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A TURFGRASS COLORANT STUDY

*John Van Dam and Kent Kurtz**

Bermudagrass *(Cynodon dactylon)* is a widely used turfgrass in Southern California. It can be readily found in recreational areas, parks, golf courses, athletic fields, memorial centers, as well as in home lawns. Regardless whether it is common bermudagrass or one of the hybrids, when temperatures begin to fall below 50° F these grasses lose their green color. During such periods they turn brown.

Recently the demand for continuous green color in turf areas has increased because of color television coverage of major sporting events, an awareness and desire for perpetual beauty and color by the American public and the growing emphasis on recreation and leisure activities. Various methods have been used to either alleviate or mask th off-colored turf. One new approach has been the development and use of green turf colorants.

To evaluate turfgrass colorants, a preliminary study was conducted on an athletic field at the campus of the California State Polytechnic College, Pomona in 1970. The study was expanded in 1971 to include 20,000 square feet of dormant Tifgreen hybrid bermudagrass on the campus baseball outfield. This enabled observations under actual play conditions and made possible the establishment of a large randomized complete block design with four replications to study ten of the most common commercial materials. The materials tested are presented in Table 1.

The colorants tested were applied at the manufacturer's recommended rate and at twice that rate. Applications to the 200 square foot test plots in the study area was made with a hand sprayer equipped with size 8 T-jet nozzels at 30 psi.

The test plots were evaluated on the basis of general appearance, hue uniformity, longevitv and intensitv of color. The weekly rated color intensities were statist&ally analyzed and the means compared using Duncan's Multiple Range Test. The tables that follow show the results of the manufacturer's rate (low rate) and twice that rate (high rate).

RESULTS

At the lowrate of application CVX (still experimental), Winterlawn and Everbright were not effective. Vichem, Grcenzit, Sta-Green, and Vitalon Light and Dark gave moderate green color. Only Stayz-Green and Greenstuff proved effective at the low rate. At this rate all materials except Stayz-Green and Greenstuff faded after six weeks.

Vichem although fading at the low rate was very satisfactory at twice the recommended rate whereas CVX and Everbright were ineffective. Greenzit, Sta-Green, Winterlawn and Vitalon light recorded readings not as satisfactory as Vichem, Stayz-Green, Vitalon Dark and Greenstuff.

After six weeks Vitalon Dark was no longer effective while Greenstuff which had held a steady color intensity recorded the highest rating. All treatments except Greenstuff faded at both the low and high rates between the fifth and seventh week. Readings at the eighth week began to reflect regrowth of the bermudagrass. From that point on no further readings were taken although the test plots were observed for a limited period. A graphic summary of the color intensity data is shown below:

[1] University of California Agricultural Extension Service, Los Angeles and Park Administration Department, California State Polytechnic College, Pomona, respectively.

TABLE 1. Color intensity of 10 commercially available turfgrass colorants applied at manufacturers recommended rates.

Zero = No color; 10 = ideal green color.

Colorants	Jan 7	Jan 15	Jan 21	Jan 20	Feb 4	Feb 10	Feb 18
CVX	1.50	1.25	1.00	1.25	1.00	1.00	2.25
Vichem	4.00	4.00	2.75	3.00	3.75	2.25	2.75
Greenzit	3.25	4.00	2.75	2.75	2.75	2.50	3.50
Sta-Green	3.00	3.00	2.75	2.75	3.25	1.75	3.00
Stayz-Green	5.75	6.50	5.75	7.00	6.25	5.00	6.25
Winterlawn	1.75	1.75	1.75	1.50	1.25	1.25	2.00
Everbright	2.25	1.75	1.50	1.25	1.25	1.25	3.25
Vitalon Light	5.00	5.25	4.75	4.50	4.25	2.75	3.75
Vitalon Dark	4.75	5.75	5.00	5.25	4.75	3.50	4.75
Greenstuff	6.25	5.50	5.50	5.50	5.25	6.00	6.00

TABLE 2. Color intensity of 10 commercially available turfgrass colorants applied AT TWICE manufactures recommended rate.
Zero = No color; 10 = ideal green color.

