Southern California Turfgrass Culture

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ENVIRONMENTAL FACTORS AFFECTING BERMUDAGRASS GROWTH AND DORMANCY

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One of the principal reasons why bermudagrass is not a more popular turf material in California is that in most areas of the state it discolors badly during cool winter weather. This discoloration or dormancy develops at temperatures well above freezing. It behaves as a typical sub-tropical grass by responding with increased rates of growth to increases in temperatures to an unknown optimum perhaps in the range of 100° F. At moderately cool temperatures, still very favorable for the growth of temperate zone grasses, its growth rate is very slow.

While these general growth responses are well known to anyone who has observed bermudagrass turf for any length of time, knowledge of the effects of specific environmental conditions has been very limited. A number of investigations have been made at UCLA in recent years directed towards a better understanding of these environmental responses.

Hoshizaki (1) observed that U-3 bermuda remained green later in the fall if given regular applications of a soluble nitrogen fertilizer such as ammonium sulfate. Organic or Urea-form nitrogen fertilizers were not as effective in holding the green color as ammonium sulfate. He also noted that the fertilized U-3 developed more new growth during warm winter periods than the unfertilized. The amount of new growth was directly related to the amounts of nitrogen previously applied.

These studies showed that there was no growth at temperatures of 35-45° F. However, growth was observed when U-3 was given these temperatures at night followed by day temperatures of approximately 75° F.

In these studies Hoshizaki was unable to experimentally produce the typical winter discoloration of bermudagrass using controlled temperature growing chambers. Later the author obtained similar negative results even though the U-3 bermuda plants were held constantly at 33° F. for over a month. Since the fluorescent lamps in these chambers supplied light of a low intensity further studies were conducted to investigate the effects of the interaction of light of higher intensity and temperature on growth and dormancy (2). Photo-destruction of chlorophyll, the green pigment in plants, by high intensity light has been demonstrated by several investigators (3 and 4).

In the first experiment U-3 bermuda sprigs consisting of a single node each were planted one to a pot and allowed to become established in a warm greenhouse. They were then transferred to a series of temperature treatments in controlled temperature growing chambers ranging from a low of 34° F. to a high of 70° F. Four pots were placed in each treatment. Two of the growing chambers used were glass walled to supply natural daylight of approximately 7,000 foot candles maximum. The other chambers were lighted by fluorescent lamps giving from 400 to 1500 foot candles.

The following measurements and observations were made during or at the end of the 55 day treatment period: increase in length of shoots, number of new shoots, total dry weight of plants and degree of discoloration.

On the basis of these growth measurements U-3 bermuda appears to require temperature above 50° F. in order to grow. However, it was observed that the grass plants would continue to grow at a night temperature as low as 34° F. and a day temperature of 70° F. or a night temperature of 40° F. and a day temperature of 60° F. Thus warm day temperatures appear to counteract the effects of low night temperatures.

As in the preliminary experiments no discoloration was noted in the plants in the low-temperature, low-light intensity treatments even if held constantly at 34’ F. On the other hand, plants given low night temperatures, but moderate day temperatures with high intensity natural daylight, developed the typical discoloration of winter dormancy. The following high light intensity treatments showed severe to moderate discoloration: 34° F. night - 50° F. day, 40° F. night - 50° F. day, 34° F. night - 60° F. day and 50° F. night - 50° F. day,

A second experiment, repeating several of the treatments of the first but using 4-inch plugs of U-3 turf, was set up for quantitative measurements of the degree of discoloration or chlorophyll destruction. After 4 weeks in the temperature treatments 2-gram samples of leaf

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tissue were removed from each pot of grass, the chlorophyll extracted, separated by column chromatography and measured on a Beckmann spectrophotometer.

