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Preemergence Weed Control In Ground Cover Plantings

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Ground cover plantings beautify highways and many landscaped areas throughout California. Weeds are objectionable and costly in these areas. Hand weeding has been a common method of weed control, particularly in new plantings. However, landscape contractors estimate hand weeding may cost as much as ten times chemical weed control. Preemergence chemicals can be used in many ground cover plantings to reduce the cost of weed control. Chemical weed control has been used only on a limited scale due to lack of knowledge and available selective weed control chemicals. Reduction in the cost of establishing these areas can be an economic saving to developers, landscape contractors and the general public.

A field study was conducted in 1967 at the University of California South Coast Field Station, Tustin, to evaluate the effectiveness of preemergence herbicides in selected commonly grown ground covers. Preemergence herbicides are those used to control weeds at germination, i.e., prior to the time the weed seedlings emerge from the soil. These herbicides are applied as close to planting time as possible for best weed control.

In this field study a high level of weed control was obtained with preemergence weed control chemicals. Several of the chemical treatments used had no noticeable affect on growth of the ground covers. Applications made after planting and irrigated in were safer than those applied before planting and mechanically incorporated. When simazine was applied postplant, injury was observed on most species in this study.

Ground covers included in the trial were primarily broadleaved herbaceous plant species. The soil was a sandy loam with a physical analysis of 57% sand, 24.7% silt, 18.3% clay and 1.0% organic matter. Two methods of treatment were included: preplant incorporated treatments with two chemicals, trifluralin (Treflan®) and diphenamid; (Dymid® , Enide ®) and postplant applications of trifluralin, diphenamid, Sirmate ® , combinations of trifluralin plus simazine, diphenamid plus simazine and trifluralin plus diphenamid. The higher rates of diphenamid, trifluralin and Sirmate were included primarily for tolerance evaluations. The ground covers, the chemicals, application timing, and rates of chemicals used are given in Tables 1, 2 and 3.

Four plants of most plant species were planted into each 5' x 10' plot and replicated four times. Three plants of *Sedum brevifolium*, *S. guatemalense* and *Pelargonium peltatum* and two plants of *Baccharis pilularis* were planted into each plot. The preplant treatments were made June 8, 1967. Planting of all of the ground covers except *Baccharis pilularis* and *Sedum guatamalenses* were made a week later, on June 12 and 13 and on June 15 the postplant treatments were applied. *B. pilularis* and *S. guatamalenses* were planted July 6, 1967.

No mechanical incorporation of the postplant treatments were used. However, sprinkler irrigation was utilized immediately after herbicide application to activate the postplant treatments.

Periodic evaluations were subsequently made on tolerances of the ground covers to the herbicides (T = tolerant; S-T = symptoms of injury; S = sensitive) and weed control effectiveness. (0-10 = weed control rating where 0 = no control; 7 = commercially acceptable control; 10 = complete weed control, i.e., no weeds.)

Postplant applications of trifluralin, diphenamid, and Sirmate®, and the combination treatment of diphenamid plus trifluralin provides a high level of tolerance at the rates used in this study (Table 1) Where simazine was added in the combination treatments, a number of the ground covers exhibited considerable injury (Table 1). On the other hand, *P. peltatum* and the *Sedums* showed remarkable tolerance when simazine was included in the treatments. Diphenamid in general showed less injury with the preplant treatments than did trifluralin (Table 2). Sirmate® provide adequate weed control and except for some early yellowing of foliage on some species, no affect on growth was observed.

Weed control was improved by incorporating the chemicals into the soil. Diphenamid was enhanced more than trifluralin (Table 3). However, as the data indicates, satisfactory weed control can be accomplished with postplant applications when followed with sprinkler irrigation and plant safety is improved. The principal weeds occurring in the trial were lambsquarters, several pigweed species, purslane and sowthistle.

Early postplant applications of some of the preemergence weed control chemicals can be used safely in several of the frequently planted ground covers. Many of the common annual weeds are controlled with these herbicides;. however, due to the selective nature of these herbicides certain weed species may not be controlled at selective rates. An advantage of this type of chemical is that a single treatment may last several months in contrast to hand weeding which may be required several times during the establishment period. Establishment is more rapid with weed competition reduced and less damage occurs to ground covers with foot traffic reduced through the planted area.

Other techniques such as black polyethylene films or preplant fumigation treatments would be more costly than the use of preemergence chemicals. These methods are useful under some conditions.

Cooperation extended by the University of California South Coast Field Station personnel and Mr. Harry Oda, of Oda's Nursery, Westminster, made this study possible.

