the plants showed little or no immediate effect from these high temperatures or root loss since the plants were watered and fertilized daily. Nevertheless, the soil volume available to the plant was only a portion of that in the container. When out planted, such plants will have to be irrigated more frequently than those whose roots fill the entire container. Very often, even these latter plants are not watered often enough.

While plants are being held for planting, place them close together, preferably in the shade. If they must be in the open, protect the outside cans on the east, south and west from. the sun. A 1 x 8 inch board, a strip of cardboard, aluminum foil, or a dike of mulch or soil will do the job. Keep the plants froni wilting. Placing the plants close together will reduce transpiration somewhat, as well as injury due to excessive movement of the tops, and help to keep t-he containers upright. Trees in leaf could. be pruned to further reduce transpiration prior to planting. In sunnny weather, to keep roqt injury to a minimum, place the plants in the landscape just a short time before they are to be planted.

Preparing the planting hole. In soils that have good structure, the planting hole need only be deep enough to take the root ball of the plant. Plant "high" in all but sandy soils. The hole can be two inches less than the depth of the soil in a five gallon container (1" less for a gallon plant). Loose soil in the bottom of the hole will settle, causing the plant to bc deeper than intended. In such cases, crown rot may occur in all but the best drained soils. In sandy soils, planting at the original depth or an inch or two deeper will keep the soil around the roots from drying as quickly.

In most planting situations, soil compaction may make soil preparation for the hole desirable. Although it may take a little longer, some arborists prefer to use a back hoe to prepare the planting hole. If an auger is used, the sides should be scarified and left rough to prevent a

---

'From: Proceedings of the 1976 ,Turf and Landscape Institute, pp. 32-42.

**Professor, Dept. of Environmental IIorticulture, U. C. Davis.

glazed surface that may be almost impervious to water and roots.

If the soil needs to be disturbed much below the final planting depth, organic matter should be added to the top 30 inches of backfill soil. If possible, after mixing the organic matter with the soil and putting it back in the hole, wet it thoroughly. Depending on the soil, it will take one or two weeks before the soil will be dry enough in which to plant. If the loose'soil is not settled before planting, it will later, creating a basin that would be the last to dry out after every rain and irrigation. This could lead to crown rot and death. This soil preparation should be done when the soil is ntither drv nor too wet; soil structure could be further broken down

The hole should be about twice as wide as the root ball for up to seven-gallon plants. Larger plants can be planted in holes less than twice the root-ball diameter. The extra diameter provides for an adequate transition zone between the root ball and the soil as well as enough space to work around the root ball. For bare-root plants, make the hole' large enough to take the roots without crowding.

Shallow soils, less than 30 inches, underlain with hardpan should have holes' drilled through the hardpan to allow for drainage and possibly some rooting. Power augers used to set utility poles can drill through most hardpan. The hole through the hardpan should be filled with coarse sand (0.5 mm) or gravel. The hardpan should be penetrated under each tree, except a clump of trees may be drained by less than one per tree. The finer the texture and the shallower the soil, the closer the holes need to be,. For such drain holes to be effective, strata under the hardpan must be permeable. After the soil has been repeatedly wetted, water in' the hole should move down at least 1/4 inch or more per hour. Otherwise, there is little value in such drain holes.

Even when filled wjth coarse sand or gravel, drain holes easily become plugged by finer soil particles carried into them by surface runoff. In silty and clayey soils, soil adjacent to drain holes may slake or flow into the drain. This not only plugs the drain but the soil around the hole may settle several inches. Although untried to my knowledge, a suggestion in, such situations is to line the upper 20- 24 inches of the hole with metal casing or concrete pipe. The top of the pipe should be the same level as the surrounding soil which should have a slight slope (4-5%) so the water can flow on the surface towards the drain hole. It would be ideal if the surface was turf to reduce the in flow of soil particles that will plug the drain. To retard plugging of the drain a two-inch thick fiberglass pad filter should be placed in the top of the drain with a layer of coarse gravel over the top. The filter could be cleaned or replaced when water infiltration was reduced too much.

If the hardpan is too thick to penetrate or rock is the impervious layer, in addition to mounds or raised beds, artificial drainage may need to be installed. Accumulation of water in a shallow soil will doom all but the 'most tolerant plants and greatly increase the care necessary in irrigation.

