

**REPORT  
ON**



# **Turfgrass Research**

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**Turfgrass Research Committee  
Agricultural Experiment Station  
The University of Arizona  
Tucson**

1962 REPORT ON TURFGRASS RESEARCH

TURFGRASS RESEARCH COMMITTEE

AGRICULTURAL EXPERIMENT STATION

THE UNIVERSITY OF ARIZONA

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## THE DISTRIBUTION AND CONTROL OF THE BERMUDAGRASS ERIOPHYID MITE

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The bermudagrass eriophyid mite, Aceria neocynodonis Keifer,<sup>1</sup> is widely distributed throughout the Southwest and is becoming established in the Southeast. The presence of the mite is easy to observe due to the characteristic injury it does to the bermudagrass, but special techniques are needed to evaluate the quantitative mite populations and grass growth. Control experiments have been conducted during the fall, spring and summer, as apparently different factors affect treatments at these seasons. The following report discusses the observations made on these subjects in Arizona during 1962.

### Distribution of the mite

Aceria neocynodonis, as of December 1962, is present in California along the Coast in the Los Angeles area, north of Tehachapi in Porterville, and throughout the southern desert valleys. It has been found in Las Vegas, Nevada, throughout southern Arizona, in New Mexico and in the western part of Texas. Infestations are present in Florida and Georgia, and all indications point to an eventual distribution of the mite in bermudagrass growing areas across the entire southern portion of the United States. The mite has also been collected in Australia and Rhodesia. Dr. H. H. Keifer (personal correspondence) believes that it is likely that Africa was the origin of this mite, since Cynodon presumably originated in Africa.

### Techniques for evaluating treatment effectiveness

Tuttle and Butler (1961) briefly described a technique using a modified "Berleze funnel" to hold samples of grass and from which the mites dropped into petri dishes for counting. During the 1962 season this technique did not work and it became apparent that considerable research and development is needed to improve this procedure. A major problem is to make the conditions in the container unfavorable so the mites migrate down and out of the grass. Apparently if conditions are not favorable, the mites tend to move further into the leaf sheaths and die there. Preliminary studies with the separation of mites in liquids do not appear practical. Other complicating factors in the quantitative evaluation of mite populations are the extreme variability of the infestations in space and time, *i.e.*, stems from a single plant may vary from extreme damage to no damage, and heavy damaging mite populations often "disappear" suddenly. This natural reduction of the mite populations from untreated plots has led to the discarding of over half of our experimental plots, particularly during the mid-summer.

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<sup>1</sup>H. H. Keifer, D. M. Tuttle and the author will submit this common name to the Committee of Common Names of Insects, Entomological Society of America.

Two types of ratings were used with success, particularly during the spring and early summer. One was a rating of the mite injury to the grass which was made by feeling the grass and noting the presence of clumps of injured stems. Plots with no mite injury were rated as 1. If just a few plants had injury, the rating was 3. More severe infestations were rated from 5 to 7, and finally the most severe infestations were rated as 9. A second type of rating was used to compare the appearance of the grass from approximately 20 to 30 feet away. Plots which did not appear greener than the untreated areas were rated as 1. Plots with dark green growth were rated as 9. This rating, of course, was one which measured the practical aspect of the treatments, i.e., promotion of green grass. It should be kept in mind that a low rating for mites is "good," while a high rating for appearance is "good."

### Review of past work

The bermudagrass eriophyid mite has been a pest of bermudagrass lawns in Arizona particularly in the late spring and early summer. Observations in September 1960 indicated that well-fertilized bermudagrass was more seriously injured by mites (Tuttle and Butler, 1961). Experiments in the spring of 1961 showed that fertilizer and insecticide combinations gave the best spring regrowth of the bermudagrass. Insecticides applied alone in the spring did not promote regrowth of mite-infested grass, or apparently even give effective mite control. Grass became greener with a treatment of an iron chelate, as well as with ammonium sulfate, irrespective of the use of insecticides. Preliminary indications also showed that insecticide applications made in the fall reduced mite injury the following spring (Butler, 1961). Experimental work in 1962 was designed to evaluate fall, spring and summer treatments for mite control and upon turfgrass appearance.

### Effect of fall insecticide treatments

In the fall of 1961, plots were set up on eight bermudagrass lawns in various parts of Tucson to evaluate the effectiveness of fall diazinon treatments on the infestation of mites in the spring. One of the experiments showed a visible beneficial effect of the treatments, one showed no effect and the others did not have mite infestations. The "effective" experiment was located on three sides of the "Fertilizer and Overseeding Experiment" at Randolph Park in Tucson. Materials were applied on October 18, 1961. Diazinon as Spectracide<sup>R</sup> (12.5% diazinon) was sprayed at 15 and 30 cc. per gal. per 200 sq. ft. with a Hudson tank-type sprayer with 6508 Tee-jet nozzle. Diazinon as a 5% granular formulation was shaken on the plots at the rate of 1 and 2 lbs. per 200 sq. ft. The plots were 10 feet wide and 20 feet long and each treatment was replicated four times. On May 15, 1962 a rating of the mite infestation was made with no visible injury as 1 and severe injury as 9. The results are given in Table 1.

Table 1. The effect of fall insecticide treatments on the bermudagrass eriophyid mite. Randolph Park, Tucson, Arizona. Treated October 18, 1961 and rated for mite injury on May 15, 1962.

<u>Treatment</u> <u>Amount per 200 sq. ft.</u>	<u>Average rating of</u> <u>mite damage</u>
Diazinon, 5% granular 2 lbs.	1
Diazinon, 5% granular 1 lb.	2
Diazinon 12.5% E.C. 30 cc./gal.	3
Diazinon 12.5% E.C. 15 cc./gal.	3
Untreated	7

There was a clear indication that all the treated plots had less mite injury than the untreated plots. The granular treatments had a much greater amount of actual diazinon and gave the best effect while the two spray treatments were intermediate but of equal effectiveness. By June 5 there was no observable difference between any of the treatments.

One of the experiments showing no effect of fall insecticide treatments was located on a border at the Casa Grande Overpass Farm on a fertilizer experiment in which two bermudagrass varieties each had eight fertilizer treatments, with four replicates. On October 4, 1961, two of the replicates were sprayed with diazinon (12.5% Spectracide) at the rate of 120 cc. in 4 gallons of water on the 500 sq. ft. of each replicate. On May 8, 1962, a mite rating indicated that the 32 individual plots of treated and untreated Tifgreen grass had no mite infestation. The Common bermudagrass had an average mite rating of 5.8 and 6.0 in the two 8-plot diazinon sprayed portions and an average of 7.0 and 6.3 in the untreated portions. These results indicated the difference in the susceptibility to bermudagrass mite between these two varieties and the ineffectiveness of the fall diazinon spraying on the mite damage to the Common variety the following spring.

#### Effect of spring treatments

##### A. Insecticides, Fertilizers, Chelates alone and in combinations.

The effectiveness of spring chemical treatments for the control of the bermudagrass eriophyid mite and for promoting the greening of the grass was evaluated on three grass areas using 25 different combinations of materials. To simplify the discussion, the results obtained from the three areas will be discussed separately.

Some of the basic treatments and rates of application per 100 square feet were: 516 grams of ammonium nitrate (33.5% N, Brea); 430 grams of Urea-Sulfur (40% N, 10% S, Shell); 452 grams Urea Form (Uramite, 38% N, DuPont); 1 lb. ammonium sulfate (21-0-0, Elephant Brand); 2 lbs. Wacco Sulfasoil (42% iron, 20% sulfur, 3% manganese, 1.25% zinc); 2 lbs. Organo Rose Food (4-12-4 with

138 Sequestrene, bloodmeal, manures, sulfur, zinc and manganese); 45 grams Tru-green (organic iron chelate); 28 grams Sequestrene 138 (Geigy); 45 grams Sequestrene 330 (Geigy); 10 oz. and 5 oz. Ethion (8% granular, CR-B-49, Niagara); and diazinon at 1 lb. and 1/2 lb. 5% granular, 1/2 and 1/4 oz. 12.5% emulsifiable concentrate (Spectracide, Geigy) and a mixture of 12.5% diazinon and 1% Mitox (Ortho) at 1/2 oz. In addition, there were several combinations of the fertilizers with diazinon sprays or granules at the same rates as when used alone.