Discoloration from the various treatments expressed as chlorophyll content of the leaves fell in the following order with the most discolored first and least discolored last:

1. 34’ F. Night - 50° F. Day High intensity daylight
2. 40° F. ” 50° F. " " " "
3. 34° F. " 60° F. " " " "
4. 40° F. " 40° F. ” Low ” lights
5. 50° F. ” 50° F. ” High ” daylight
6. 40° F. ” 60° F. " " " ”
7. 34° F. " 34° F. Low " lights
8. 50° F. " 50° F. " " " "
9. 34° F. " 50° F. " " " "

Treatments 1, 2 and 3 contained significantly less chlorophyll than all of the other treatments. The largest quantities of chlorophyll were from plants kept under the low intensity artificial light even though the temperatures were as cold as or colder than those for the severely discolored plants. Plants in treatment 7, 8 and 9 which had the largest quantities of chlorophyll appeared the same in color as healthy summer grown bermuda turf.

These experiments have shown first of all that U-3 bermudagrass has a relatively high minimum temperature requirement for growth - above 50° F. We also see that U-3 bermuda will withstand low night temperatures just above freezing and continue to grow provided day temperatures are sufficiently above 50° F.

Winter dormancy or discoloration of bermudagrass which is commonly observed at temperatures well above freezing, as shown by these studies, is caused by an interaction of moderately low temperatures and bright sunlight. Apparently this interaction causes a rate of chlorophyll destruction exceeding the rate of chlorophyll synthesis within the bermudagrass leaf, thus producing the typical winter bermudagrass discoloration.

When the light falling on the plant is of sufficient intensity the lower the temperature at night the more severe and rapid the discoloration. However, higher day temperatures appear to reduce the effects of the night temperatures.

Several questions remain to be answered by further experiments. The manner in which an increased availability of nitrogen acts to reduce the effects of bright sunlight and low temperatures is not known.

Strains of bermudagrass differ greatly in their ability to retain green color during cool weather. How these strains differ physiologically, biochemically or anatomically to create these differences in color retention must be determined by more investigations. If these differences are discovered breeding of new color retaining bermudagrasses may be greatly accelerated. This knowledge may also make possible new techniques or treatments to improve winter color of any bermudagrass turf.

Literature cited

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3. Shirley, H. L. The influence of light intensity and light quality upon the growth of plants. Amer. Journ. Bot. 16:354-390. 1929.

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New Book on Turf Culture

Your Lawn, How to Make it and Keep it
By: R. Milton Carleton

Publisher: D. Van Nostrand Company, 120 Alexander St. Princeton, New Jersey. Price: $3.95

This book discusses most aspects of general lawn culture in a non-technical practical manner. Primarily for the amateur but contains many things which will be helpful to the professional as well.

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The Control of *Poa annua*, Annual Bluegrass in Putting Greens

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Poa annua is the most serious weed pest on putting greens throughout the United States. Observation of many old greens have shown that they may be as much as 80 to 90 percent *Poa annua*. When the situation becomes this bad partial or complete rebuilding of the green is necessary, However, if the contamination is less various management and chemical control practices should be adopted.

Attempts to control *Poa Annua* should start in the fall in California or any area where grasses remain active throughout the winter months. Starting a control program at this time has two advantages, (1) This is the peak season for seed germination. (2) The bentgrasses will have several months of favorable growing weather to fill in bare spots and to form a dense turf.

On the other hand, during the spring and early summer months everything possible should be done to keep the *Poa annua* alive and healthy. The grasses growing at this time will make the turf for the summer and must be lived with until fall. Don't apply herbicides which will weaken the *Poa annua* at this time but instead aerify, fertilize and nurse it into as healthy growth as possible so that its chances of surviving the hot weather ahead will be the maximum possible.

Fall *Poa annua* control, as most weed control programs, has two aspects, management and chemical. It should start as soon as the hot weather is over with thorough aerification, vertical mowing, fertilization and top dressing. Any thin or bare spots should be overseeded with Penn Cross or plugged,sodded or sprigged with a vegetative bent such as Congressional or Old Orchard.

Poa annua will grow in compacted overly wet soils at the expense of the bentgrasses which cannot compete under these conditions. Therefore fall aerification is essential in order to open up the soil for deeper root penetration of the bentgrass. Top dressing should be sand in the particle size range of 0.4 to 0.2 mm or this sand mixed with about 15% organic matter such as peat or sawdust.