Planting trees in paved areas. Trees are often planted in paved areas-along downtown streets, in paved patios, etc. Many times provision is not made for adequate irrigation, drainage and aeration, particularly as the trees become larger. Furthermore, adequate surface exposure is frequently complicated by the need for foot traffic near the trunk of the trees. Yet an open planting basin in a paved area can be a hazard to pedestrians.

Soil or sind placed even with the paving or loose brick laid on sand are used to offer the necessary footing but each is difficult to irrigate and the surface can be&me an uneven hazard with time.

One satisfactory solution is to build a 'square planting basin with two half-covers that extend the paving to within a few inches of the tree trunk. A standardized opening is cut in old paving or formed in new, usually 48 inches square. A lip is formed to hold the two half-covers so their surfaces will be level with the surrounding paving.

The covers are pre-cast to fit half of the opening with a semi-circle left out for the tree trunk. The covers can be finished to add to the design of the pavement: The covers can be changed to provide a larger opening when the trunk gets larger.

The soil level can be several inches below the bottam of the covers to provide aeration and a reservoir for water during irrigation. A 2-4 inch layer of coarse gravel or small rock can be placed on the soil surface to keep the soil from being washed if the basins are watered by hose or tank truck. Sloping irrigation and aeration wells or holes can be drilled from the corners of the basin under the paving to increase the rooting volume irrigated. Such holes can also direct root growth downward under the pavement.

The planter covers can be lifted to inspect the basin or lower trunk, to weed, or to clean out debris.

In new construction the' paving around such planting basins should be sloped to carry surface runoff water to a drain or the street gutter and not into the tree wells. If the paving drains into tree wells, the trees could be subjected to excess water at a time when they usually do not need it. Also, the water from a concrete surface could add to the alkalinity of the tree basin.

One of the main problems with tree wells is that tliey become waste receptacles and the debris on the paved areas is often swept into the wells. This is part of the cost of having trees for landscaping in paved areas. A solid cover as described above probably would collect less debris than would a more open metal grate.

Setting the *plant*. Although not necessarily critical to the survival of a plant, a number of factors might be considered in setting the plant in the hole.

1. Orienting a plant a certain way in the hole may give the most pleasing landscape effect.

2. With grafted trees, placing the scion (the bud or graft) towards the afternoon sun reduces the possibility of sunburn just above the bud union. Low foliage mav shade this area or if exposed the trunk can be painted with a white latex paint.

3. Low branches of trees may be pointed towards areas of little or no activity, leaving more head room over active areas. This would reduce the amount of pruning needed and could increase the landscape effectiveness of the plant.

4. If prevailing wind is a problem, orient the side of the plant with the most branches into the wind.

5. If wind, sunburn and appearance are not problems, place the largest branch or heavy side of the plant towards the northeast. The less developed side of the plant will be favored with more light.

6. With bare-root trees, the largest root might be placed in the direction of the prevailing wind to better support the top.

Any injured, diseased, twisted or dead roots on bare-root trees should be cut back to healthy tissue. Spread the roots in the bottom of the hole to provide good anchorage and reduce circling and twisting.

Loosen, cut and remove some of the roots of container-grown plants that are matted at the bottom or circling around the outside of the root ball. In freeing the roots at the periphery of the root ball, break away some of the soil to provide better contact between the root ball and the fill soil. Straightening the peripherv roots so they extend two or more inches into the fill soil will double the soil volume available to the plant compared to that of the original five-gallon root volume. In addition, the roots will be in the fill soil and able to grow in it more easily than having to grow out of an undisturbed root ball. Removing one-fourth to one-half the roots in the outer inch of the root ball should not set back any but the most sensitive plants. If anything, most plants will be stimulated

In most cases, back fill the hole with the original soil unless it is undesirable. Organic matter is advisable for heavy or extremely sandy soils or those that have been severely compacted. Mix 20-40% organic matter, by volume, with the back fill soil. Since most container plants are grown in light, sandy organic soils, the organic matter aids in the transition to the landscape soil.

In most situations, fertilizer should not be placed in the planting hole or mixed with the back fill soil. It is inconvenient, time consuming and can result in plant injury. Most plants will grow well the first part or all of the first growing season without additional fertilizer. If fertilizer is needed, it usually is nitrogen alone that is deficient. Nitrogen, as nitrate or urea, will move into the soil with irrigation or rain from surface applications after planting.