Colorants	Jan 7	Jan 15	Jan 21	Jan 28	Feb4	Feb 10	Feb 18
cvx	2.50	2.25	2.00	1.75	1.75	1.50	2.75
Vichem	7.25	8.00	7.50	7.75	7.25	6.75	7.25
Greenzit	4.50	5.50	5.25	5.00	4.50	3.25	3.75
Sta-Green	4.50	5.25	4.75	4.25	3.75	3.50	4.00
Stayz-Green	a.75	8.50	7.75	8.75	8.25	7.50	7.50
Winterlawn	4.50	5.00	4.25	4.50	4.25	4.00	5.00
Everbright	3.00	2.75	2.75	4.25	2.00	4.00	3.00
Vitalon Light	4.25	5.75	5.50	4.75	4.00	3.75	4.50
Vitalon Dark	5.25	6.25	6.25	5.75	5.00	4.00	4.25
Greenstuff	8.50	7.50	7.50	7.25	7.25	8.25	7.25

At the completion of the test, no plant injury was observed when treated with either the high or low rates of the various colorants. However, bermudagrass broke dormancy quicker in the treated area than in the surrounding non-test area. The weedy grass, *Poa annua*, was more prevalent in the non-treated check area than in the colorant treated area. This observation should be studied further.

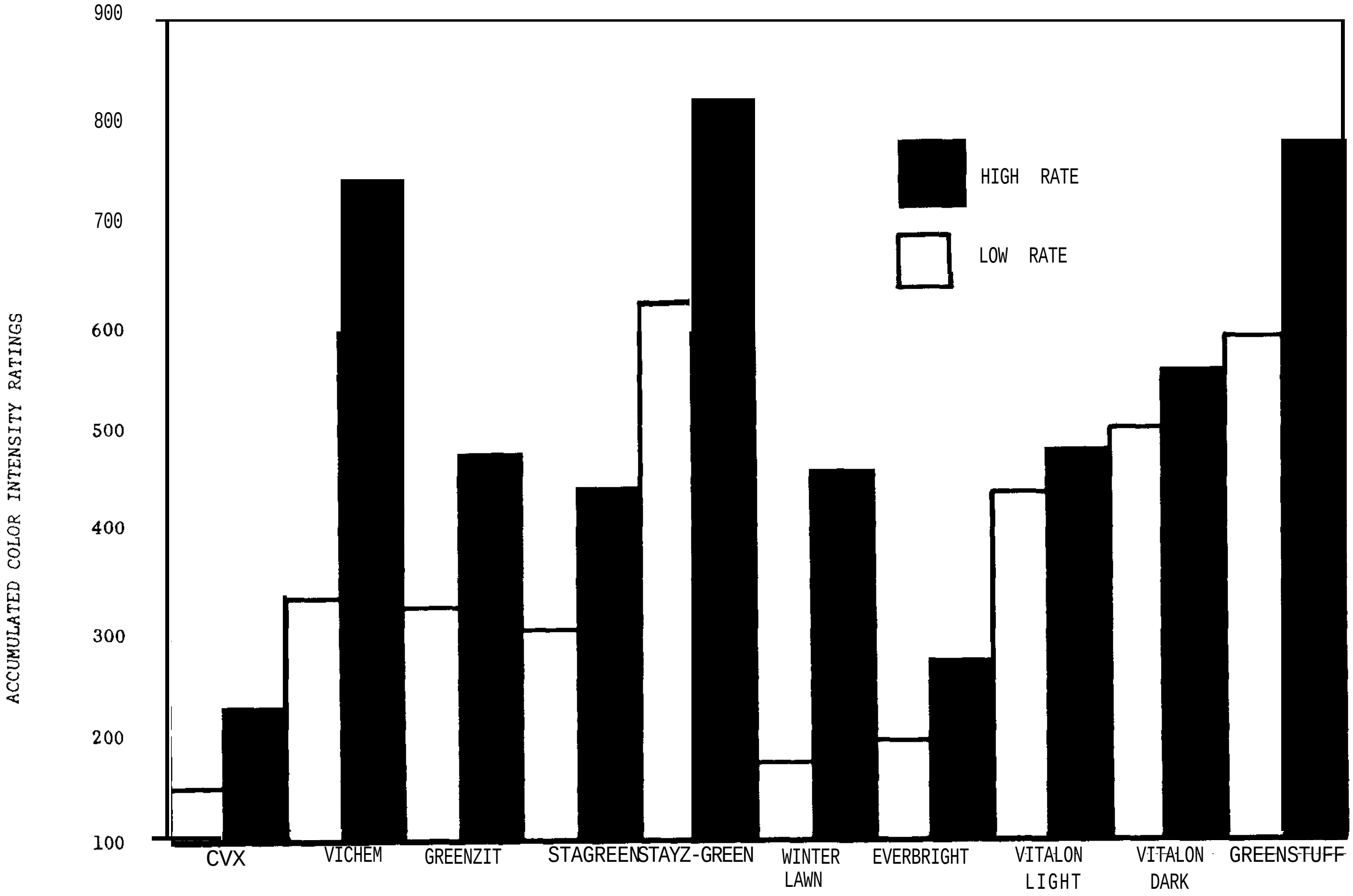
The most satisfactory time to treat dormant turfgrass for maximum satisfaction is when the grass is dry. The equipment used must be capable of applying the material uniformly.