The fertilizers were shaken on the 100 sq. ft. plots from paper bags. The iron chelates were sprayed with a hose proportioner sprayer using 2 gallons of water per plot. The insecticide sprays were also applied with a hose proportioner using 1 gallon of water per plot. The granular insecticides were shaken from a quart jar with holes in the lid. The treatments were applied to plots on the University's Overpass Farm on April 4 and on April 5 to plots at Cragin School and at Randolph Park.

The first observations at the University Farm indicated that within one week the plots treated with Sequestrene 138 and 330, with and without diazinon, showed a distinctly greener appearance. The Organo Rose Food, with Sequestrene 138, did not appear greener. The greening effect of the iron chelates did not last more than a few weeks.

On May 23 a rating of the mite injury was made at the University Farm. The plots with fertilizers or chelates were rated for mite injury and had a combined average of 7.4, which indicated severe mite damage. The plots with fertilizers and chelates combined with diazinon spray had an average mite injury rating of 4.2. No additional information was obtained as all the plots in both lawns appeared similar.

Experimental plots at Randolph Park were located in an area with a low level of fertility and the grass was severely infested with mites. Ratings of the severity of the mite injury were made, as well as the green appearance of the grass. A summary of the effect of spring treatments for the control of the bermudagrass mite, as determined by the presence of mite-infested grass and by the promotion of greener grass, is shown in Table 2. The ratings are averages of readings from two replicates made for mite injury on May 8, 15, 21; June 5 and 14, and for greenness observations on May 1, 15, 21 and June 5. As observed in previous experiments, the insecticide treatments alone, except for the granular diazinon, did not give good mite control, but in combination with fertilizers, the extent of the mite damage was less. One of the best single treatments was Urea-Sulfur, which had fewer mites when used alone and in combinations with diazinon spray. It also appeared to "green up" the grass the best.

Another summary of these data is given in Table 3, in which the averages of ratings for several similar treatments are grouped. This clearly shows that for spring treatment of bermudagrass, the combination of fertilizer and insecticide is the best treatment for certain conditions of mite infestation and low soil fertility.

Table 2. The effect of spring treatments on the bermudagrass eriophyid mite. Randolph Park, Tucson, Arizona. Treated April 5, 1962. See text for dates observations were made.

<u>Materials</u>	<u>Amount per 100 sq.ft.</u>	<u>Average rating of mite damage</u>	<u>Average rating of greenness</u>
Ammonium nitrate 33.5% N	516 gms.	8.4	4.7
Urea-Sulfur 40% N, 10% S	430 gms.	6.6	6.3
Urea Form (Uramite) 38% N	452 gms.	7.2	2.9
Ammonium sulfate 21% N	1 lb.	8.0	5.0
Wacco Sulfasoil	2 lbs.	6.0	1.5
Organo Rose Food	2 lbs.	8.4	3.5
Sequestrene Fe330	45 gms.	7.2	1.5
Diazinon 5% granular	1/2 lb.	2.4	1.8
Diazinon 12.5%	1/2 oz.	7.0	2.0
Diazinon 12.5%	1/4 oz.	5.8	1.5
Diazinon 12.5% + 1% Mitox	1/2 oz.	6.4	1.5
Ethion 8% granular	10 oz.	7.0	1.5
Ethion 8% granular	5 oz.	6.4	1.5
Ammonium nitrate + diazinon	516 gms. + 1/2 oz.	4.0	7.4
Urea-Sulfur + diazinon	430 gms. + 1/2 oz.	3.0	7.0
Urea Form + diazinon	452 gms. + 1/2 oz.	6.0	4.0
Ammonium sulfate + diazinon	1 lb. + 1/2 oz.	5.6	5.6
Untreated		7.5	1.6

Table 3. The effect of spring treatments on the bermudagrass eriophyid mite. A grouping of treatments presented in Table 2. Randolph Park, Tucson, Arizona. Treated April 5, 1962. See text for dates observations were made.

<u>Combination</u>	<u>No. Treatment Averages</u>	<u>Average Mite Rating</u>	<u>Average Greenness Rating</u>
Diazinon sprays with fertilizers	4	4.9	6.0
Diazinon sprays and granular	4	5.4	1.7
Ethion treatments	2	6.7	1.5
Fertilizers alone	4	7.5	4.7y
Untreated	3	7.5	1.6

B. Insecticide, Fertilizer and Fungicide alone and in combinations.

A factorial experiment was designed to evaluate the effect of ammonium nitrate, diazinon granules and Captan fungicide on mite infestation and re-growth of the grass. The experiment was located in Randolph Park where the lawn was in need of nitrogen, had a rather severe infestation of mites, and had symptoms of disease. The materials and rates per 100 sq. ft. consisted of 258 grams of ammonium nitrate (33.5% N, Broya), 1/2 pound of 5% diazinon granules and/or a spray of 2 tablespoons of Ortho Lawn Spray (60% Captan, 5.3% cadmium carbonate, 3% BHC and 1.95% iron) in approximately 1/2 gallon of water applied with a Hudson 2-gallon tank-type sprayer with a 6508 Tee-jet nozzle. The plots were 10 x 10 ft. and each treatment was replicated four times. The materials were applied on May 17, 1962.

Ratings of mite injury and greenness of the grass were made on June 14. There was considerable variation in the ratings within treatments but there are some trends that are worth reporting. The treatment including all three materials gave the best mite control and appearance of the grass. The treatments including diazinon averaged better mite control than the other materials and, as might be expected, the ammonium nitrate treatments gave the best grass color. The data are shown in Table 4.



Table 4. The effect of spring treatments on the bermudagrass eriophid mite. Randolph Park, Tucson, Arizona. Treated May 17, 1962.

<u>Materials</u>	<u>Average rating of mite damage</u>	<u>Average rating of greenness</u>
Diazinon + ammonium nitrate + Captan	1.0	8.5
Diazinon	2.0	3.0
Diazinon + Captan	2.5	2.5
Diazinon + ammonium nitrate	3.0	9.0
Untreated	4.0	4.0
Captan	5.5	1.5
Captan + ammonium nitrate	7.5	8.0
Ammonium nitrate	8.0	6.5

Averages for groups of materials

All these materials in treatment	1.0	8.5
Diazinon treatments	2.5	4.8
Captan treatments	5.4	4.0
Ammonium nitrate treatments	6.2	7.8
Untreated	4.0	3.0

C. Comparison of Granular Insecticide Treatments.

The effect of various granular formulations on mite injury was evaluated in an experiment also at Randolph Park. The materials and rates per 100 sq. ft. consisted of 5, 10, and 15 ounces of 8% Ethion (Niagara, CR-B-49; 2-6-62), 1/2 and 1 pound of 5% Zectran (Dow, Formulation M2049), and 1/8, 1/4, 1/2 and 1 pound of 5% diazinon granules (Geigy), 1/4 pound of 10% diazinon granules (Geigy), and a single spray treatment of 1/2 ounce of diazinon emulsifiable concentrate (12.5% diazinon, Spectracide) in a Hudson 2-gallon tank-type sprayer with a 6508 Tee-jet nozzle. The plots were 10 x 10 feet and each treatment was replicated four times. The materials were applied on May 17, 1962.

Ratings of the mite injury were made on June 14. There was considerable variation of the ratings within the treatments but some general trends are of interest and summarized in Table 5.