TABLE 1 Ground Cover Tolerances To Preplant Incorporated Herbicide

Ground covers	Chemicals and Rates* Diphenamid 8	16	Trifluralin 2	4
Aloysia Triphylla (Lippia)	T**	T**	T	T
Baccharis pilularis	T	T	T	S-T
Cerastium tomentosum	T	T	T	T
Delasperma albe	S-T**	S-T**	s	s
Drosanthemum hispidum	T**	T**	S-T	3-T
Gazania splendens	T	T**	T	T
Hedera canariensis (Algerian ivy)	T	T**	T**	T**
Hedera helix (English ivy)	T	T	T	T
Hymenocyclus lutolus	T	T	S-T	S-T
Osteospermum fruticosus	T**	T**	T	T
Pelargonium peltatum	T	T	T**	T**
Sedum brevifolium	S-T	S-T	s	s
Sedum guatemalense	T	T	S-T	S-T
Vinca minor	T**	T**	T**	T**

- Rates given are in pounds of actual ingredient per acre (AI/A)

** stunting

Chlorosis (early)

T = Tolerant at rate evaluated

S-T-Symptoms Of injury

S = Sensitive to herbicide at rate evaluated

Preplant treatments applied as emulsifiable concentrate or wettable powder.

TABLE 2 Ground Cover Tolerances To Postplant Herbicide Treatments

Ground Covers	Chemicals & Rates* Diphenamid 5	10	Sirmate 4	8	Trifluralin 2	4	Diphenamid 10+4 Trifluralin	Diphenamid 5+1 Simazine	Trifluralin 4+1 Simazine
Aloysia triphylla (Lippia)	T	T	T	T#	T	T	T	S	S
Baccharis pilularis	T	T	T	T	T	T	T	S	S
Cerastium tomentosum	T	T	T	T	T	T	T	S	S
Delasperma alba	T	T	T	T	T	T	T	S	S
Dronsanthemum hispidum	T	T	T	T#	T	T	T	S	S
Gazania splendens	T	T	T	T	T	T	T	S-T	S
Hedera canariensis (Algerian ivy)	T	T	T	T	T	T	T	S	S
Hedera helix (English ivy)	T	T	T	T#	T	T	T	S	S
Hymenocyclus luteolus	T	T	T	T	T	T	T	S	S
Osteospermum fruticosus	T	T	T	T	T	T	T	S	S
Pelargonium peltatum (Ivy geranium)	T	T	T	T	T	T	T	T	T
Sedum brevifolium	T	T	T	T	T	T	T	T	T
Sedum guatemalense	T	T	T	T	T	T	T	T	T
Vinca minor	T	T	T	T#	T	T	T	S-T	S-T

* Rates given are in pounds of actual ingredient per acre (AI/A)

Chlorosis (early)

T = Tolerant at rate evaluated

S-T = Symptoms of injury

S = Sensitive to herbicide at rate evaluated

Postplant treatments applied as granules except simazine which was a 80% wettable powder for mutation.

TABLE 3 Annual Weed Control Results Comparing Preplant Chemical Treatments on Ground Covers.

Chemical and Treatment	Rates**	Weed Control#
Preplant incorporated		
Diphenamid	8	8.5*
Diphenamid	16	8.2
Trifluralin	2	10.0
Trifluralin	4	10.0
Postplant		
Diphenamid	5	6.5
Diphenamid	10	6.2
Sirmate	4	8.2
Sirmate	8	9.2
Trifluralin	2	9.2
Trifluralin	4	9.9
Diphenamid + Trifluralin	10 + 4	9.8
Diphenamid + Simazine	5+1	9.5
Trifluralin + Simazine	4+ 1	10.0

* One month following treatments

** Rates are given in pounds Of actual ingredient per acre (AI/A)

Rating scale--0=no control, 10=100% control

Southern Chinch Bug, A New Pest of Turfgrass in California

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The southern chinch bug, *Blissus insularis* Barber, was found damaging St. Augustine grass in 1967 in the east Whittier-La Habra area of Los Angeles and Orange counties. Since we have not had an opportunity to do any experimental work, this account of the southern chinch bug is taken mainly from a circular by S.H. Kerr* and a notice (dated October 10, 1967) of the Bureau of Entomology of the California Department of Agriculture.

In the U.S. the southern chinch bug is found in all of Florida and in the southern portion of states bordering the Gulf of Mexico from Florida to Texas. It is also found in other countries in or bordering the Caribbean Sea or the Gulf of Mexico. Hosts are various grasses, but in Florida it has caused serious damage only on St. Augustine grass.

*Recommendations for commercial lawn spray m e n. Florida Agricultural Experiment Station Circular S-121C, April, 1966.

DESCRIPTION, LIFE HISTORY AND INJURY

In size the southern chinch bug ranges in length from about 1/20th of an inch for the newly hatched nymphs to about 1/5th of an inch for the adults. The nymphs are reddish in color with a white band across the back, and turn black as they approach the adult stage. The adults are black with nearly all white wings which are folded flat over the body. There are both long and short-winged forms.

In northern Florida the adults may hibernate in the winter, but in most of the states all stages are found the year around. In the east Whittier area, all stages were collected in January, 1968. During the summer in Florida the eggs hatch in 1 – l-1/2 weeks and the young become adults in 4 - 5 weeks.