The roots or root ball should set on a firm base with the center slightly higher than the edge of the hole. This will help in spreading the roots and to a certain extent in draining water from the base of the roots. Work the soil around the roots so that they are not compressed into a tight mass, but are spreading and supported by soil underneath them. After each three or four inches of soil has been placed in the hole, firm the soil around the roots or root ball with your foot, taking care not to tear, bruise, or debark the roots. The original ground level in the nursery or of the root ball should be one to two inches above the finished ground level.

Basins for trees should be at least 30 inches in diameter. Fill the basin with water to further settle the soil and to provide the plants with water. This can be effective11 done using a three to four foot pipe on a hose to fill the basin. Force the pipe, with water running, through the soil around the roots and root ball. This will improve contact between the fill soil and the root ball or roots. The plant can be moved slightly to facilitate soil consolidation.

If the plant has settled so that the original soil line is below the soil surface, while the soil is muddy, bare-root trees can be raised by lifting on the trunk. They should be raised slightly higher than desired and then settled back into the soil to provide better soil contact with the roots. With container plants, use a shovel under the root ball to raise the plants. This should be kept to a minimum, since the more a plant is raised, the closer the roots are drawn together.

After the soil has drained, the final contour of the basin can be created with the base of the plant slightly higher than the bottom of the basin (1) . Unless some soil has fallen or been taken from the top of the root ball, do not add soil to the top of the root ball to obtain the desired basin contour. This is particularly important if the back fill soil is finer texture than that of the root ball. When so covered, the root ball may wet with difficulty, if at all.

LITERATURE CITED

1. Harris, R. W. and W. B. Davis. 1963. Planting landscape trees. Cal. Agr. Ext. OSA.

2. _______ 1967. Factors influencing root development of container-grown trees. Proc. Int. Shade Tree Conf. 43:304-314.

3. Wong, Toynette, R. W. Harris and R. E. Fissell. 1971. Influence of high soil temperatures of five wood-species. Jour. Amer. Soc. IIort. Sci. 96:80-83.

UC TURF CORNER

*Victor A. Gibeault, Forrest Cress**

DEFOLIATION, SOIL AND AIR TEMPERATURE EFFECTS ON KENTUCKY BLUEGRASS GROWTH

Defoliation is highly detrimental to Kentucky bluegrass growth and development even at favorable soil temperature, recent University of California, Riverside, research results show.

Using controlled temperature water baths and growth chambers, Kentucky bluegrass "Merion" plants were grown at various soil and air temperatures and at three clipping heights to determine the interaction effects of temperature and defoliation on growth.

Defoliation reduced dry weight of tops, number of innovations, root length and percent of nonstructural carbohydrates, at all soil and air temperatures. Although a soil temperature of 18°C produced the most root and top growth in unclipped plants, this superiority was completely negated by defoliation.

The UCR researchers who conducted the experiments note that frequent defoliation by reduring the plants' ability to assimilate carbon reduces nonstructural carbohydrate accumulation and restricts all aspects of growth. As defoliation intensity is increased, it becomes the overriding influence reducing or negating the effects of favorable temperatures and intensifying the effects of unfavorable temperatures. Thus, studies of temperature effects without defoliation or with only a single clipping height may be misleading with respect to turf or pasture management.

("Soil Temperature, Air Temperature, and Defoliation Effects on Growth and Nonstructural Carbohydrates of Kentucky Bluegrass," by V. B. Youngner and F. J. Nudge, Agronomy Journal, Vol. 68, March-April 1976.)

NITROGEN EFFECTS ON BLUEGRASS RECOVERY FROM WILTING, SCALPING

Scalping and wilting, both problems that often plague turfgrass managers and affected by nitrogen fertility, have received little attention in turfgrass fertilizer evaluations.

In general, as nitrogen rates are increased, "Merion" Kentucky bluegrass wilts faster, recovers slower, recovers better from scalping, and decreases in carbohydrates.

These are findings from a Pennsylvania State University study aimed at determining the effect of different nitrogen sources, rates and timing on the resistance to and recovery from wilting and scalping.

Sod plugs were taken from field plots fertilized at different rates and application dates with urea, Uramite, Milorganite, isobutylidene diurea, Urex, and 18-16-12 (with two-thirds of the nitrogen from ureaform) and a check plot. Plugs were placed in an unshaded greenhouse for several simultaneously conducted experiments.