Table 5. Comparison of granular insecticides for bermudagrass eriophyid mite control. Randolph Park, Tucson, Arizona. Treated May 17, 1962.

<u>Material</u>	<u>Amount per 100 sq. ft.</u>	<u>Rating of mite injury on June 14</u>
Diazinon 5% granular	1 lb.	1.0
Diazinon 5% granular	1/2 lb.	1.5
Diazinon 10% granular	1/4 lb.	2.0
Diazinon 5% granular	1/4 lb.	3.0
Diazinon 5% granular	1/8 lb.	6.0
Ethion 8% granular	15 oz.	3.75
Ethion 8% granular	10 oz.	4.5
Ethion 8% granular	5 oz.	5.5
Zectran 5% granular	1 lb.	5.5
Zectran 5% granular	1/2 lb.	5.0
Diazinon 12.5% EC	1/2 oz.	5.0
Untreated		4.5
		7.5

Effect of summer insecticide treatments

Two experiments were set up in August to compare the effectiveness of a number of insecticides for bermudagrass eriophyid mite control. There were no useful results obtained from either of these experiments although field ratings were made and grass samples taken and processed for mite counting.

One explanation of the irregular variations in the mite populations was that the plots were flood irrigated. It is very possible that flood irrigation affects the populations, as heavy summer rains have in past years. There is also the probability that there are predatory mites affecting the bermudagrass mite populations, as discussed by Butler (1961).

Due to the lack of new information, the conclusions indicated by the 1961 report still stand. The recommended bermudagrass eriophyid mite control treatment in the summer is one ounce of 12.5% diazinon in one gallon of water per 200 square feet. Dusting sulfur may also be used. Promising materials include Eradex, Ethion, Phostex, Thiodan and Zectran. Formulations of Tedion, malathion and Dibrom appear to be relatively ineffective.

Literature cited

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VARIATIONS IN RESPONSE OF BERMUDAGRASS STRAINS TO BERMUDAGRASS ERIOPHYID MITE INFESTATIONS

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Bermudagrass strains were observed in 1960 and 1961 to respond very differently to natural infestations of the bermudagrass eriophyid mite, Aceria neocynodonis Keifer. Detailed results of the 1961 observations were reported in the 1961 Report on Turfgrass Research (Ariz. Agr. Expt. Sta. Rpt. 203: 15-19).

The same plots at the University's Casa Grande Overpass Farm were used in 1962, except that only two replicates were used. Ratings of mite injury to plants were made on May 8, 22, 31, June 7, 14 and August 2. Plots were rated from 1-least to 9-most mite damage.

In general, the mite infestation was not as severe in 1962 as 1961. Eight strains were not rated in 1962 because of loss of stand. In several cases, the reduction in stand was probably primarily due to severe mite infestations. Mite damage was most severe in 1962 at the time of the May 22 observations. A summary of the average ratings of mite injury to various bermudagrass strains made in May and June is given in Table 1. The numbers in parenthesis are the 1961 average ratings.

Table 1. A summary of the ratings of bermudagrass eriophyid mite injury to various bermudagrass strains grown in field plots. Tucson, Arizona. May and June 1962. \*

			Rating of 1			
B12 P.I.	210 979	(1)	B114 K1-51 (Kan.)	(2)	B146 3Com.sel.(i3)	(1)
B15 P.I.	213 383	(1)	B116 Everglades	(2)	B147 Tiffine	(2)
B16aP.I.	213 385	(1)	B118 K9 (Kan.)	(1)	B148 Tiflawn	(2)
B16bP.I.	213 385	(1)	B119 Florida 8	(1)	B153 Mex. sel.	(2)
B18 P.I.	213 388	(1)	B120 K24-54 (Kan.)	(2)	B154 Mex. sel.	(1)
B19 P.I.	213 389	(1)	B123 Q-2 (Kan.)	(1)	B163 PI 225 595	(1)
B33 P.I.	224 140	(1)	B124 Texturf 10	(1)	B164 PI 213 385	(2)
B34 P.I.	224 141	(1)	B126 Gene Tift	(1)	B165 PI 224 694	(2)
B38 P.I.	224 145	(1)	B127 M6 (Kan.)	(1)	B167 K2-51 (Kan.)	(1)
B39 P.I.	224 146	(1)	B129 Common (W)	(1)	B168 <u>C. incompletus</u>	(1)
B42 P.I.	224 149	(2)	B130 T-8 (Kan.)	(1)	B169 African Int.	(1)
B44 P.I.	224 151	(1)	B131 Tifway	(1)	B170 Mt. Rainier	(1)
B52 P.I.	224 694	(1)	B132 Common sel.(J)	(2)	B173 P-16 (Kan.)	(1)
B61 P.I.	225 809	(1)	B133 Common sel.	(1)	B175 S-16 (Kan.)	(1)
B71 P.I.	258 846	(1)	B134 Common sel.(4)	(1)	B176 F-7 (Kan.)	(1)
B102 Tifgreen		(2)	B136 Royal Cape	(1)	B177 C-7 (Kan.)	(1)
B104 <u>C. magennisii</u>		(2)	B137 T 4 (Kan.)	(1)	B178 R-8 (Kan.)	(1)
B105 Dooley 1		(1)	B139 H-8 (Kan.)	(1)	B179 E-5 (Kan.)	(1)
B107 Tex 22		(1)	B140 J-5 (Kan.)	(1)	B180 B-1 (Kan.)	(1)
B110 Texturf 1F		(2)	B141 N-5 (Kan.)	(1)	B181 E-1 (Kan.)	(1)
B111 <u>C. bradleyi</u>		(1)	B142 T. Common(T)	(1)	B263 M.S.U. (Mich.)	(1)
B112 Ugandagrass		(1)	B143 Snyder	(1)	B285 Greenfield	(1)
B113 Ohio		(1)	B145 2Com.sel.(i2)	(1)		

Table 1. (cont.)

		Rating of 2			
B22 P.I. 213 391	(1)	B128 G-11 (Kan.)	(2)	Giant seed G1	(2)
B115 Q 17 (Kan.)	(1)	B159 Mex. sel.	(3)		
		Rating of 3			
B 32 P.I. 214 139	(1)	B144 Com. sel. (il)	(4)	Common seed C2	(5)
B103 U-3	(1)	B152 Mex. sel.	(4)		
B121 Florida 50	(4)	B174 O-8 (Kan.)	(1)		
		Rating of 4			
B 138 Brunswick	(5)	B162 P.I. 224 131	(3)	Common seed C1	(4)
		Rating of 6			
B122 Ormond	(4)	B156 Mex. sel.	(6)		
		Rating of 8			
B108 Tex. 8	(5)	B135 T-11	(5)		
Not Rated - Poor Stand					
B23 P.I. 213 457	(7)	B56 P.I. 225 126	(1)	Seed from U-3	(5)
B36 P.I. 224 143	(2)	B101 K23-54 (Kan.)	(6)	Common seed C3	(6)
B49 P.I. 224 691	(4)	B265 Los Mochis	(5)		

\* Number in parenthesis is average 1961 mite injury rating.

## FERTILIZATION OF TWO VARIETIES OF BERMUDAGRASS

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An experiment on nitrogen fertilization of Common and Tifgreen bermudagrass, which was established in September of 1960, was continued throughout 1962. The main purpose of the experiment was to compare the effectiveness of various carriers of nitrogen for the two varieties. The plot was located on a Gila fine sandy loam soil on the Casa Grande Overpass Farm, field L. border 14.

### Effect of previous year's fertilizer program on soil nitrate

Soil samples were taken before fertilization on March 16 at depths of two and twelve inches. The purpose was to determine nitrate content of the soil as affected by the previous year's treatments and depth of sampling (Table 1).