In feeding, the bugs insert their beak into the grass and suck out the plant juices causing yellowish to brownish patches in the lawn. Damaged areas are often found along concrete walks and drives.

CONTROL

Some of the insecticides recommended in Florida and their rate of application are given below:

Insecticide	Amount active ingredient/acre	Fonulation	Amount formulation for 5000 sq. feet
Baygon	7 - 10 lbs	1.5 lbslgal ec	69 - 98 fl oz
Diazinon	4 - 8 lbs	4 lbs/gal EC	1 - 2 pints
Diazinon	4 - 8 lbs	25% wp	2 - 4 lbs
Dursban	1 - 1 1/2 lbs	2 lbs/gal EC	7 1/2 - 11 fl oz
Ethion	7 1/4 10 lbs	4 lbs/gal EC	26 - 37 fl oz
Ethion	7 1/4 - 10 lbs	25% WP	3 l/3 - 4 3/4 lbs
v-c 13	17 - 35 lbs	8 lbs/gal EC	1 - 2 quarts

1 EC = emulsion concentrate, WP = wettable powder.

In lawn spraying usually 100 gallons of spray is applied to 5000 square feet. The Florida circular indicates that better control may be obtained by using a larger amount of water, i.e., use the same amount of insecticide per acre but increase the volume of water so that 150-200 gallons of spray is applied to 5000 square feet. The greater volume of water helps to wash the insecticide down into the thatch where the chinch.bugs are.

Granular formulations of the above insecticides are effective and are used at the same amount of a c t ive ingredient per acre as for the sprays. The granules should be lightly watered in after application.

At this point we do not know just how serious a problem the southern chinch bug will be in California. This summer we intend to conduct experiments to obtain information on control under California conditions.

Water Usage

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Water for maintaining golf courses is becoming more costly, hence it is not surprising that considerable interest is being expressed in water use or water requirements for turf.

Recent developments are showing that water use rates for any specific crop are closely related to climatic variables. While complicated instrumentation is required, it can be anticipated that information for guiding irrigation practices will be available on a regional basis. However, many adaptations of the climatological data will still be needed to account for soil and plant variables.

A parallel approach to water use measurement is based on using soil water sensors. When properly located with respect to rooting depth, such indicators may be used to guide the timing and duration of irrigation management. While different in many engineering details, such an approach is analogous to the control of the temperature of a building by a thermostat. The temperature range is set to accommodate the inhabitants and the amount of heat or fuel used varies with the climate and the heat losses of the building. An important part of this analogy is that the quantity of heat used is known only after a suitable time period has elapsed and when the bills for fuel are due and payable. Just as it is difficult to predict heat requirements, it is equally difficult to predict in advance the amount of water a specific area of turf will require, since long-range climatic variables are not predictable.

It is not necessarily the purpose of this report to induce superintendents to expand their use of soil water sensors. However, it does appear expedient to show some of the results of water use measurements and soil water management of turf based on the use of sensors.

It may appear to many that a tensiometer is just one of an increasing list of soil water instruments being offered for guiding irrigation management. In terms of basic principles, however, the tensiometer is the only instrument now in practical use whose readings relate directly without calibration to the energy or potential status of water in a soil. Readings in various soils may be interpreted on a “scale of wetness” without consideration of the soil type or soil water content. It is not surprising that as early as 1943, three developments were undertaken to use a tensiometer as a hydrostat for automatically irrigating certain crops.

Commercial development of automatic irrigation systems have been developed for turf more extensively than for most other crops. Irrigation systems using time clock controls, with and without hydrostats, have been available for quite a number of years. The usefulness in metering the water supplied under automatic irrigation as a measure of water requirement of turf has not been emphasized.

WATER USE MEASUREMENT

In 1961 a plot of turf 120 feet square centrally located on the campus of the University of California at Riverside was provided with an automatic irrigation system with a tensiometer type hydrostat[1]. The porous cup was located at a depth of 3.5 inches. When soil suction exceeded 20 centibars at this depth, the time clock turned on the sprinklers for a one hour duration at 2:00 A.M. Water meter readings showed that an average water depth of 0.5 inch was applied for the entire plot. Water distribution patterns were measured occasionally and showed that more nearly .35 inch was applied where the hydrostat was located. Evapotranspiration computations were made using the application depth corrected for non-uniform sprinkler distribution. A more practical water use is based on the meter reading converted to depth of water applied over the entire plot.

A neighboring plot of equal size was irrigated by a system with time clock control but where changes in timing and duration of irrigation were set manually. Table 1 gives the monthly calculations for the 1962 calendar year. Accompanying monthly air temperatures are also listed in the table.

[1]Funds for purchasing the system were provided by the Water Resources Center, University of California, Los Angeles. Moist-0-Matic, Inc., Riverside, California, contributed to the installation.

TABLE 1 Monthly irrigation applications and values corrected for non-uniform distribution of water by sprinklers. Also included are rainfall and air temperature data from the Citrus Research Weather Station.