No positive chemical control for *Poa annua* is known at present. Since its seeds germinate most heavily in the fall of the year, pre-emergence chemical control appears to be the most promising approach. However, distinctly perennial strains have been observed (2). These are especially common in putting greens where the close mowing and heavy watering seems to favor their survival and spread. Since these perennial strains are known to survive for at least 3 years and perhaps much longer, pre-emergence chemical control will be successful only if practiced consistently year after year.

Lead arsenate is the only chemical which has been used generally for this purpose. Daniel (1) in 1956 reported successful control of *Poa annua* with Lead Arsenate. Mruk and DeFrance (3) reported fair to good control with Neburon, disodium methyl arsonate, lead arsenate and chloro I P C in 1957.

Studies on *Poa annua* control at UCLA have been conducted as both greenhouse and field experiments. In greenhouse studies seed was planted in either flats or 4-inch pots which were treated with the series of herbicides to be tested. All treatments were replicated four times. Control was expressed either as an estimated percent of the check or if an exact number of seeds were planted as actual counts of surviving seedlings.

The first greenhouse studies were for the purpose of determining minimum effective application rates for a large number of pre-emergence herbicides. Rates were not considered effective unless inhibition of germination was nearly 100%. Results of these tests are summarized below.

Chemical

1. Lead Arsenate - Control not complete even at 30 lbs./1000 sq. ft.
2. Eptam-1 lb. per acre, 25 to 50% control at l/2 lb./A.
3. Neburon - Control not complete even at 7 lbs./A.
4. Randox - l/2 lb./A.
5. Alanap 3 - Partial control at 3/4 lb./A. and above
6. Natrin - Poor control at maximum rate of 6 lbs./A.
7. Crag #l - No control at maximum rate of 10 lbs./A.
8. Simazin - 1 lb./A. - fair control at l/2 lb./A.
9. Vegedex - 1 lb./A. - fair control at l/2 lb./A.
10. Falone (3Y9) - granular 20 lbs./1000 sq. ft.

In order to determine what differences in response to chemicals might exist between different strains of *Poa annua* a second greenhouse experiment was conducted in 1958. Seed of six fairly pure strains of *Poa annua* from self pollinated plants were selected and planted, twenty-five seeds per pot. Six herbicides, Eptam, Randox, Vegedex, Alanap 3, and Simazin were applied at two rates. The first rate was the minimum effective rate determined from the previous experiment and the second rate was slightly lower in each case. Results were completely negative -- no strain appeared to be any more or less susceptible to any herbicide than the others.

Field tests were conducted during the winter of 1958-59 using the same herbicides. Calcium arsenate was the

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only chemical used which had not been included in the greenhouse tests. The turf was an old block of creeping bentgrass under putting green management. It had been moderately contaminated with *Poa annua* the previous winter. Each treatment was replicated three times, Applications were made October 17, 1958.

Results of this test are summarized in the table below:

CHEMICAL	RATE	BENTGRASS INJURY	PERCENT OF AREA CONTAINING POA ANNUA
1. Simazin	1/2 lb./A.	Moderate injury	26.83
2. Simazin	1 lb./A.	Severe injury	16.83
3. Calcium Arsenate (80%)	12 lbs./1000 sq. ft.	No injury	33.16
4. Calcium Arsenate (80%)	16 lbs./1000 sq. ft.	No injury	20.50
5. Eptam	1/2 lb./A.	No injury	59.16
6. Eptam	1 lb./A.	No injury	31.00
7. Alanap 3	11/2 lbs./A.	No injury	61.33
8. Alanap 3	3 lbs./A.	No injury	40.33
9. Lead Arsenate	12 lbs./1000 sq. ft.	No injury	20.83
10. Lead Arsenate	16 lbs./1000 sq. ft.	No injury	18.16
11. Falone – granular	21/2 lbs./1000 sq.ft.	Slight injury	62.33
12. Falone – granular	5 lbs./1000 sq. ft.	Moderate injury	68.12
13. Falone – granular	20 lbs./1000 sq. ft.	Severe injury	74.50
14. Vegedex	1/2 lb./A.	No injury	52.83
15. Vegedex	1 lb./A.	No injury	49.83
16. Neburon (18.5%)	4 lbs./A.	No injury	47.66
17. Neburon (18.5%)	8 lbs./A.	No injury	27.25
18. Randox	1/2 lb./A.	No injury	53.16
19. Randox	1 lb./A.	No injury	62.66
20. Check – no treatment			66.87
21. Neburon (4% granular)	4 lbs./A.	No injury	73.66
22. Neburon (4% granular)	8 lbs./A.	No injury	37.33