There was a highly significant difference in nitrate content resulting from the previous year's treatments. Urea-sulfur, urea, ammonium sulfate and ammonium nitrate gave the highest nitrate values for both sampling depths although the twelve-inch sample was consistently lower in nitrate than the two-inch samples. Since this was true for all treatments as well as the check, most of this difference in nitrate content at the different depths was apparently due to the higher organic matter content of the surface soil. The data shows that fertilization can provide some available nitrogen over a relatively long period, even in a fairly coarse-textured soil.

### Experimental procedure, 1962

Treatments and rates of fertilization in 1962 were generally the same as in the previous year with some exceptions. One new fertilizer, Aqua Humus, was substituted for urea-formaldehyde. Other materials included ammonium nitrate and ammonium sulfate, both common inorganic fertilizers which leave an acid reaction in soils. Also used was calcium nitrate which leaves a basic soil reaction. Nitrate nitrogen is recognized as being readily available to plants and subject to leaching losses. Ammonium nitrogen is not subject to leaching although ammonium is rapidly converted to nitrate in warm soils. Urea, another fertilizer used in the experiment, generally is converted to ammonium and then to nitrate in soils and thus tends to provide available nitrogen over a longer period of time than the three inorganic fertilizers mentioned previously. Both ammonium and urea nitrogen can be taken up by plants to some extent but nitrate is considered to be the form of nitrogen of highest availability. Another fertilizer used was urea-sulfur, a commercial mixture containing 40 percent urea nitrogen and 10 percent elemental sulfur. Aqua Humus, an organic type fertilizer used, contains 12 percent total soluble nitrogen (5 percent ammonical, 6 percent urea, and 1 percent humic nitrogen), 9 percent available  $P_2O_5$ , and 6 percent available  $K_2O$ . Milorganite is an organic fertilizer composed of activated sewage sludge; therefore, the release of available nitrogen depends on the microbiological activity in the soil.

During the summer of 1961 the plots were to be fertilized eight times, giving a total application of 1.5 pounds of nitrogen per 100 square feet. This means that approximately 0.19 pounds of nitrogen per 100 square feet was applied each time. During 1962, the rate of application was the same; however, the plots were fertilized only when it was apparent that nitrogen was needed, instead of the regular schedule of the previous year. This would provide a picture of nitrogen requirements as seen, in many instances, by the home owner and others concerned with turf fertilization. This resulted in a lower total application of nitrogen for the year since the plots were fertilized only four times during the season, namely March 16, June 20, August 9, and October 12. With this schedule most plots could have used more nitrogen than was applied. Also an application of 0-45-0 at a rate of 1,000 pounds per acre was made on August 9 to all plots to insure a sufficient supply of available phosphorus.

#### Results of 1962 fertilizer program

A capacitance meter<sup>1</sup> was used by Turner (see Report on Turfgrass Research 203, 1961) to measure density of Common bermudagrass at Randolph Park. He found a good correlation between clipping weights and capacitance readings. Capacitance meter reading, clipping weights, and visual observations were used to determine turf quality in 1962 (Table 2).

There was a highly significant difference in clipping weights as a result of the various fertilizer treatments. Up to the end of July the urea-sulfur treatment was the best, especially for the Tifgreen variety, as shown by all three measurements. The other fertilizers, with the exception of Milorganite, provided good response but great differences were not found. Calcium nitrate did appear to be the least beneficial of the remaining fertilizers, probably because it is more subject to leaching losses than the others. Milorganite did not provide good early season growth and clipping weights were not significantly greater than the check, although both capacitance determinations and visual observations showed better growth than the check.

After the second week in July the urea-sulfur plots were no longer outstanding and the Milorganite plots looked better than those with other fertilizers. The check plots did not produce much growth throughout the season and the color was light green to yellow as expected with a severe nitrogen deficiency.

There was a consistent difference between turf density (capacitance reading) of the check as compared with the fertilized plots for both varieties. Differences in density with the various treatments agreed fairly well with clipping weights and visual observations, indicating this to be a good measure of turf quality. The capacitance meter, therefore, appears to be a very useful tool for rapidly measuring turf density without cutting or otherwise disturbing the grass.

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<sup>1</sup>See Joel E. Fletcher and Max E. Robinson. A Capacitance Meter for Estimating Forage Weight. Jour. Range Mangt. 9:96-97. 1956.

Soil samples (2 inches) were taken from all plots on August 2 and October 31 for nitrate and soil pH determinations (Table 3). During the first week of August the grass was growing slowly, apparently because of a lack of available nitrogen. Soil samples were taken to show if there was any difference in nitrate content as a result of previous fertilizations and to show the overall nitrate levels. Although the grass was growing slowly at this time, the fertilized plots were considerably greener than the check.

There was a statistically significant difference in nitrate content of both sets of soil samples as a result of the previous fertilizer treatments. The treatments which resulted in the highest nitrate concentrations were urea-sulfur, Aqua Humus, ammonium nitrate, urea, and ammonium sulfate. Nitrate values from the calcium nitrate and Milorganite plots were not significantly greater than those of the check.

Soil pH was determined to show if enough of the different fertilizers had been applied to alter the soil reaction. Any acidification of an alkaline soil could be of value in preventing mid-summer chlorosis which often appears on certain grass varieties. Soil pH values did not change, however, as a result of the small amount of fertilizer applied. Average pH values were approximately 7.7.

#### Summary

Soil samples taken in the spring before fertilization showed that plots that had been fertilized the previous summer were higher in nitrates than the check plots. Several nitrogen fertilizers were used on Common and Tifgreen bermudagrass in 1962. It was found that urea-sulfur gave the best results on both varieties for the first half of the season while Milorganite gave very good results later in the year. However, ammonium nitrate, ammonium sulfate, and urea gave good results throughout the season. Calcium nitrate gave the shortest lasting response of the fertilizers used. The capacitance meter gave a good indication of differences in turf quality for both varieties of bermudagrass.



TABLE I

Effect of depth of sampling and previous treatment on nitrate content of soil under Common bermudagrass, sampled March 16, 1962.<sup>1</sup>

Treatment	ppm NO <sub>3</sub>	
	2 inch depth	12 inch depth
Check	20.8	14.0
Ammonium Nitrate	33.0*	27.0*
Ammonium Sulfate	38.3*	26.8*
Calcium Nitrate	29.0	18.8
Urea	41.8*	26.8*
Urea-Sulfur	54.3*	35.5*
Urea-Formaldehyde	26.5	23.3
Milorganite	32.8*	19.3
LSD <sub>05</sub>	11.3	7.8

\*Significant over the check at the 5 percent level

<sup>1</sup>Average of four replicates

TABLE II

Clipping weights, capacitance (density) readings, and visual observations of Common and Tifgreen bermudagrass.

Treatment	Common			Tifgreen		
	Clipping Weights <sup>1</sup>	Capacitance Readings <sup>2</sup>	Visual Rank <sup>3</sup>	Clipping Weights <sup>1</sup>	Capacitance Readings <sup>2</sup>	Visual Rank <sup>3</sup>
Check	130.8	52.7	4.00	12.8	50.2	3.8
Ammonium Nitrate	250.5*	64.3	6.0	46.3*	57.2	5.0
Ammonium Sulfate	254.2*	64.0	6.5	40.8*	60.5	5.0
Calcium Nitrate	227.5*	60.4	5.5	46.3*	57.9	5.3
Urea	300.0*	64.1	6.8	56.0*	57.9	5.5
Urea-Sulfur	291.0*	68.6	7.8	85.3*	67.4	7.0
Aqua Humus	324.5*	68.2	7.0	52.3*	55.4	6.3
Milorganite	187.0	56.1	6.5	25.8	54.0	4.3
LSD <sub>05</sub>	58.9			28.0		

\*Significant over the check at the 5 percent level

<sup>1</sup>Grams dry weight from 18 square feet, cut on July 3, average of four replicates.