1962	Depth of water from Meter readings, inches: Semi-automatic system	Fully automatic system	Depth of water on instrument area, inches	Rainfall surface, inches	Evapo-trans-piration, inches	Mean monthly air temperature °F
Jan.	2.14	2.17	1.4	1.9	3.3	53
Feb.		0.57	0.4	3.7	4.1*	51
Mar.	0.78	2.71	1.8	0.8	2.6	51
Apr.	8.64	7.76	5.2		5.2	64
May	9.34	7.45	5.0	0.3	5.3	62
June	9.16	7.35	4.9		4.9	68
July	11.35	8.61	5.7		5.7	74
Aug.	11.96	8.36	5.5		5.5	77
Sep.	11.63	5.90	3.9		3.9	73
Oct.	4.52	4.03	2.7		2.7	64
Nov.	4.78	3.01	2.0		2.0	60
Dec.	3.71	2.63	1.7		1.7	54
Total	78.01	60.55	40.2	6.7	46.9	

*Rainfall probably exceeded evapotranspiration for February.

Perhaps of equal interest to the water use rates measured by this technique is an evaluation of how well the system performed. The quality of turf is, of course, the primary means of evaluation. However, factors other than soil water management such as disease, insects, nutrition, and adverse weather conditions have some influence on turf quality. For the purposes of this experiment, soil water management was evaluated by installing tensiometers to read soil suction at several soil depths and at two locations in the plot.

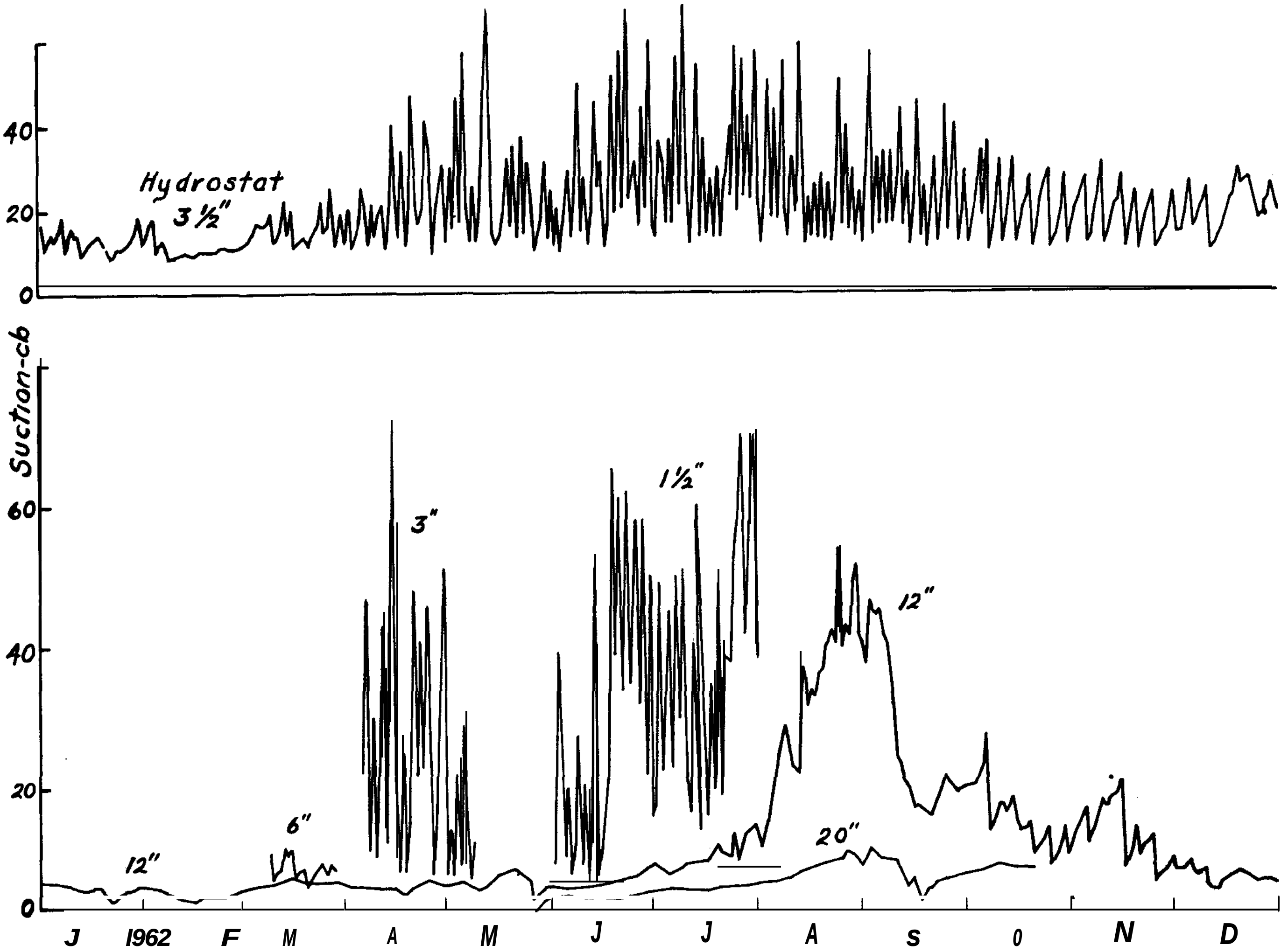

FIGURE 1 Daily readings taken at 5:00 P. M. on a vacuum gauge in the hydrostat connecting of an automatic irrigation system and similar readings on tensiometers for the depths indicated in inches. Readings for the 1.5, 3, 6, and 20 inch depths are for selected periods to illustrate variations occurring throughout the entire year.