Comments from baseball coaches and players using the campus baseball field indicated colorant acceptance. Players stated balls were easier to follow, discoloration of equipment, balls or uniforms was practically nil, and the area treated, in spite of various color shadings due to the test, was more attractive in appearance than the non-treated areas.

Observations were made to evaluate the ease with which the colorants could be removed from spraying equipment. This was done by mixing a quart of water

FIGURE 1

SUMMARY OF COLOR INTENSITY AT LOW AND HIGH RATES



with the appropriate amount of commercial material. The solution was allowed to remain in a glass beaker for ten minutes. The beaker was then emptied, dipped twice into 75° F water, inverted and allowed to dry. The beakers were 'numerically ranked as to clearness or a lack of film on the glass. A rating of ten indicated no residue and exceptional clarity. One indicated residue clinging within the beaker. The colorants tested ranked as follows:

Vitalon Dark	1
Vitalon Light	2
Sta-Green	3
Greenstuff	4
Vichem Green	5
Greenzit	6
Stayz-Green	7
Winterlawn	8
Everbright	9
CVX	Not tested

Appreciation is extended to the product manufacturers who submitted their materials for study. Further appreciation is given to officials of the California State Polytechnic College for use of the recreation area on which the study was conducted.

THATCHREMOVAL*

*Paul E. Rieke***

Thatch has been variously defined as the layer of organic accumulation in turgrass sod between the soil surface and the green portion of the turfgrass plant. Its composition is the dead roots, stems, and leaves, although living roots and stems are also an intricate part of the thatch layer.

A limited amount of thatch is usually considered desirable because it provides some resilience to the turf. It may tend to buffer soil temperatures from air temperatures and reduce weed invasions(1).

Generally, however, thatch is considered undesirable because it accumulates to objectionable levels and several disadvantages become apparent (1,4,6): 1) roots tend to grow in the thatch layer rather than into the soil making the turf more drouth susceptible; 2) the thatch layer may become hydrophobic, severely reducing water infiltration rates and decreasing water use efficiency; 3) dry spots often develop, requiring increased attention to watering and other management practices; 4) aeration may be reduced, possibly to the point of limiting growth; 5) water retained in the thatch layer may provide an environment conducive to pathogen activity; 6) thatch may harbor certain turfgrass insects; 7) thatch may cause the development of an uneven surface, reducing turfgrass quality, and increasing the opportunity for scalping of the turf; 8) effectiveness of certain pesticide treatments may be reduced because of the inability of water to penetrate into the thatch layer; 9) it is difficult to obtain satisfactory overseeding under heavy thatch conditions; and 10) the management practices required to reduce thatch are costly, usually cause some injury to the turf, and may take the turf area out of use for a period of time.

Factors contributing to thatch formation

Several factors are suggested as contributing to thatch accumulation and, therefore, affect the thatch removal program required for a given turfgrass area. A most significant factor is the extremelv vigorous growth and high density of plants usually associated with high quality turf. Such turf is achieved by utilizing: 1) heavy nitrogen fertilization rates; 2) intensive irrigation, especially when frequent and heavy rates are applied; 3) highly vigorous species and varieties of turfgrasscs; and 4) frequent pesticide applications. Other factors which may contribute to thatch accmnulation are; 5) compacted and heavy soils which are poorly drained; 6) acid soil conditions; 7) return of clipings to the turf; 8) mowing practices; 9) environmental conditions which encourage rapid growth of grasses; and 10) the amount of traffic on the area.