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The degree of control can be determined from the last column of the table, the lower the percent of area containing *Poa annua* the greater the control. From this table it may be seen that the following herbicides were effective in controlling *Poa annua:* Calcium arsenate at 12 and 16 lbs. per 1000 sq. ft., Eptam at 1 lb. per acre, Alanap 3 at 3 lbs. per acre, Lead Arsenate at 12 and 16 lbs. per acre, and Neburon at 8 lbs. per acre of either the liquid or granular formulation. Simazin gave excellent control but must be eliminated because of the injury to the bentgrass.

Certain inconsistencies with the data from the greenhouse tests may be noted. Lead Arsenate and Neburon were ineffective in the greenhouse but gave good control in the field. Vegedex and Randox which destroyed all seedlings in the greenhouse tests produced only slight control at the best in the field tests. It may be that higher rates of these materials would have given good control as field conditions very often necessitate higher herbicide application rates than those in the greenhouse. Why Lead Arsenate and Neburon should be effective in the field when they were not in the greenhouse cannot be explained.

If any of these chemicals are to be tried in a turf maintenance program certain precautions must be taken. They should be tested for toxicity to bentgrass under the local conditions. A corner of a nursery or practice green could be used for this. Formulations and local soil and weather conditions may vary sufficiently to increase the injury to the bentgrass turf. For example, calcium arsenate formulations with a large water soluble arsenic fraction are more phytotoxic than those with a low fraction. For maximum safety the water soluble arsenic should not exceed 0.5%. Toxicity of many herbicides increases more or less directly with increase in temperature. Pre-emergence herbicides should not be used on newly reseeded turf or prior to overseeding.

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2. Hovin, Arne W. Variations in Annual Bluegrass. Golf Course Reporter 25(7):18-19.1957.
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Uses for Zoysiagrasses in the Southwest

The good and bad features of the Zoysias and their merits compared with those of the new bermudagrasses have been discussed many times. The question which should be asked now is; where can they be used to best advantage?

Zoysias are moderately shade tolerant, extremely tough and wear resistant. It is almost impossible to take a divot out of a dense Zoysia turf. Therefore we suggest that they be tried on a shaded golf tee where bermudagrasses are thin and weak. Emerald or Matrella are preferred to Meyer for this purpose as they start to grow earlier in the spring, continue to grow later in the fall and may retain fair to good color throughout the winter in many mild climates.

The slow growth of the Zoysias suggests that another place on the golf course where they may be useful is around the sand traps. A strip one foot wide around the trap will serve to greatly reduce the amount of trimming and edging required. The surrounding bermudagrass will be unable to penetrate this Zoysia barrier.

The problem of what to plant in shady areas often arises when bermudagrasses are selected for the main expanse of lawn. Emerald or matrella blend well with many of the bermudas and require similar management so should be considered unless the shade is very dense.

Zoysias, of course, may be used on any home lawn. They are highly resistant to a scuffing type of wear so are excellent for play areas.

The slow rate of establishment of Zoysia is often the reason why other grasses are selected instead. A temporary lawn may be established with seeded temperate climate grasses and changed to Zoysia by setting plugs on one foot centers throughout the lawn. The Zoysia will gradually spread, filling thin and bare areas which may develop. This method will reduce the weeding problem and give a solid lawn cover at all times.

New laboratory Facility

Ornamental Horticulture Area
University of California, Los Angeles

A new laboratory facility has been added to the UCLA campus at 300 Veteran Avenue. This building is dedicated to the quest for knowledge in plant science with particular reference to the ornamental plants. Within this building are facilities which will allow the conduct of studies in plant genetics and in the physiology and biochemistry of ornamental plants including turfgrasses.