Figure 1 is a record of the variations occurring in the hydrostat which controlled the irrigation system and also shows the daily readings made at 5:00 P.M. on tensiometers for various soil depths near the hydrostat's location. Readings for the entire year are given only for the 12 inch depth. Typical records for brief time periods are shown for 1.5, 3, 6, and 20 inch depths. Of interest to note are the very rapid changes occurring in tensiometer readings for the 1.5 and 3 inch depths. This is a good indication that most of the roots absorbing water were located in surface 4 or 5 inches of soil. Hence the hydrostat was appropriately located at 3.5 inches.

For most of the year the water used from the surface 12 inches of soil was well balanced by the amount supplied by the irrigation system. This is shown by the 12 inch tensiometer which changed very little until the end of July. During August, soil water depletion did occur at the depths near the 12 inch layer. However, without any adjustment to the control system, water use by the turf was less in September and the system was able to resupply water to the 12 inch depth.

The system perameters were preselected to minimize downward drainage of water. For the purpose of measuring water requirements of the turf, it was expedient to reduce this downward "loss" to a minimum rather than to attempt its quantitative evaluation. Under arid climatic conditions, the timing and duration of irrigations must be selected to give some downward drainage to prevent soluble salt accumulation in the root zone.

IRRIGATION MANAGEMENT RELATED TO GOLF GREEN CONSTRUCTION

During 1964 a demonstration was carried out to show irrigation management related to golf green construction. The United States Golf Association: (1) published in 1960 a proposed plan for golf green construction. This proposal and others (2) recommend the use of coarse sandy mixes as surface layers for greens to avoid the adverse conditions associated with soil compaction. Certain built-in layers including pea gravel and sand are specified in the recommendations. Little is known of the effects of changing the proposed design.

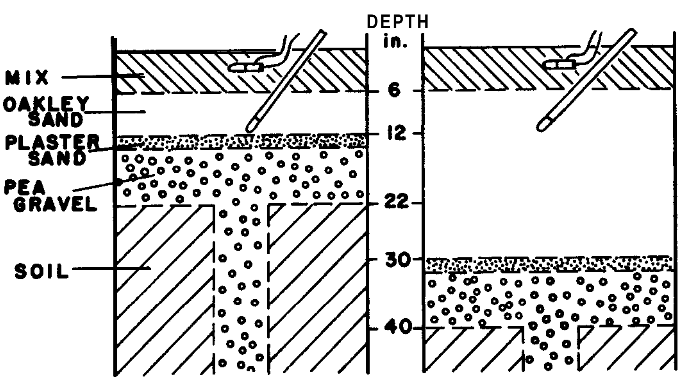

FIGURE 2 Sketch of model golf green profiles used to determine relative water storage properties. Tensiometers were located at 2 and 10 inch depths respectively.

Figure 2 is a sketch of two profiles studied in model sized soil containers three feet in diameter. The left profile is similar to the above mentioned recommendations. The profile on the right differs essentially by having a 24 inch layer of fine sand between the planting mix and the coarse sand and gravel layers povided for drainage. As another variable to study, two soil mixes were prepared, arbitrarily called coarse and fine. The fine mix was made from Oakley fine sand amended with 25% by volume of redwood shavings. The coarse mix had 25% Oakley sand, 25% redwood shavings, and 50% plaster sand. Each of the mixes was used with each of the profiles shown in Figure 2. Tensiometers were positioned as shown in the figure. The cups in the mix were placed at a depth of 2 inches. One small tube from each cup was connected to a mercury manometer, not shown in the figure. The other tube was used for filling the system with water and closed by a clamp at other times. The deeper tensiometers were located at an average depth of 10 inches.

It was convenient to carry out this experiment inside an aluminum lathhouse. Relative evaluations of the water properties of mixes were established, but irrigation schedules or estimated transpiration rates should not be interpreted for normal greens management. It was also expedient to use dicondra as the growing plant to withdraw water from the mixes. This selection reduced the need for frequent clipping which could have been carried out only by hand on such small greens.

The Oakley sand used in this experiment contained less than 1% silt plus clay and the sand fraction was largely between 0.1 and 0.5 mm in size. It is an aoelian soil rather widely distributed around Riverside. The Oakley sand was used unamended for the soil layer between the top soil mix and the plaster sand interface in the 3 0 inch profile.