Means of thatch removal

There have been several research studies on the troublesome thatch problem, but results are often variable because of the complexity of the environmental and management factors which affect thatch accumulation.

Practices which have been utilized in thatch control are topdressing, vertical mowing, coring (aerification), liming, clipping removal, spiking, and fertilization. Many of these practices have other objectives, but still affect thatch accumulation.

Topdressing has given the most consistent reductions in measurable thatch of treatments reported (2,8). Mixing soil with the thatch apparentlv provides more favorable conditions for microbial activity and thatch decomposition. Topdressing is costly and timeconsuming, however, so this technique is usually practiced only on small areas which are intensively managed. In addition, good quality soil materials for topdressing are often difficult to locate, or if commercially prepared, quite expensive for use on large areas.

Vertical mowing is suggested most widely as the tool to use for thatch removal. Engel and Alderfer (2) reported topdressing and vertical mowing were about equally effective in controlling thatch in a bentgrass green. Vertical mowing reduced the amount of topdressing needed for thatch reduction in Tifgreen bermudagrass in Mississippi (8). On a heavily thatched bcrmudagrass turf, Morgan (7) found that irrigation water did not penetrate the thatch, but when the turf was vertically mowed the water penetrated to a 4-inch depth, improving infiltration. Vertical mowing and coring increased penetration to 15 inches. No report was made on the degree of thatch control.

The depth of vertical mowing is significant in thatch removal. With a very shallow setting little more is achieved than lifting and slicing stolons which aids in reduction of grain and close mowing on greens. For thatch removal the teeth (or tines, flails, etc.) are normally set to pcnctrate to the soil surface. More than one treatment may be needed for effective removal. The degree of thatch-accumulation, the condition of the turf, and the type of vertical mower will all bc factors in determining how many passes and how frequently vertical mowing should bc practiced.

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* From: Turf — Specifications and Costs. Proceedings of Southem California Turfgrass Institute. May 18, 19, 1971.

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Coring has given a limited degree of thatch control under greens conditions (2). This treatment is more effective if the soil cores are worked back into the turf and the thatch debris is removed.

Liming has given variable results (2,5). Most of the studies have been conducted on acid soils in eastern U.S. It is doubtful if liming itself would be beneficial in California where the soils and water used in irrigation are both already quite high in pH.

Clipping removal is a standard recommendation for keeping thatch problems at a minimum in home lawns, yet detailed thatch studies (5,6) indicate that grass leaves decompose very rapidly and probably contribute very little to thatch accumulations. Clippings should always be removed, however, if they interfere with use of the turf or if they cause significant smothering or shading conditions.

Spiking penetrates the thatch with knives that go down into the soil. The major advantages is improved water infiltration with little damage to the turf, although the influence is short term.

Fertilization with nitrogen has been suggested for thatch reduction because of the wide carbon: nitrogen ratios reported in thatch (5,6) - When heavy nitrogen fertilization is practiced, increased thatch usually results (2) because of increased vigor and density of growth.

In attempts to increase thatch decomposition under field conditions, additions of gypsum, sugar, and nitrogen had no effect on thatch in bentgrass turf (5). Martin (6), working with J. B. Beard, studied the decomposition of red fescue thatch in the laboratorv. Pectinase, sucrose and ferulic acid caused increased carbon dioxide evolution in test tube studies, indicating there might be hope for use of such chemicals in field studies. Much more research needs to be done but, ultimately, chemical additives might be a practical, economic alternative to present methods of thatch control.

Continued use of pesticides which kill earthworms has resulted in significant increases in thatch accumulation in Kentucky bluegrass (J. D. Butler, unpublished data). Detailed studies on soil plugs indicated less thatch and creater numbers of worm channels in the untreated plots. Under acid soil conditions reduced earthworm populations and increased thatch are commonly observed (3)

Specifications for thatch control

Because of variation in degree of thatch accumulation, condition of the turf, environmental conditions, budget, equipment available, manpower available, use of the turf area, and level of maintenance, it is impossible to design a program of thatch removal for all turfgrass areas. Some turfs may never need thatch removal, while others may require treatment as high as 8 to 10 times annually.