<sup>2</sup>Average of four replicates, two determinations per plot, June 25

<sup>3</sup>Ranked 1 to 9, poorest to best, on June 25.

TABLE III

Soil nitrate concentration and pH as affected by previous treatment with two varieties of bermudagrass.						
Treatment	Common			Tifgreen		
	ppm NO <sub>3</sub>		Soil <sup>2</sup>	ppm NO <sub>3</sub>		Soil <sup>2</sup>
	Aug. 2	Oct. 31	pH	Aug. 2	Oct. 31	pH
Check	15.6	31.9	7.7	13.2	31.9	7.7
Ammonium Nitrate	24.9*	60.2*	7.7	24.2*	31.9	7.7
Ammonium Sulfate	26.0*	50.0	7.7	16.2	42.5	7.6
Calcium Nitrate	20.6	39.4	7.7	16.7	36.3	7.7
Urea	25.6*	53.5*	7.7	16.1	44.7	7.7
Urea-Sulfur	24.8*	52.7*	7.7	22.5*	53.5*	7.7
Aqua Humus	29.4*	42.9	7.6	28.9*	56.6*	7.6
Milorganite	20.0	49.1	7.6	16.9	38.9	7.7
LSD <sub>05</sub>	8.8	19.9		6.9	15.8	

\*Significant over the check at the 5 percent level

<sup>1</sup>Average of four replicates

<sup>2</sup>Soil pH determined on a saturated paste.

## EVALUATION OF BERMUDAGRASS VARIETIES AND STRAINS

A. A. Baltensperger  
Department of Agronomy

The bermudagrass variety and strain experiment reported in Turfgrass Research Report 203<sup>1</sup> has been continued through 1962. Many of the 96 strains, evaluated over three years, are being used in the bermudagrass breeding program. Several of the varieties included in the test are being used in the state of Arizona for turfgrass.

A brief summary of the performance of several varieties managed as general purpose turfgrass is as follows:

1. Seeded varieties -- Common was generally equal or superior to the other seeded varieties tested. Common is established easily, recovers from adverse conditions and abuse rapidly and generally has few disease problems. On the negative side Common is very susceptible to bermudagrass mite and may easily develop poor color.

2. Sprigged varieties -- Tifgreen, Tifway, B181, B142, Ormond and B145 were high in general performance. All had good color and provided satisfactory turfgrass in the Tucson area. Limitations of Tifgreen and Tifway are that they are subject to thatch formation and Tifgreen is susceptible to summer blight. Ormond is susceptible to bermudagrass mites.

For detailed performance data on bermudagrass varieties see Turfgrass Research Report 203.<sup>1</sup>

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<sup>1</sup>Baltensperger, A. A. Evaluation of Bermudagrass Varieties and Strains. Agric. Exp. Sta. Turfgrass Research Report 203. University of Arizona, Tucson, Arizona. 1961.

REDUCE DORMANCY OF BERMUDAGRASS BY SOIL HEATING

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Synopsis

It is possible to keep bermudagrass green and growing during the winter at Tucson, Arizona, when artificial soil heating is used. In this experiment there was little or no observable damage noted in spring and summer growth from bermudagrass plots which were not allowed to go dormant.

Practical use of soil heating for keeping bermudagrass green during the winter may be possible; however, further experimenting should be done to ascertain the minimum amount of equipment and heat necessary under field conditions. It is expected that pipes carrying warm water may be equally effective in preventing winter dormancy of bermudagrass.

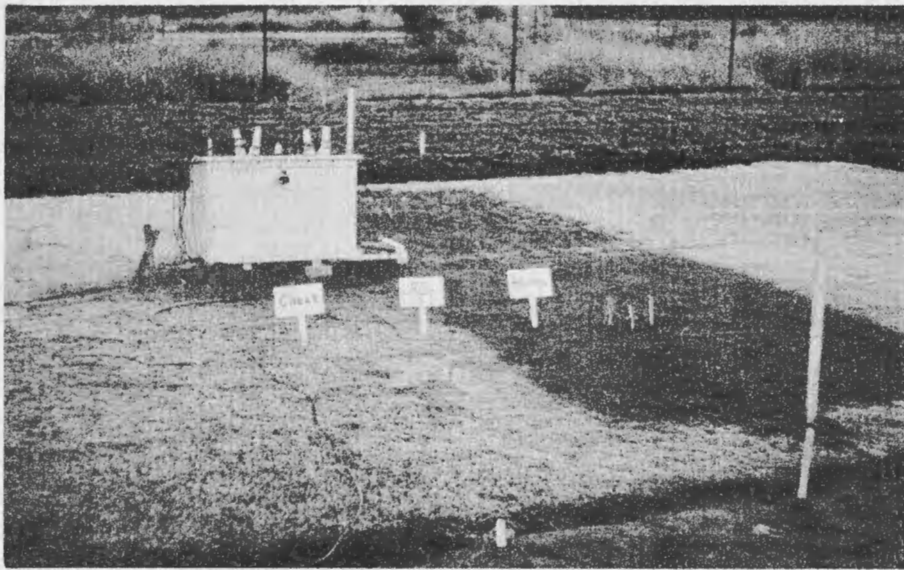


Figure 1. Heated plots remained green during cold periods.  
Picture taken 28 December 1961.

In conjunction with bermudagrass breeding for reduced dormancy, there has been interest in the effect twelve months of greenness would have on bermudagrass turf.

The principal objective of the experiment was to determine the effect of a lack of winter dormancy on spring and summer growth and quality of bermudagrass grown under turfgrass conditions.

Two varieties, Common and Tifgreen, were used. Plot size was six feet by ten feet. Common was clipped at one inch once a week and Tifgreen was clipped at 3/4 inch once a week. Heat was applied through electric resistance cables placed in the soil at a three inch spacing and at a three inch depth. Individual mercury thermostats were used to regulate the heating of the four heated plots. Soil heating equipment was installed about six months prior to heating which began in November, 1961. A 12 drop temperature recorder was set to record the temperature every 24 minutes at a given location. Temperatures were recorded with this instrument at the soil surface and at one inch and three inch depths.

The bermudagrass was well-established by late summer in 1961 and received general-purpose management prior to heating. The thermo-regulators<sup>1</sup> for the heated plots were set to go on when the soil temperature at one inch below the soil surface went below 70° F. This minimum temperature of 70° F. was used in order to insure that the bermudagrass in these plots would not become dormant. We believe 70° F. is somewhat in excess of that required to prevent winter dormancy under winter conditions expected at Tucson, Arizona, because the previous winter a trial heating indicated a minimum soil temperature of 65° F. at 1 inch below the soil surface was sufficient.

Average surface temperatures, days of frost and air temperatures are shown in Table 1. Surface temperatures were taken on the heated and unheated plots using the multiple drop temperature recorder. These temperatures represent the mean of four recordings per day (1:00 AM, 7:00 AM, 1:00 PM, and 7:00 PM) averaged for each month. Air temperatures are from official recordings taken near the experimental area. Heated plots averaged from 11° F. (Nov.) to 24° F. (Jan.) warmer than the unheated plots. March was a cooler month than normal for this station and averaged about 4° lower than the long time average. Data not presented which is important to winter dormancy of bermudagrass are temperatures freezing or below. Dates of temperatures 32° F. or below were as follows:

21 Nov. -- 28°	11 Jan. -- 26°
22 & 29 Dec. -- 32°	12 Jan. -- low 21°
4 Jan. -- 32°	15 Jan. -- low 28°
10 Jan. -- 29°	28 Feb. -- 27°

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<sup>1</sup>The author acknowledges the assistance of Mr. R. C. Jones and Dr. D. M. Anderson of the Agricultural Chemistry and Soils Department for technical assistance on thermo-regulator and electrical equipment installation.