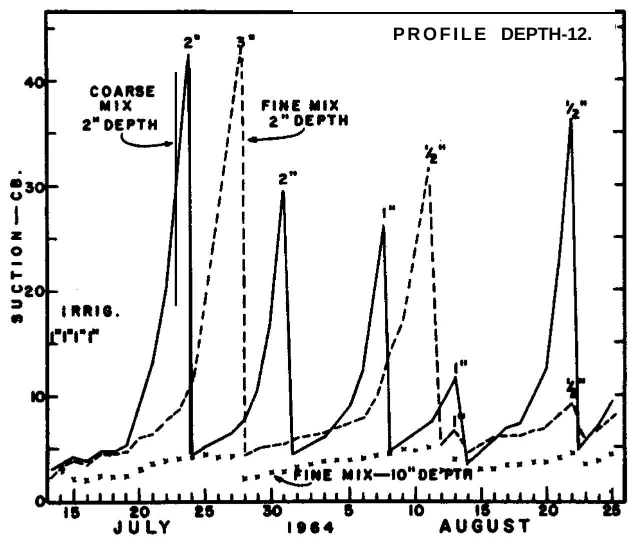

FIGURE 3 Soil Suction values indicated by tensiometers at 2 inch depths for two soil mixes in the soil profile with a 12 inch depth to the coarse sand layer. The numbers indicate the amount of irrigation water applied as surface inches.

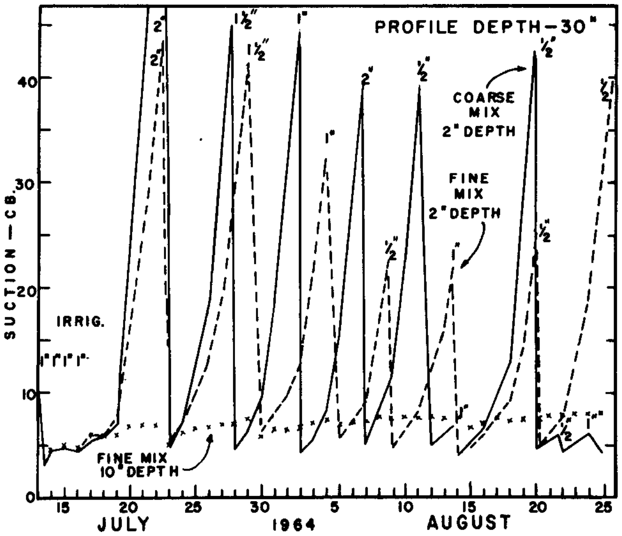

FIGURE 4 Soil suction and amounts of irrigation water similar to Figure 3 but for a soil profile with a 30 inch depth to the coarse sand layer.

Figures 3 and 4 show a comparison of the irrigation management based on tensiometer readings as influenced by the fine and coarse soil mixes and by the profile depth. The time period shown in the figure started near mid-July when one inch irrigations were applied on four successive days. This greatly exceeded the plant use requirements and assured that all four profiles would have initial conditions at or near their maximum storage capacity. Following this, irrigations were applied only when the surface tensiometer readings reached or exceeded 30 centibars. An exception to this schedule occurred on August 13 when all models were given simultaneous one inch irrigations.

It is evident that the number or frequency of irrigations was greater for both surface mixes in the profile with the 30 inch depth to the sand layer (Figure 4 as compared to Figure 3). While the fine mix required fewer irrigations than the coarse mix in both profiles, the difference in water stored for plant use by these two mixes was not as great as was predicted from laboratory measurements.

Efficient water use was not an important consideration in this experiment. The quantity of water applied at each irrigation is shown on the figures. The values represent surface inches applied. The larger amounts were applied on purpose to exceed the stored water capacity in each case. Later in August,, the amounts were progressively reduced in an attempt to demonstrate the minimum amount to apply before causing the irrigation interval to be shortened. Since in most cases, a one half inch of water applied in late August had about the same effect on subsequent tensiometer readings as a 2 or 3 inch irrigation in July, it is evident that irrigation water in excess of a one half inch application was draining out of the soil profile into the sand and gravel below.

From July 18 to August 26 the number of irrigations ranged from 3 to 7 when irrigation timing was based on soil water sensors. This evaluation of water stored for turf use as measured by irrigation frequency could become an important design criterion.

SUMMARY

Studies relating to turf water requirements were carried out by automatically managing irrigation to replace the soil water used and metering the irrigation water. Soil water sensors or tensiometers were used to guide the automatic irrigation program.

Effects of varying the soil mix and drainage profile of a golf green on irrigation management were demonstrated.

LITERATURE CITED

1. Anonymous. Specifications for a method of putting green construction. U.S. Golf Association Journal and Turf Management. September 1960. l-5.