The heart of the installation is six controlled environment rooms for plant growing. Each of these rooms is supplied with dirt-filtered, smog-filtered, washed air at a controlled temperature and humidity. All air from the room is circulated through an air-conditioning unit every two minutes and 10% new air constantly introduced. This means that every 20 minutes the air is completely renewed. Temperatures are controllabIe to ±1° F. Each room then operates at an automatically controlled temperature and humidity.

Each room is divided by light-tight partitions into 4 chambers. The ceiling of two of the chambers is a solid bank of fluorescent light(with a few incandescent lights) with an output of 2000 foot candles. In these chambers it is possible *to* grow plants through their entire life cycle. The other two chambers are equipped with low intensity fluorescent and incandescent lights which are used for photoperiod studies. All lights are automatically turned off and on by time clocks. The envelope temperature of the fluorescent rubes in rhe high light intensity chambers is kept constant at most efficient operating temperature regardless of room temperature. To accomplish this the lights are separated from the chamber by a glass ceiling and the temperature is controlled above this ceiling by an automatic damper and blower system which allows cooling air to pass over the lights when necessary.

Attached to these controlled environment chambers are two 36' x 95' free span greenhouses of steel frame and aluminum bar construction. One of these is divided into three chambers which allows for 3 temperatures. All chambers are ventilated with smog-filtered, evaporative-cooled, forced air. The greenhouse has a concrete floor which facilitates moving plants on carts to and from the controlled environment rooms and between chambers. With the three greenhouse chambers and the controlled environment rooms, it is possible to subject plants to numerous combinations of well controlled environments. Experience at the Earhart Plant Research Laboratory of the California Institute of Technology has proven the worth of such controlled environments for plant research.

Laboratories are located on the floor above the controlled environment rooms. There are five office-laboratories for individual staff members. There is a general biochemistry laboratory, a small "hot" lab for preparation of radioactive plant materials, a counting room for radioactive counting, a, general cytology-anatomy laboratory, and a sterile culture laboratory with a transfer chamber.

A small secretary-receptionist office, a conference room, and a plant and soil handling area complete the facility except for the machinery rooms and service areas.

The total floor area, including the greenhouses is 11,692 sq. ft.

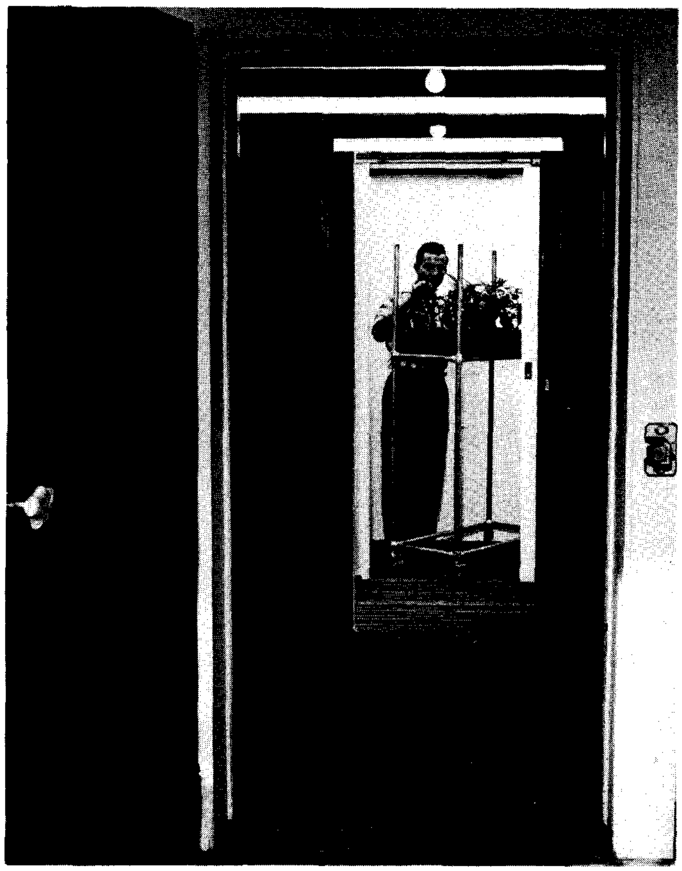

Fig. 1. Inside view of one of the controlled environment growing chambers showing the four compartments divided by sliding doors.

