EFFECT OF FOUR GROWTH SUPPRESSANTS UPON FOUR TURF-TYPE BERMUDAGRASS VARIETIES

By

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CHAPTER I

INTRODUCTION

A luxuriant color and fine vegetative turf cover are the primary goals of most turf workers and owners. The maintenance of a beautiful turf is not only costly but entails much labor. The spreading characteristics of some turf grasses when they encroach into flower gardens and ornamental shrubs are troublesome. Reduction of maintenance costs, primarily by reducing the number of times turf would need to be mowed per season, might be accomplished by retarding plant growth with plant suppressants.

For many years agriculturists and researchers have used different substances to alter plant growth. Primary interest seems to be in growth promoting substances. However, much work has been completed with growth suppressants or retardants.

Growth regulator research on turfgrasses has primarily dealt with cool season grasses and virtually ignored warm season grasses such as bermudagrass (Cynodon spp.).

The purpose of this study was to determine whether or not vegetative growth of bermudagrass could be suppressed with chemical growth regulators. The objective of this investigation was to maintain bermudagrass at a slow rate of vegetative growth so as to reduce the number of mowings needed per growing season.

It would be most desirable to maintain a low-growing turf which is

neither discolored nor injured to the extent that tissue is killed. Lateral growth of stolons would be acceptable, however, the upright vegetative growth should be suppressed without injuring the life processes of the plant.

CHAPTER II

LITERATURE REVIEW

Very little literature can be cited which has direct bearing on this study. This review deals primarily with the effect of growth suppressants on grasses with as much reference to bermudagrass as possible.

It is an established fact that various growth regulators will suppress vegetative as well as floral growth. It appears that effects of growth substances tend to develop shorter, stockier plants with greener, broader leaves. Investigation by Zukel (24)[1] has shown that suppressance was more pronounced upon young plants. Zukel (25) later reported that one substance, 1, 2-dihydrophyridazine-3-6-dione, hereafter referred to as maleic hydrazide, should only be applied to established turf.

It was first shown in 1949 by Schoene and Hoffman (15) that plants could be suppressed using maleic hydrazide. It was found that, with different rates of application of maleic hydrazide, bentgrass and bluegrass turf varied from slight retardance to two month's suppression. Investigations by Greulach and Atchison (6), Greulach and Haesloop (7) and Williamson (22) have shown that maleic hydrazide suppresses cell division by reducing the mitotic index. Inhibition of floral and vegetative growth of bermudagrass with maleic hydrazide was reported by Folkner (5) and Zukel (24). Schoene and Hoffman (15) also reported that

[1]Figures in parenthesis refer to Literature Cited

maleic hydrazide retarded vegetative growth of bentgrass and bluegrass. Tukey (21) reported that tillering in grasses is favored by maleic hydrazide and is retarded by growth promoting substances.

It was reported by Zukel (25) that maleic hydrazide is absorbed within twenty-four hours, whereas, Crafts et al. (3) found that four hours were sufficient for enough absorption of chemical to observe its activity in the plant. Zukel et al. (26) reported that the rate of absorption was dependent upon the amount of the chemical remaining on the leaves after spraying and the percent of relative humidity. Johnsongrass held at 40% and 100% relative humidity gave a "half life" value of chemical absorption of 128 and 2 hours respectively.

Folkner (5), working with maleic hydrazide, sprayed flats of bermudagrass to runoff with concentrations of 0.016%, 0.05%, and 0.15% with Vel as a wetting agent. Inhibition of both vegetative and floral parts was observed in direct relation to concentration. It was found that no turf discoloration occurred at any concentration of maleic hydrazide.

From experiments conducted by spraying roadsides in Connecticut, Zukel (25) reported that maleic hydrazide at the rate of 4 pounds per acre would reduce the frequency of mowing. Excessive dosage, however, would produce browning of the grasses. Byrd (2) using 4 pounds per acre upon sandbur infested bermudagrass, reported inhibition of growth without discoloration of the turf for one season. Moore (14) reported that plant root tips of bush bean (Phaseolus vulgaris), Kentucky bluegrass (Poa pratensis), field corn (Zea mays var. indentata), and crabgrass (Digitaria sanquinalis and Digitaria ischaemum), were killed with maleic hydrazide application which interferes with water absorption. Plants not

producing lateral buds, such as Kentucky bluegrass and bush bean, were killed due to lack of water absorption, whereas, crabgrass and field corn, which produced lateral buds, only lost the topgrowth present at the time of treatment. Morphological changes caused by the modification of the respiratory activity of the plant were witnessed by Isenberg (10). It was found that low concentrations of applied sprays of maleic hydrazide stimulate respiratory activity while high concentrations reduce or inhibit respiratory activity.