2. Lunt, O.R. 1956. A method for minimizing compaction in putting greens. Southern California Turfgrass 6 (3): l-4.

3. Post, K., and J.G. Scoley. 1943. Automatic watering of greenhouse crops. Cornell University Agricultural Experiment Station Bulletin. 793:36.

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Turfgrass Diseases: The Relationship of Potassium*

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Fertilizer naturally plays a most important role in the maintenance of good turf. Well-balanced nutritional programs can aid materially in helping to suppress weeds and diseases. Potassium, one of the three major plant food elements, plays an important role in turfgrass vigor, which in turf influences disease development.

Potassium serves many roles in the grass plant and, if it becomes deficient can cause:

1. Accumulation of carbohydrates that cannot be synthesized into proteins.
2. An excess of non-protein nitrogen.
3. Failure to produce new cells for lack of amino acids essential for protoplasm formation.
4. Slower growth of meristematic tissue that permits replacement of diseased tissues.
5. Thinner cell walls and epidermal tissues.

According to George McNew, in the United States Department of Agriculture Yearbook, Plant Diseases, severe potassium deficiency could interfere with the activity of more than 25 different enzymes. He stated that more plant diseases have been retarded by the use of potash fertilizers than any other substance, perhaps because potassium is so essential for catalyzing cell activities. He further stated that the balance of nutrient elements may be more important than concentration of total fertilizer when plants are exposed to attack by parasites. A deficiency or surplus of any one element often promotes diseases.

EFFECT OF POTASSIUM

Dr. E.M. Evans and associates at Auburn University have reported a leaf spa disease on Coastal Bermudagrass that is related to soil potassium levels. This is one of the few papers in the literature that links a turfgrass pathologic problem with potassium deficiency. This disease is caused by two fungus species. Severe disease attacks were incited with zero levels of potassium and high nitrogen treatments. They concluded that severity was directly related to the degree of potassium deficiency.

DOLLAR SPOT DISEASE

W.E. Pritchett and Granville C. Horn of Florida have reported less dollar spot disease caused by *Sclerotinia homeocarpa* where potassium was applied. J. Drew Smith in his book *Fungi and Turf Diseases* in 1955 stated that application of potash assisted slightly in recovery from infection of *Sclerotinia* dollar spot disease. Here are two indications, arrived at independently, that potassium does have some effect on dollar spot.

BROWN PATCH

Pennsylvania State University has reported that brown patch disease, caused by *Rhizoctonia solani,* increased with increasing rates of nitrogen only when phosphorus and potassium were not concurrently increased. J.R.Bloom and Houston B. Couch in their investigations on the effect of nutrition, pH, and soil moisture on *Rhizoctonia* brown patch concluded that, as nitrogen is increased, there must be a concurrent increase in phosphorus and potassium to help lessen disease proneness and severity.

RED THREAD DISEASE

Red Thread is a fungus disease caused by *Corticium fuciforme.*

In tests conducted at the Western Washington Research and Extension Center at Puyallup, Wash., we have found that nitrogen produced significant differences in the percent of diseased area or the number of stromata produced by the red thread fungus. Potassium was significant in bringing about a decrease in infection during one of these years. As potassium was increased from the zero level to eight pounds concurrently with nitrogen from four to eight pounds per 1,000 sq. ft. per season, the percentage of area infected likewise decreased. The greatest infection from *Corticium* red thread occurs in the Pacific Northwest in late summer and during the fall. Tissue analyses show that potassium is lower in grass tissue during this period when infection is almost nil. Plots receiving a balanced high level of nutrition escape almost completely from red thread attacks during the growing season, but are infected somewhat during slower periods in fall and winter.

Most agronomists and pathologists agree that in the case of red thread, high nutritional levels increase the growth rate of the leaves, and the infected tissue is removed before becoming objectionable.

FUSARIUM PATCH DISEASE

Fusarium patch disease is caused by the fungus *Fusarium nivali.* In our investigations in western Washington we have found this disease to decrease with increasing levels of potassium from zero to eight pounds per 1,000 sq. ft. per season on putting green turf. Increasing levels of potassium, however, did not prove to be significant in every year.

Increasing potassium levels tend to keep the disease incidence reduced somewhat in the six-pound and eight-pound per 1,000 sq. ft. per season nitrogen range but, when nitrogen was increased to 20 pounds per 1,000 sq. ft. per season, potassium had little effect on disease incidence. This seems to be positive proof chat 20 pounds of nitrogen in relation to the four pounds of phosphorus and eight pounds of potassium per 1,000 sq. ft. per season are in balance and do not respond in a reasonable manner. Again, the greatest *Fusarium* patch infection occurs from early fall to early winter when the potassium level of tissue is approaching its lowest level.

OPHIOBOLUS PATCH DISEASE

This disease, caused by the fungus *Ophiobolus graminis,* var. avenue has responded with practical significance to both phosphorus and potassium nutrition. We have reported in a previous paper, published in the Agronomy Journal, that potassium had a suppressing effect on the amount of disease in two years of investigations at Washington State University. Potassium was found to reduce the amount of disease, regardless of nitrogen and phosphorus levels.