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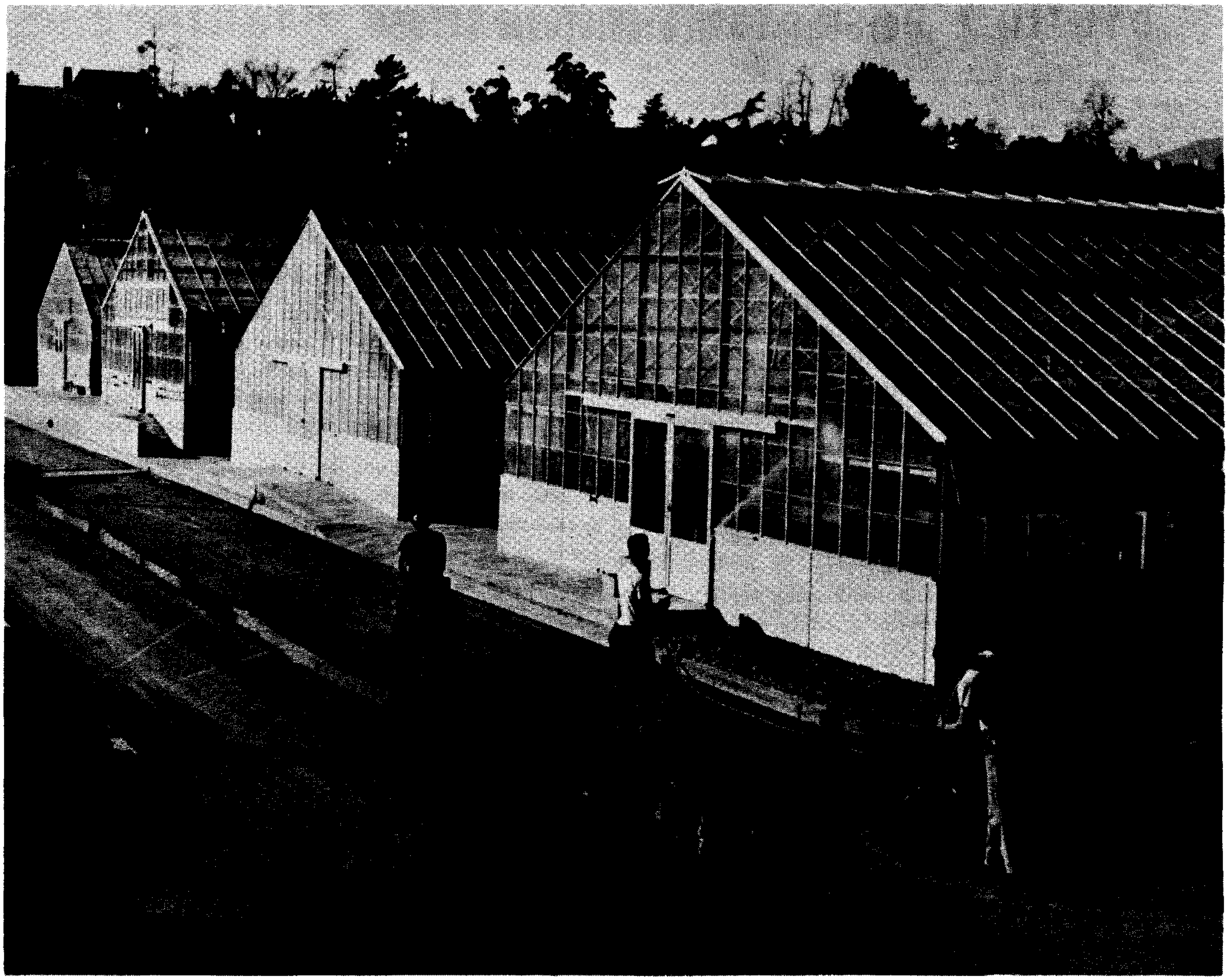

Pig. 2. The new controlled temperature greenhouses.

Specifications for Sprinkler Installations

The Irrigation Sprinkler Contractors Association, Inc., has prepared a 15-page guide to assist in the preparation of specifications for sprinkler system installations. It appears to be an excellent outline of the subject, well prepared and complete. The guide is divided into three main sections, (1) General Specifications (2) Material Specifications (3) Installation Specifications. The back page presents a nine-point code of ethics for members of the Association.