A study of the residual effects of maleic hydrazide by Levi and Crafts (11) on some California soils showed no direct correlation between clay content, pH, or fertility level and toxicity. Therefore, they concluded that maleic hydrazide would not constitute a problem in California soils.

It was found by Marth et al. (13) and Wirwille and Mitchell (23) that the quaternary ammonium compound (4, hydroxy-5-isopropyl-2-methyl-phenyl) trimethylammonium chloride, 1-piperidine carboxylate, hereafter to be referred to as Amo-1618, would suppress beans, chrysanthemums and a few other plants. Halevy and Cathey (8) also found that cucumbers were vegetatively suppressed with application of Amo-1618. This chemical thusfar, as shown by Marth et al. (13) has been non-active on grass. Marth et al. (13) and Wirwille and Mitchell (23), working with bean seeds (Phaseolus vulgaris, variety Black Valentine), reported that stem length was reduced and maturity delayed with application of from 1 to 100 pounds active Amo-1618 per acre. Marth and Mitchell (12) stated that Amo-1618 was found to persist in the soil for a period of seven months under field conditions, and about eight years in the greenhouse.

Halevy and Cathey (8), using dark and light grown cucumber seedlings,

found that Amo-1618 retarded the growth of all plants. Neither treatment of light made any significant difference on the effects of the Amo-1618.

As early as 1908, Schreiner and Reed (16) reported the use of trimethylammonium compounds on plants. In 1959, Tolbert and Wittwer (20) reported some effects and properties of two quaternary ammonium compounds, (2-chloroethyl) trimethylammonium chloride and allyl trimethylammonium bromide, hereafter to be referred to as CCC and AMAB respectively.

The effect of CCC and AMAB upon wheat has been studied extensively by Tolbert (18 and 19). Tolbert (19), working with wheat, found that the most characteristic development of growth was shorter stems. Also, the stems were thicker, the leaves broader and tillering was earlier and more pronounced than the untreated plants. The actions of CCC on wheat were mutually antagonistic to the actions of gibberellin, a growth promoting substance. Tolbert and Wittwer (20) found vegetative growth suppressing characteristics were more pronounced on wheat than barley or oats.

In an experiment conducted by Stuart and Cathey (17) CCC reduced the internode length, thus reducing stem length of poinsettia and hydrangea plants. An over treatment of CCC was found to induce chlorosis for only a short period of time in plants before they regained the green color. It was also shown that the dosages considered maximum or minimum to retard growth with CCC varied throughout the year and from plant to plant. CCC was active for only one season's growth or less and was less active in summer than in winter. Hucker et al. (9) found, however, that quaternary ammonium compounds were less active at or about 40°F. and most active at 120°F.

Tolbert (18) stated that the trimethylammonium cation was essential for suppression activity. Tolbert (19) later stated that compounds of the structure $(CH_3)_3\ N^+\ CH_2\ -CH_2\ X$ were active when the "X" was a chloro, bromo, or $=CH_2$ group, or other groups of similar electron density. It was postulated by Tolbert (18) that there is a protein surface with two binding positions for the quaternary ammonium molecule. Since the compound has such a high specificity of structure for biological activity, one site may be specific for the trimethylammonium cation; a second site would be located about the length of the ethyl carbon chain away from the first site. The chloro, bromo or $=CH_2$ group in the compound located over the second site would then induce activity.

Hucker et al. (9) reported the quaternary ammonium compounds were active on or around a neutral pH with activity increasing with a rise or lowering of pH.

It has been reported (1) that improper timing of applications in relation to temperature and relative humidity could be one of the main problems in retarding appreciably the vegetative growth of turf grasses with CCC.