For effective thatch control one must consider the total management program including fertilization, mowing, and. irrigation, as well as cultivation practices. As an example of some programs, the Southern California Golf Association reported in 1967 that superintendents in the metropolitan area practiced an average of 4.5 vertical mowings, 2 topdressings, and 2.5 corings on putting greens. On non-metropolitan courses each practice was followed 3 times per year on the average.

Data compiled from reports presented by turf managers at recent conferences show that golf and bowling greens receive the most intensive treatment with a high as 5 corings, 8 vertical mowings, and 4 topdressings annually. Intensively managed cemeteries, football fields, and fairways receive intermediate management, while general athletic fields and parks usually receive the fewest treatments. Each turf manager must adjust his program to utilize the practices which best fit his particular set of circumstances.

In the following discussion, only vertical mowing will be considered. Vertical mowing should be practiced during periods when active growth can be expected to follow. This is important for recovery from the thinning and injury which occur due to treatment. Nitrogen tertilization 2 to 3 weeks previous to treatment will encourage rapid recovery.

For warm season grasses, vertical mowing is suggested during late spring to early summer (May, June) and late summer to early fall (October, November). Light treatments are often utilized during the summer on turf which tends to thatch readily without serious injury. For cool season grasses, Mach to early April, and October to early November are recommended. Treatment during hot weather should be avoided.

Other factors which should be considered in the timing of vertical mowing includes laborpool, use of the area, requirement for overseeding, and degree of *Poa annu* problem. For example, Youngner (9) reported serious *poa annua* infestation within 10 days after vertical mowing of bermudagrass turf in November. Cultivation of turf which contains appreciable quantities of Poa annua seeds should be avoided during its peak period of germination unless chemical control treatments are also utilized.

Evaluation of cost factors in vertical mowing is difficult because few records are available which consider this practice alone. Based on information provided through personal contact and reports from previous conferences, costs range from as low as $7.50 per acre to as high as $23 per acre per vertical mowing. This range in figures reflects a number of variables including: equipment depreciation (or rental), equipment repair and servicing, labor and benefits costs per hour, number of men needed for the job, travel time, collection and disposal of thatch debris, size of area to be treated, type of equipment available, and intensity of vertical mowing needed for a given turf area. Not all of these factors were considered equally in the figures quoted above.

Conclusions are: 1) further research is needed to understand the value of specific treatments for thatch control and to develop new methods of control; 2) thatch removal is only one of a series of management practices which influene thatch; and 3) thatch removal costs vary considerably depending on the particular situation and the method of calculation of expenses.

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GROUND COVERS: SPECIFICATIONS AND COSTS*

By James C. Perry**

For the last several years I have had a chance to observe the performance of numerous ground covers in various locations. Many of these ground covers differ greatly in their behavior in new environments from that in their natural habitat.

There are manv points to cover on this subject and some of these are briefly:

1. Selection of the plant material to fit the situation.
2. Soil Preparation.
3. Plant spacing.
4. Maintenance practice.
5. Feeding and Fertilizing program.
6. Costs involved in establishing the right ground cover in a particular location.

All of the above are modified by the exposure, soil conditions, amount of moisture available and the results desired. So often there is a poor choice of plants for a particular location. As an example, I have seen plantings of Gazanias, in a heavy, tight soil on the north side of a building, without any direct sunshine in the immediate area. As a result they do not bloom and the plant is not healthy. I have seen Algerian Ivy, with its large, lush green leaf, planted in the inland valleys, on a south exposure, in light sand soil without any amondments added to the existing soil. As a result the Ivy burned badly on hot summer days as it was very difficult to supply sufficient moisture.

To avoid such pitfalls, know a little about the plant and try to create an enviromnent as nearly the same as it enjoyed in its natural habitat. If these conditions can be duplicated, fine; if not, then select a plant that will tolerate the conditions to which it will be exposed.

Some ground covers are not frost hardy. Many of them will not tolerate the freezing temperatures of some of our inland valleys and mountainous areas. Fortunately, there are many others that will tolerate extremely low temperatures and their use in these colder aras is much more practical.