Table 1. Mean monthly soil surface temperatures, number of days of frost, and mean minimum and maximum air temperatures at Plant Materials Center, Tucson, Arizona. 1961 - 1962.

	TEMPERATURES											
	Nov.		Dec.		Jan.		Feb.		March		April	
<u>Soil Surface</u>												
Heated	63		66		70		74		71		--	
Unheated	<u>52</u>		<u>49</u>		<u>46</u>		<u>53</u>		<u>51</u>		<u>--</u>	
Difference	11		17		24		21		20		0	
<u>Days of Frost</u>												
	11		11		8		2		4		0	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
<u>Air</u>	41	69	39	63	38	63	44	70	41	69	54	92

Heated and unheated plot temperatures at various depths in the soil are presented in Table 2. These figures also represent the mean temperature recorded at six-hour intervals (1:00 AM, 7:00 AM, 1:00 PM, and 7:00 PM) averaged for each month. The heated plot soil temperatures during December and January were as warm or warmer at six and twelve inches as in the immediate area of the heating cable. Frost was slight or absent on the heated plots.

The clipped weights presented in Table 3 indicate the large growth differences between heated and unheated plots. These figures are averages of weekly clippings expressed in grams of oven dry material per ten square feet. Color retention in the heated plots was satisfactory for all but about two weeks during early January.

Color retention scores are presented in Table 4. Greenness was scored from 1 - least to 9 - most. If the heated plot values are compared with the unheated plot values, the large differences for the four months -- December, January, February, and March -- is noted. The identical averages scores for the two varieties are interesting, especially on the unheated plots. Tifgreen has been reported to maintain slightly longer winter greenness than Common. The particular winter at Tucson may have been a factor. Heavy frosts in late November and a cool March may have resulted in less varietal variation being expressed. In late March the unheated plots began top growth and had similar color ratings to the heated plots during April.

Table 2. Mean monthly soil temperatures at 1, 3, 6 and 12 inches below the soil surface on heated and unheated plots at Tucson, Arizona. 1961 - 1962.

	SOIL TEMPERATURES					
	Nov.	Dec.	Jan.	Feb.	Mar.	Ave.
<u>Unheated</u>						
Below soil surface						
1 inch	53	50	46	53	51	51
3 inches	54	51	46	54	52	51
6 inches		50	50			
12 inches		52	52			
<u>Heated</u>						
Below soil surface						
1 inch	67	68	72	74	68	68
3 inches	70	72	74	76	73	73
6 inches		72	76			
12 inches		75	78			

Table 3. Mean weekly clippings removed from heated and unheated plots of Common and Tifgreen bermudagrass and expressed as grams of oven dry material per harvested area at Tucson, Arizona. 1961 - 1962.

	CLIPPING WEIGHTS				
	Feb.	Mar.	Apr.	May	June
<u>Heated</u>					
Common	333	180	758	770	568
Tifgreen	360	185	553	428	328
<u>Unheated</u>					
Common	24	3	294	379	782
Tifgreen	33	21	312	262	371

Table 4. Mean color scores of heated and unheated plots of Common and Tifgreen bermudagrass scored as 1 - least to 9 - most greenness, at Tucson, Arizona, 1961 - 1962.

		COLOR RETENTION OF BERMUDAGRASS					
		Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
<u>Heated</u>							
Common		9	7	4	8	8	9
Tifgreen		9	7	4	8	8	9
<u>Unheated</u>							
Common		6	2	1	3	3	8
Tifgreen		6	2	1	3	3	8

The loss of color during the first part of January was mostly caused by disease. It was identified as being in the Fusarium group. The disease was controlled by close clipping to 1/2 inch of all plots for the last two weeks of January. The foliage of the heated plots was quite wet throughout the heating period and this perhaps was a factor as far as diseases were concerned. Perhaps lower clipping height would be desirable to help control winter disease. No disease was noted on the heated or unheated plots after the first of February with the exception of one small area in one of the heated Tifgreen plots which was slightly damaged by Helminthosporium early in July. This damage could not be definitely attributed to any detrimental effect from a lack of winter dormancy.

It appears that at least two factors contribute to winter dormancy in the Tucson areas. One - frost, and two - low temperature even without frost where chlorophyll synthesis may be slower than chlorophyll destruction by intense light.<sup>2</sup>

Further experimenting is suggested before this type of soil heating should be used in a practical way in keeping bermudagrass green in the winter. Such factors as maximum effective spacing and depth of resistance cables should be explored. The minimum heating necessary for both frost protection and growth were not established in this experiment.

Practical soil heating conceivably could be accomplished by pumping warm water through the pipe placed at intervals below the soil surface. This procedure may be most feasible around heated swimming pool areas.

<sup>2</sup>Youngner, V. B. Climate and Growth of Turfgrasses. California Turfgrass Culture. Vol. 10, No. 3, pp. 23-24. 1960.



WEED CONTROL RESEARCH IN BERMUDAGRASS TURF

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Work during the past year included evaluation of several herbicides for control of smooth crabgrass (Digitaria ischaemum) and prostrate spurge (Euphorbia spp.) and evaluation of field applications of 2-(2,4,5-trichlorophenoxy) propionic acid (silvex) for the control of chaffweed (Alternanthera repens).

Preemergence applications of herbicides for crabgrass control

Six herbicides were applied to dormant common bermudagrass at the El Rio Country Club, Tucson, Arizona. Calcium arsenate at 365 pounds per acre, 2, 6-dichlorobenzonitrile (dichlorobenil) at two pounds per acre, 3-(3,4-dichlorophenyl)-1,1-dimethylurea (diuron) at 1.6 pounds per acre, 0-(2,4-dichlorophenyl)-0-methyl isopropylphosphoramidothioate (DMPA) liquid and granular at 15 pounds per acre, "Bandane" liquid and granular at 32 pounds per acre, and 2,3,5,6-tetrachloroterephthalic acid (DCPA) wettable powder and granules at ten pounds per acre were applied on April 12, 1962. The area was irrigated soon after treatment. Plots were 20 by 30 feet and treatments were replicated eight times. Surface soil of the test contained 37% sand, 39% silt, and 24% clay.

Each month during the summer the effects of herbicides on crabgrass and bermudagrass were evaluated. The data on crabgrass control and bermudagrass cover and appearance are summarized in Table 1.

Table 1. Crabgrass infestations and bermudagrass cover and appearance after preemergence applications of herbicides.

Herbicide	Treatment lb/A	Crabgrass infestation Estimated percent of ground covered				Bermudagrass Estimated percent of ground covered		Turf appearance 10 = excellent 0 = very poor	
		6/12	7/16	8/13	9/14	6/12	8/13	6/12	7/16
Calcium arsenate	365	1	5	3	2	96	97	8.5	9.0
Dichlorobenil	2	6	24	28	41	80	72	6.2	7.6
Diuron	1.6	0	3	6	6	84	94	4.8	8.8
DMPA, liquid	15	0	6	6	5	95	94	8.0	8.9
DMPA, granular	15	1	0	0	0	96	100	8.0	9.2
Bandane, liquid	32	4	10	13	16	86	87	6.8	9.0
Bandane, granular	32	1	2	2	4	96	98	8.5	9.0
DCPA, granule A*	10	1	1	3	4	96	97	9.0	9.4
DCPA, granule B*	10	0	0	0	1	97	100	8.2	9.6
DCPA, wettable powder	10	0	0	0	0	92	100	7.0	9.6
Check, untreated		8	33	35	35	81	65	7.1	7.5

\*granule A was "Lawnguard", granule B was "Balcite".

The formulations of DCPA (trade name "Dacthal") and the granular DMPA (trade name "Zytron") gave the best crabgrass control. Herbicide formulations containing nitrogen fertilizer had the best turf appearance early in the season. Herbicides containing DCPA had the best appearance at midseason.