BALANCED NUTRITION IS A MUST

Here again, we cannot deny the value of the overall effects of a balanced nutritional program. Our results at Washington State University to date show that a balanced pogram made up of three parts of nitrogen, 1 part of phosphorus, and 2 parts potassium is giving best results in our turfgrass management programs. The intensity is quite another factor and, if not brought up to certain levels, means little, particularly in the case of *Opbiobolus* patch disease and red thread. Our results have shown on putting green turf that 12 pounds of nitrogen, four pounds of phosphorus (P_2O_5) and eight pounds of potassium (K_2O) per 1,000 sq. ft. per season have given us best results Likewise, on less intensely managed areas, such as good quality lawns or fairways, we have found that six to eight pounds of nitrogen, two to three pounds of phosphorus (P_2O_5) and four pounds of potassium (K_2O) per 1,000 sq. ft. per season is a good program.

*Reprinted from USGA Green Section Record.

REMOVAL OF SOIL POTASSIUM

We have observed the decline in soil potassium in our same research plots over the past eight years at the Puyallup Station. Soil potassium levels have declined constantly when nitrogen was applied at 12 and 20 pounds per 1,000 sq. ft. and potassium at four and eight pounds per 1,000 sq. ft. per season. These same potassium levels at the six-pound nitrogen rate are holding soil levels fairly constant. Where no potassium has been applied for eight years some plots, particularly in the high nitrogen range, show levels as low as 90 pounds per acre in 1967. These levels have drop d from a level over.590 pounds per acre initially when t e experiment was initiated.

SUMMARY

It is difficult to select any one nutrient and establish a threshold value at which it determines certain degrees of disease susceptibility. We feel that, as nutrient levels approach a critical minimum, we may be able to assign primary roles to these certain elements.

It is obvious from these studies in observing the build-up and suppression of turfgrass diseases that nutritional programs alone are not the sole answer. Carefully planned and executed fungicidal programs must be accepted by the golf superintendent or other turfgrass manager if he is to maintain clean and healthy turf.

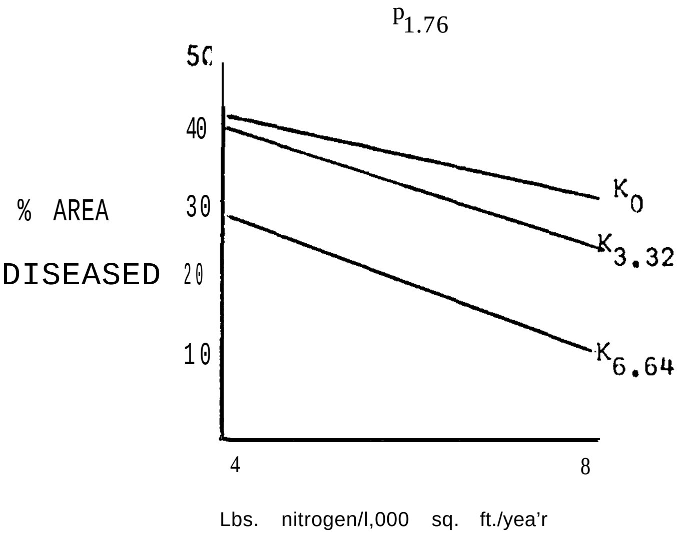

FIG. 1 Decrease in Red thread infection (Corticium fuciforme) with increasing rates of both nitrogen and potassium.

Note: Both P and K ore expressed in elemental, not oxide.

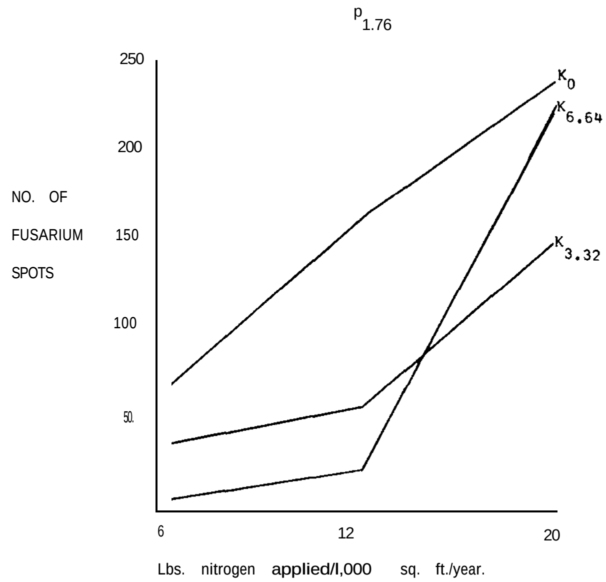

FIG. 2 Number of Fusarium patch spots (Fusarium nivole)are lowestwith increasingrotesofpotassium butincreasewith increasingratesofnitrogen.

.Note: Both P and K expressed in elemental, not oxide.

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