Some of the more pleasing ground covers that are used in southern California have been introduced to us from other parts of the world. Although our climate may be quite favorable, the local alkaline soils are often not favorable for good growth. Most of the tropical and semi-tropical, as well as shade type plants, must have a great deal of moisture in a well drained, porous soil. These soils should be prepared by the use of organic amendments to permit the proper root development and growth and to retain moisture in the root area. Plants such as Ivies, Ajugas, Pachysandra, Mosses are some in this group. The opposite group of plants in their soil demands could be the Achillia, Arototheca, Cerastium, Rosemary, Baccharis and Thymes. These do not necessarily require an extremely porous, well-drained light soil, although they certainly would grow well if this was provided.

The shade plants, where bloom and color is desired, need a very good soil, as they are normally grown under trees or some overhang. To achieve the best flowers, considerable light should be provided and direct sunlight is not objectionable in the early morning or late afternoon. Try to avoid the hot burning mid-day sun between 11:00 a.m. and 3:00 p.m. on tender shade plants. Plants like Mazus, Helxine Moss, Campanula, Coleus and Begonias are some of this type.

The spacing of ground cover plants should be no further apart than perits the plants to completely cover the ground within one growing season. Spare planting has caused considerable disappointment on the part of many clients since a certain amount of erosion, weeds and a higher cost of maintenance frequently occurs. On the other hand, if some of the larger, faster-growing plant material, such as Honeysuckle, is planted rather close together, it has a tendency to stunt. We know that Honeysuckle can be planted four feet apart, but if it is planted at this distance, two years later you can still see the original plant, as it will mound on these four foot centers. The same thing is true of the *Baccharis piluaris* variety Twin Peaks. If they are spaced no more than 18-24 inches apart they will tend to make a smoother cover without showing these mounds where the original plant was set.

I am often asked what kind of a plant can be supplied that will grow on a steep bank. Even though I may understand what is meant, my answer very often is: if the soil is prepared and moisture is supplied, anv of the plants will grow on the steep bank. We know it is more difficult to provide a loose, porous soil, that will retain moisture on a steep bank, but it can be done. The real question is: what kind of plant will grow on this bank without any soil preparation and little or no water? Although a few species would survive, the best results would be achieved by insuring that adequate moisture and plant food, especially nitrogen, is available.

There are very few plantings that I have seen where all of the plant material can be watered the same, by the same system, and be successful. Certain slope plantings should have a very low ater application rate to permit it to soak into the bank without running off. Areas where large trees or shrubs are present will require more water than areas where the same species is growing in the open. Often ground covers in flat open ground are under the same sprinkler system as the lawn, when really the ground covers need only one-half as much water as does the average well-kept lawn. Two things are commonly observed in the summer. The Ivies are frequently burned and many plants, particularly on slopes, have a poor appearance due to the lack of water. In other areas Ajuga, Gazanias, and Iceplant are dying because of disease that results from too much water. We have observed irrigation-related problems with items such as the Pcruvian Verbenas, Ajugas, Camomile, Cerastium, Gazanias, Herniaria, Lotus, Osteospermum, Polygonum, Potentilla, Strawberry, the Iceplants and Sedums. These and perhaps others should not be wet but should have perfect drainage and frequent light waterings. When kept constantl wet in a tight heavy soil, they are bound to have troub e.

The costs of ground covers do vary somewhat. Very often a particular ground cover is purchased because of

* From: Turf — Specifications and Costs. Proceedings of Southern California Turfgrass Institute. May 18, 19, 1971

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the low cost per flat. This can be false economy. For example, Osteospermum, 50 plants per flat, planted two feet apart will cost much less per square foot of planting than will Rosea Iceplant with 100 plants per flat, planted 12 inches apart.

I would like to stress that the greatest cost associated with ground cover establishment is the replacement cost that is often required. This is particularly true if plantings are being put in on a hot day in summer on a south exposure. On a hot dry location a great deal of expense in time and plant material would be saved if those areas could be planted during the cool moist season of the year. Never put a plant in dry ground and never plant a dry plant. Do not plant a five dollar plant in a five cent hole; always plant a five cent plant in a five dollar hole and your results will be better.