Copies may be obtained from the Irrigation Sprinkler Contractors Association, Post Office Box 5180, Metropolitan Station, Los Angeles 55, California.

Addition to List of Nurseries Selling Improved Vegetatively Propagated Turfgrasses

Dennis Seed and Zoysiagrass Company
7461 Laurel Canyon Blvd.
Nortb Hollywood, California

ZOYSIAGRASSES
- Emerald
- Matrella
- Meyer
- Tenuifolia

BERMUDAGRASSES
- Everglades #3
- Sunturf (Magennisii)

Crabgrass Control Tests - 1959

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A large number of new herbicides for crabgrass control were introduced by the chemical industry for sale or testing during the 1959 season. The excellent results obtained with calcium arsenate in 1958 tests at several experiment stations, including California, stimulated the interest of the industry so that a number of companies are now manufacturing calcium arsenate herbicides.

The UCLA tests were conducted on an area of bermuda turf near the campus which had been heavily infested with crabgrass in 1958. Small additional tests were run on dichondra and bentgrass turf in the Ornamental Horticulture Area. Most tests were replicated four times. Because of the dry mild winter and spring crabgrass seed germination was erratic, starting several weeks earlier than usual and never reaching a peak germination period. This caused results of the tests to be less conclusive than they might have been otherwise. The promising materials are discussed briefly below.

Calcium Arsenate. Several companies contributed calcium arsenate formulations for testing. All of these produced acceptable crabgrass control. Bermudagrass and bentgrass were not harmed by any of the products beyond a temporary discoloration. One product which contained less than 0.5% water soluble arsenic caused no injury or discoloration to dichondra, clover or any of the grasses in the tests. However, those containing approximately 5% water soluble arsenic were highly toxic to dichondra and clover as well as discoloring the grasses. Thus it appears that any calcium arsenate formulation for general dichondra and turfgrass application should be low in soluble arsenic, preferably not more than 0.5%. Rates which applied approximately 3 to 4 lbs. of arsenic as metallic gave good crabgrass control with a single winter application, Lead arsenate also effectively controls crabgrass but generally requires higher rates and costs nearly twice as much. Both lead and calcium arsenate are dangerous poisons and should be handled carefully. Arsenic may accumulate in the human system until it reaches an injurious level.

Calcium arsenate materials were submitted by the following companies: 0. E. Linck Company, California Spray Chemical Company, Chipman Chemical Company and Germains Seed Company.

Halt. The active ingredient in this product is technical chlordane on a fine vermiculite carrier. Good crabgrass control was achieved at the rate recommended by the manufacturer (0. M. Scott and Sons). No injury was observed on turfgrasses or dichondra and only slight burning of clover.

DAC 893. A new herbicide manufactured by the Diamond Alkali Company. The name of the active ingredient, given to the Department on a confidential basis, cannot be released until company approval is given. It was submitted for testing as a 50% wettable powder to be applied at the rate of 5 to 10 lbs. of the active per acre. Complete crabgrass control was achieved with a single application at 7 1/2 lbs. active per acre. Only slight injury to clover was noted and none to the grasses. It was not tested on dichondra. Human toxicity is reported to be very low.

L-13489. This new herbicide manufactured by the Eli Lilly Company was submitted for testing as a 50% wettable powder and an 8.3% granular. The name of the active ingredient of this product was also given as confidential. The wettable powder gave nearly complete crabgrass control at 8 lbs. per acre in a single early spring application. This chemical appears to be effective as either a pre-emergence and early post-emergence herbicide. Human toxicity is reported to be low. A related compound L-09726 was not as effective. No injury to the turfgrasses from either compound was observed.

Several other herbicides included in the tests did not give the desired crabgrass control. In the case of at least two of them this may have been because the materials were late in arriving so that applications were made after a fair amount of crabgrass seed had germinated.

Pre-emergence herbicides must be applied by early February to ensure success in Southern California. Many chemical companies not located in this area are not aware of this fact and submit their products for testing too late in the season to be included.