Dichlorobenil and the liquid formulation of bandane did not give satisfactory control of crabgrass. Diuron caused the most severe injury to bermudagrass observed in eight years of testing.

Foliage applications of herbicides for spurge control

Herbicides were applied to the foliage when spurge stems were two to four inches long. 2,4-dichlorophenoxyacetic acid (2,4-D) at one and two pounds per acre, 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) at one pound per acre, silvex at one pound per acre, N-(2,4-dichlorophenyl) methacrylamide (DCMA) at three and six pounds per acre; DCMA at three pounds per acre and disodium monomethyl-arsenate (DMA) at one pound per acre, 2,3,6-trichlorobenzoic acid (2,3,6-TBA) at two pounds per acre, 2-methyl-3,6-dichlorobenzoic acid "Banvel-D" at two pounds per acre and 5-bromo-3-isopropyl-6-methyl uracil (isocil) at three pounds per acre were applied on June 22, 1962.

Effects of herbicides on spurge and crabgrass were evaluated periodically. The data on spurge control and bermudagrass injury are summarized in Table 2.

The best selective spurge control was achieved with 2,4,5-T and silvex. Spurge plants become red after treatment with 2,4,5-T, silvex, and DCMA plus DMA.

Isocil and Banvel-D controlled spurge but injured bermudagrass. Bermudagrass treated with isocil has not recovered three months after treatment.

Table 2. Spurge control and bermudagrass injury after foliage applications of herbicides.

Herbicide	Treatment lb/A	Spurge control percent estimated			Bermudagrass injury	
		6/26	7/13	8/13	0 = none 100 = topgrowth dead	6/26
2,4-D, amine	1	20	25	0	0	0
2,4-D, amine	2	50	85	45	0	0
2,4,5-T, amine	1	60	75	50	10	0
Silvex, ester	1	60	85	50	10	0
DCMA	3	10	0	0	0	0
DCMA	6	60	0	0	0	0
DCMA and DMA	3 1	10	50	45	0	0
2,3,6-TBA	2	0	50	25	0	0
Banvel-D	2	80	75	45	40	20
Isocil	3	20	100	0	10	100
Check, untreated		0	0	0	0	0

Chaffweed control with silvex

A scattered infestation of chaffweed in bermudagrass turf at Tucson was treated with repeat applications of an ester of silvex. When runners (stems) were six to eight inches long, silvex was applied to infested spots at the rate of one pound per acre in 160 gallons of water. The spray solution contained one percent "X-77." Treatment was repeated twice when runners on regrowth were four to eight inches long.

Topgrowth of chaffweed dies within one to two weeks after treatment. Regrowth occurred six to eight weeks after treatment. Three applications of silvex reduced the chaffweed infestation 60 to 80 percent during a single season. Many of the remaining plants may not survive the winter.

All bermudagrass foliage contacted by the silvex browned within one week but normal regrowth occurred within two to three weeks.

OVERSEEDING TRIALS--1961-62

J. Folkner  
Department of Horticulture

Following the experiment of 1960-61 with 13 varieties of cool season grasses (1) the plots were re-established. Fewer varieties of grass were used eliminating from the trials certain varieties of bents, fescues and the new bluegrass strains which had proved not at all satisfactory for this purpose.

The grasses used this year were annual rye grass, the most commonly used for overseeding in Arizona as a check, redtop, seaside bent, highland bent and two Scotts family brand mixtures--#11 and #13.

The plots were seeded and topdressed with manure November 29, 1961. The normal recommendation for seeding rye is October 1-15, a time when the temperatures are such that bermudagrass has ceased its growth.

In normal years intensive watering is necessary to germinate and effect a satisfactory stand of grass. However, during the fall of 1961 the weather was rainy and overcast much of the time and the first watering was necessary December 20, about a month after seeding, rain and heavy frost followed at intervals thereafter.

Readings of coverage were started on December 20 and continued at weekly intervals thereafter noting coverage, color, weed infestation and the re-growth of bermudagrass in the plots until the transition was absolutely complete August 13. These readings could have been discontinued at an earlier date as most of the cool season grasses had vanished but we were also interested in the recovery of the summer turf.

The spring was quite warm beginning with daytime temperatures in the 70°F. range in February, 80°F. in April and ranging gradually up to 100°F. in June when the normal transition from the winter to summer turf begins.

In the desert areas of Arizona the problem of maintaining the cool season grasses is not one of temperature alone: it is a combination of temperature, humidity and various fungus diseases. In the Phoenix-Tucson area a monsoon season actually exists. A period of high temperatures, heavy wind and rain and high humidity starts the early part of July and continues through August. All of these contribute to the rapid development and spread of various fungus diseases. Even under these adverse conditions Seaside bentgrass is the standard turf for putting greens on all the golf courses built since the war, excluding municipal courses.

Average Number Days Germination--All Varieties:

Ryegrass--14	Pennlawn--15	Redtop--16	Highland Bent--14
Scotts Family Brand #11--18	Scotts Family Brand #13--17		

Family #11 Analysis

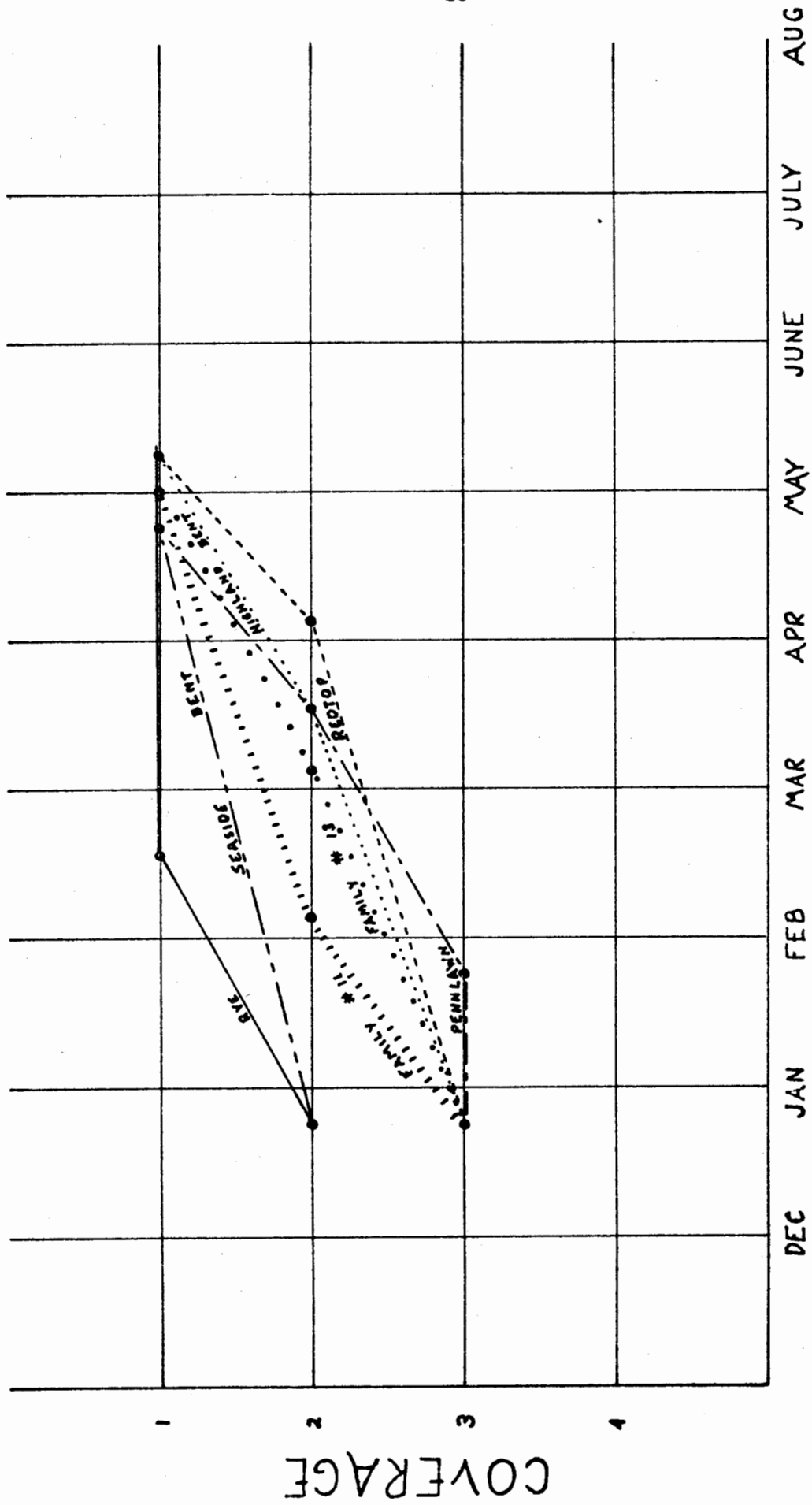
Chewings Red Fescue 32.35; Kentucky Bluegrass 23.36% (Washington grown);  
Kentucky Bluegrass 11.20% (Oregon grown); Kentucky Bluegrass 10.34% (Idaho  
grown); Creeping red fescue 20.17%.