STRANGERS IN A STRANGE LAND*

By Tokuji Furuta**

I have chosen to use this title because, like the person in the book with the same title, we have arrived at a point in time when we may be intellectually and emotionally unprepared to survive in the new community of Environmental Horticulture. Survive in the strange land this stranger did. And like this stranger, to survive we must set out to completely assimilate the new situation by thoroughly understanding, identifying with, emphasizing and feeling it. Then and only then can we fully understand the interrelationships and responsibilities of all professions that make possible environments where each man can express his humanity.

The community of Environmental Horticulture is made up of a diverse group of individuals — some call themselves Landscape Architects, some are nurserymen, many are Landscape Contractors. You know the rest.

Each has a sense of his responsibilities, each feels his responsibilities begin when he receives the product and ends when he passes it on to the next person. Collectively and individually, each knows he is working towards the creation of environments for man, and that what he does influences what others must, can or should do.

The landscaped environment is space to which artifacts have been added and peopled with man. For a long time, the objective was thought to have this space pleasing to the eye, but not to be used, touched, to become an emotional part of the man. The space was “developed” or “landscaped” when the artifacts were tied together with plants, as one used string to tie together packages of different color and shapes.

Now we see emerging a new definition of the purpose of environments. Really it is not new — the definition was always there- we were not perceptive enough to see or articulate it. And with this realization comes a new awareness of each person’s responsibilities.

What is the objective of the landscaped development with which we are individually associated, or to which we contribute products? Is the objective of a golf course the same as that of a park — or industrial landscape? I use the singular because I believe the basic objective is the same, it is only the means of achieving it that is different. This objective: To create and maintain an environment where each person can express his humanity.

The environment must be pleasing to all the senses. To be fully rewarding, man must be able to interact emotionally with the environment. The emotion is not the same from time to time because changing features, color, people change the environment. The environment is never static, our reaction with it is never static.

To create and maintain this environment, this is the only justification of the community of Environmental Horticulture. Each person has a role. The rhetoric must not narrowly define the prejudices of each person or profession without considering the interrelationships and auxiliary effects. One must be aware of the cultural context. The cultural context often influences what works in environmental design. Our ideas must become realistic, flexible and unbigoted.

Environments where people interact in a pleasant manner may be “Highly developed” or not. By highly developed, I mean the introduction of many artifacts — and plants. Whatever the degree of development, five different aspects must be considrd if it is to become satisfying.

First, is the planned solution to the question — how should the artifacts and plants be arranged that man can express his humanity? The solution may contain not only the arrangements, but the name, size, form, etc. of the products to be used. Obviously if the pieces are not placed together properly, the solution is a failure. Equally obviously, the person making the plan is dependent on those handling steps 3 to 5 for success of his plan.

Secondly, is the product to be used. The producers of these products — plants, bark, bricks etc. — have less to say about the success of the environment than those managing the next three steps. These managers can cause any product to fail to provide satisfactory service. Specifications usually describe these products at the time of delivery. Specifications do not guarantee performance unless one rigidly controls how they are installed and maintained. Specifications are only a language of commerce.

Third, is the care of the product from the time it is received from the producer until it is installed in the environment. This could be a few hours to many days — or weeks. If the care is inadequate, the product becomes unusable. The care to be furnished must be specified and rigorously followed.

Fourth, is the actual installation. Years of dedicated work by the producers of the plants and other products could be ruined in a few moments during this step by neglect, carelessness or ignorance. It is doubly important

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here to have specifications for installation that are faithfully followed.

Lastly, and certainlv the most important step, is the aftercare — or maintenance. Here is the artisan, the person that looks after our environment that you and I can express our humanity. Specifications for maintenance may be somewhat flexible but a thinking man is needed. It is not necessary that each conform to rigid and set rules. It is not necessary that all plants have the same shape or size.

Each person in the Environmental Horticultural community can determine whereine he fits. He can see his role in helping to create the human environments of the future. He will see that the definition of the business he is in has been redefined.

We are beginning to formulate the right assumptions, to ask the right questions. We are beginning to develop critical attitudes toward our own assumptions and habits of thought. Just as we are redefining the objective of our business, we are redefining our interrelationships; we are sharing a common responsibility. The responsibility — it was always ours — to create together an environment where each individual can express his humanity.