One set of plugs was allowed to wilt. Turf fertilized at the highest nitrogen rate tended to wilt quickest, while the unfertilized check was most resistant to wilting. After watering, turf that was slowest to wilt recovered quickest.

Another set of plugs was allowed to grow nine weeks, after which length, width, green and dry weight, and percent moisture of leaves were measured. The grass was scalped to 1.3 cm, and data on regrowth were collected. Plants fertilized at the highest nitrogen rates recovered faster, had greater clipping weight, longer and wider leaves, and higher percent moisture than those lightly fertilized. Plants treated with a low rate of Uramite, however, recovered rapidly, indicating release of residual nitrogen from prior seasons.

Total nonstructural carbohydrates were lower for fertilized than unfertilized turf, and changes in carbohydrates with time were influenced by the nitrogen treatment.

("Effect of Nitrogen Fertilization on the Recovery of 'Merion' Kentucky Bluegrass from Scalping and Wilting," by T. L,. Watschkc and D. V. Waddington, Agronomy Journal Vol. 67, No. 4, July-August 1975.)

RED FESCUE AND ITS SHADE TOLERANCE

Both Kentucky bluegrass and red fescue can provide good turf in full sun, whereas red fescue generally produces a markedly superior turf in shade. Why the difference in shade tolerance?

Research has shown that reduced light intensity has a marked influence on plants by lowering the photosynthetic and respiratory rates, light compensation point, and light saturation level. The photosynthetic-respiratory balance is a critical factor in shade adaptation. For a plant to survive, net photosynthesis must exceed respiration.

Reduced light intensity also alters the anatomy of plants in numerous ways: thinner, narrower leaf blades, less cross sectional leaf area, thinner mesophyll, smaller epidermal cells, thinner- cell walls, reduced vasular tissue development, changes in stomata frequency and size, and alteration of chloroplast size and structure..

Rearchers at Michigan State University recently conducted some studies aimed at further elucidating the shade adaptive mechanisms of red fescue.

In one study, the net photosynthetic and dark respiratory responses of swards and individual plants of "Merion"

---

*Extension Environmental Horticulturist and Extension Communicator, U.C. Riverside, respectively.

Kentucky bluegrass and "Pennlawn" red fescue, under reduced light intensities were compared, Results showed that the slope of the rate-intensity curve was similar for the Kentucky bluegrass and the red fescue at each light intensity, although the slope decreased with lower light.

The species also responded similarly,, in terms of light compensation points. Only the photosynthetic-respiratory balance was observed as a possible shade adaptive mechanism of Pennlawn. It was able to maintain a. positive balance at reduced light intensities, whereas Merion could not.

In a study aimed at characterizing their anatomical responses to reduced light intensities, Merion displayed a decrease in cuticle thickness and vascular and support tissues whereas Pennlawn did not. Stomata density of both species decreased under reduced light. Stomata pore length of both species did not vary with light intensity. The. number of chloroplasts/cross sectional unit area decreased with reduced light intensity for both species. Merion had, increased thylakoid and grana stack development within' individual chloroplasts at reduced light intensities, whereas Pennlawn chloroplast ultrastructure remained unchanged.

The Michigan researchers who conducted the second study note that shade adaptation of Pennlawn may be related to more developed cuticle, vascular, and support tissue and to chloroplast ultrastructure. Stomata and chlorplast density responses of the two species to reduced light intensity were similar and could not be associated with the ability of Pennlawn to provide a more desirable turf in the shade than Merion.

("Anatomical Responses of 'Merion' Kentucky Bluegrass and 'Pennlawn' Red Fescue at Reduced Light Intensities," by J. F. Wilkinson and J. B. Beard, and "Anatomical Responses of 'Merion', Kentucky Bluegrass and 'Pennlawn' Red Fescue at Reduced Light Intensities," by J. F. Wilkinson and J. B. Beard, *Crop Science,* Vol. 15, March-April 1975.)

CALIFORNIA TURFGRASS CULTURE
Department of Plant Science, University of California Riverside,. California 92502
Editors, Victor B. Youngner and Victor A. Gibeault

CALIFORNIA TURFGRASS CULTURE is sponsored and financed by the regional Turfgrass Councils and other turf/landscape organizations. Subscription to this publication is through membership in one of the councils listed below.