Family #13 Analysis

Creeping red fescue 41.27%; Kentucky Bluegrass 40.39%; Chewings red fescue  
14.76%.

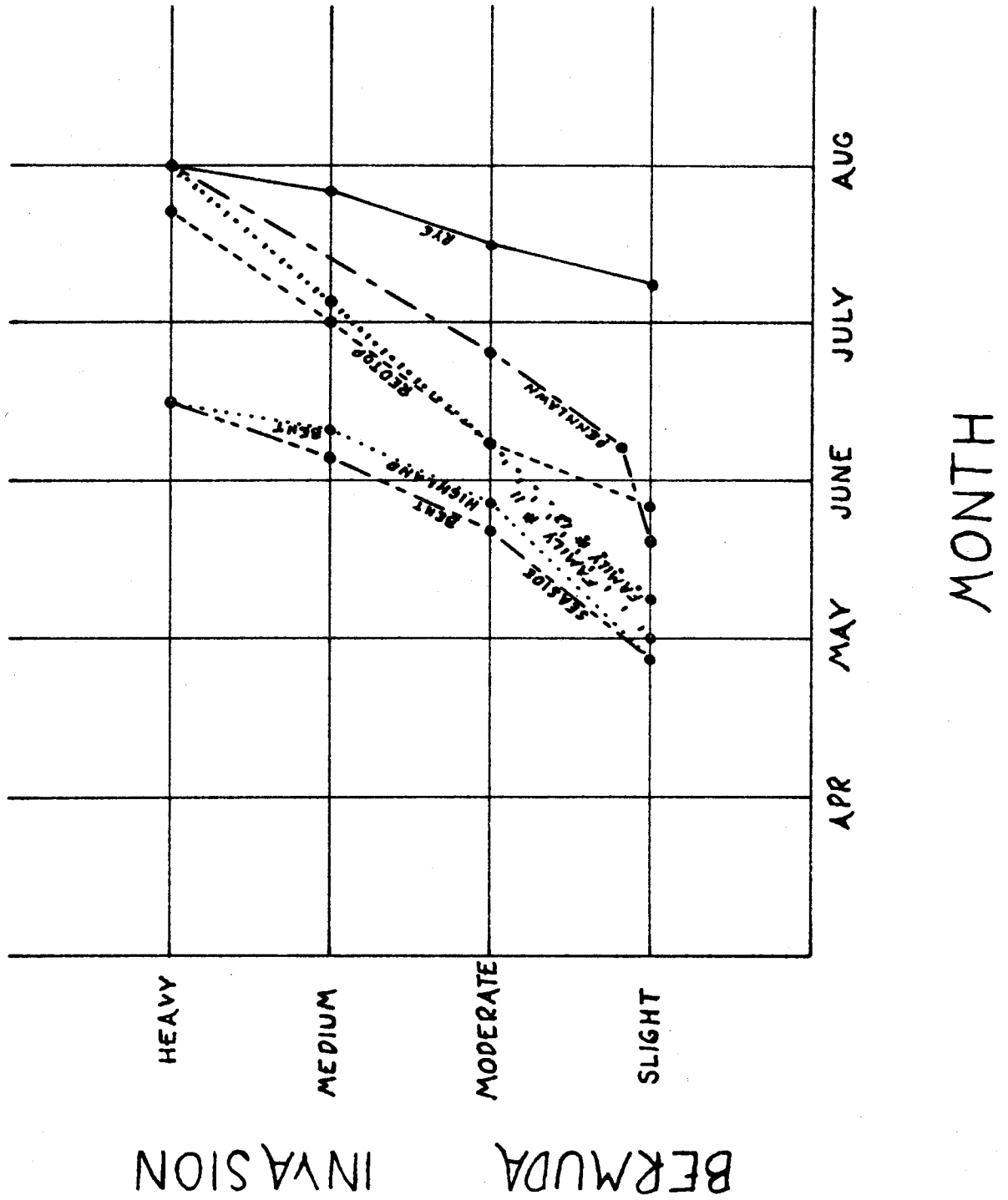
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(1) Arizona Exp. Station Research Progress Report 203, Turfgrass Research,  
December, 1961.



MONTH

- 1 - HIGH
- 2 - MEDIUM
- 3 - LOW
- 4 - NONE



## BIOLOGICAL CONTROL OF PUNCTUREVINE

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### Puncturevine weevils become established in Arizona

Two weevils that eat puncturevine, Tribulus tenestris, were shipped to Tucson from Rome, Italy during the summer of 1961. Both weevils are found on the island of Sicily, in Italy and in some parts of southern France. The United States Department of Agriculture, Biological Control of Weeds Investigations conducted extensive host plant preference studies on the weevils in Europe for several years and determined that these insects feed only on puncturevine. The weevils were shipped to the United States and examined in the USDA quarantine facilities before release. Authority for the release in Arizona was granted by the State Entomologist under the provision of Title 3, Chapter 2 of the Arizona Revised Statutes.

One species of weevil, Microlarinus lypriformis, develops within the stems and sometimes on the crown of the puncturevine. Stems become hollowed out by the feeding of the larvae, and the adults eat holes in the stems through which they emerge. The other species of weevil, Microlarinus lareyniei, feeds within the seeds and hollows them out. Infested seeds have holes from which the adult beetles escape from the seed.

In the area at Tucson where 200 of each species of weevils were released just a year previously, the insects built up in large numbers and almost every plant in the immediate area was infested. Many plants had seed weevils feeding in as many as 80 percent of the seeds. During the single year, both weevils moved from the release site so that they could be found infesting plants from one-half to three-quarters of a mile away in several directions.

### The distribution of the weevils within Arizona

Weevil-infested puncturevine plants were collected and bags of plants distributed to over 250 individuals at the Arizona-Sonora Desert Museum on August 11-12, 1962, for release in various localities in Tucson. Infested plants were also given to a number of visitors from other Arizona communities. The Tucson Public Schools released large bags of weevil-infested vines at eight schools. Bags of vines were sent to seven county agricultural agents for release in their counties and to University Branch Stations.

A technique was developed for collecting adult weevils from the vines with a vacuum collection machine. This enabled shipments of containers of 100 weevils each to 24 golf courses in Arizona and provided weevils to Arizona State Highway Department maintenance crews for release in their sections.

It is unlikely that the weevils will be available again at the Tucson release area, so additional distribution will have to take place from the weevil-infested areas in each county. For further information, contact your County Agricultural Agent.