EVALUATION OF TURFGRASS GROWTH RETARDANT CHEMICALS

Stephen T. Cockerham, Agronomist, and David Barlow, Technician, Cal-Turf, Inc.

Turfgrass managers have always shown a great deal of interest in the use of growth retardants. The appeal stems from visions of reduced moisture and nutrient requirements, less equipment repair, and vast savings of man hours. Research has shown that many of these chemicals will really do remarkable things, but it still remains for the turfgrass manager to evaluate how practical they are.

In looking at growth retardants from the viewpoint of both researcher and possible user, various evaluation techniques were employed. Chemicals were applied to turfgrasses in greenhouse studies as well as in commercial sod fields.

The greenhouse trials consisted of Tifgreen hybrid bermuda plugs treated with the growth retardants. Comparisons between treatments were made by visual evaluation, which took height of growth and vigor into consideration, and by weight of oven-dried clippings (Table 1). Cvcocel at 8 lbs. ai/A and 12 lbs. ai/A visually retarded the grass better than other materials but there was no significant difference in the clipping dry weights. Cycocel had forced the bermuda into a compact growth with thicker blades and stems. This was not surprising as cycocel is considered quite valuable to commercial flower growers for producing compact plants.

Field trials on Tifgreen hybrid bermuda have not shown uniform growth inhibition, however interesting effects on the dormancy of the bermuda have been observed. Cycocel at 8 lbs. ai/A delayed the onset of dormancy, but did not prevent the bronze coloration common to Tifgreen and Tifdwarf in cool weather. This delay in dormancy was slightly over a week, which could be of interest if one were preparing for an important golf tournament or football game.

Additional field trials put out in Tifdwarf hybrid bermuda have shown some growth retardation, this being difficult to evaluate on the dwarf cultivar. Seedhead production of bermuda and *Poa annua* was inhibited by a combination of maleic hydrazide at 3 lbs. ai/A and chlorfluorinol (CF-125) at 1 lb. ai/A. This could be one step in a *Poa annua* control program, keeping in mind that established plants are still present and seed will continue to germinate unless additional control measures are taken.

The application of maleic hydrazide to Kentucky bluegrass in field trials showed quite satisfactory retardation for several months (Table II). Cycocel had no effect. Retardation of Kentucky bluegrass was not without problems. During weather periods in which bluegrass is most susceptible to rust *(Puccinia spp.)* the disease so severe infected the retarded turf that many plants were kille . One of the new systemic fungicides might alleviate this problem.

Some turfgrass managers may be considering applications of growth retardant chemicals. Evaluations of the products such as these may help the prospective user avoid products such as these may help the respective user avoid some pitfalls and improve the per ormance of the treatment.

TABLE I.-Effects of growth retardants on Tifgreen hybrid bermuda

Treatment	Rate lbs ai/A	Greenhouse Ave. Retardation rating[1]	Ave. Oven ory wt. Clippings	Field Trial Dormany Ave. Rating[2]
Cycocel	8	3.2	3.3 gms	2
	4 + 4[3]	2.1	2.9 '	1
		2.1		
	12	1.2	2.9 "	1
Maleic Hydrazide	3	2.8	2.3 '	2
Chlorfluorinol	2	4.2	3.8 '	2
Maleic Hvdrazide + chlor-	1			3
fluorinol	1	4.1 3.8	3.4 3.0 "	2
Control			"	

[1]Rating 0 = no growth 5 = maximum growth

[2]Rating 0 = no dormancy 5 = total dormancy

[3]Second application made 21 days after first.

TABLE II.-Effects of growth retardants on Kentucky bluegrass blend (Merion, Newport, Windsor) in Field Trials.

Treatment	Rate Lbs. ai/A	Ave. Retarating Rating1	Rust Rating2
Cycocel	8	10	0
Chlorfluorinol	2	8	7
Maleic hydrazide +	3		
Chlorfluorinol	1	2.5	9
Maleic hydrazide +	1.5		
Chlorfluorinol	1	8.5	8
Control		10	0

'Inhibition 0 = no growth 10 = maximum growth

Rust (Puccinia spp.) 0 = no rust 10 = 100% dead turf

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