CHAPTER III

METHODS AND MATERIALS

Four commercially important turf-type bermudagrasses were selected from the turfgrass nursery on the Agronomy Research Station located west of Stillwater, Oklahoma, to be used in this study. The varieties used were:

Common bermuda - *Cynodon dactylon*
Sunturf - *Cynodon magennisii*
Tifgreen - *Cynodon dactylon* x *C. transvaalensis*
U-3 - *Cynodon dactylon*

Two greenhouse studies were conducted to determine the effect of four growth suppression substances upon the four different bermudagrasses. One phase of this study involved the use of (2-chloroethyl) trimethylammonium chloride (CCC) and allyl trimethylammonium bromide (AMAB) on established plants. In the second phase, 1,2-dihydrophyridazine-3-6-dione (maleic hydrazide) and (4, hydroxy-5-isopropyl-2-methylphenyl) trimethylammonium chloride, 1, piperidine carboxylate (Amo-1618) were tested on transplanted stolons and CCC and AMAB were tested for residual growth suppressing effect. Stolons from the plants previously treated with CCC or AMAB were used to test for the residual effect.

Study of the Effect of CCC and AMAB Upon Established Bermudagrass

Single bermudagrass sprigs from base material of each variety were planted in sixty-four, four inch clay pots. There were sixteen pots of

each variety. The date of this planting was May 6, 1960.

The potting soil used in this study consisted of a sterilized soil mixture of two parts Norge fine sandy loam, one part of sand and one part of peat moss. The potting soil had a pH of 6.4. The soil was kept at a level of one inch from the top of the pot at all times throughout the study.

All plants were increased by two methods: (1) by replanting any stolons present back in the pot of their origin and (2) by clipping the topgrowth weekly to an inch in height to promote tillering. Attempt was made to provide all plants with adequate water and fertilizer throughout the study. However, it appeared that lack of water and excessive heat and transpiration caused some topgrowth of some of the plants to wilt and die. This loss was not found consistently in any one variety, chemical, or rate of chemical.

On March 19, 1961, all grasses were clipped to one inch heights above the top of the pot and six pots of each variety were treated, three with CCC and three with AMAB. Three pots of grass of each variety were designated as checks to compare their growth with that of the treated plants. Both CCC and AMAB chemicals were applied at the rates of 10^{-4}, 10^{-3}, and 10^{-2} molar solutions in 100 ml of water as a soil drench. Treatments were applied each week for three weeks. To assure maximum absorption, treated plants were not watered for 24 hours. All other plants originally planted were maintained for the second study.

Evaluation of each growth regulator for suppression was determined on the number of nodes counted in a given length of stolon, the average length of internodes between these nodes and the length of stolon as measured to the growing point on each stolon. Four stolons from each

plant were chosen at random and marked with small white tags. Measurements from these stolons were recorded. These stolons, except where killed by drought were planted in pots in the greenhouse at the beginning of the second phase of the study on May 22, 1961. On April 16, May 8, and May 22, 1961, recordings of the internode length, number of nodes, and length of stolon were taken on each of the plants.

A Study of the Effects of Maleic Hydrazide and Amo-1618 and the Residual Effects of CCC and AMAB Upon Bermudagrass

A continuation of the first study was conducted in the greenhouse on the Agronomy Research Station, west of Stillwater, Oklahoma.

On May 22, 1961, four stolons, containing five nodes each, were clipped from each of fifteen plants. Plants of the same four varieties of bermudagrass were used in both phases of this study. Sixty plants of each variety were planted in four inch clay pots. Stolons tagged in the earlier study were used if possible. If treated stolons had been killed because of drought, other stolons were chosen at random from the plant.

The same ratio of potting soil as mixed for the earlier planting was used.

One week after planting maleic hydrazide and Amo-1618 were applied. Maleic hydrazide was applied at the rate of 2, 4, and 8 pounds active per acre and Amo-1618 was applied at 50, 100, and 150 pounds active per acre.

At the time of chemical application a record was taken of the number of nodes, average length of internodes and height of plant above the top of the pot. Measurements of the overall length of the stolon, number of nodes, and average length of internodes were also taken June 9,

and June 24, 1961. On the latter date each plant was clipped level with the top of the pot. The clippings were oven-dried and weighed to determine the quantity of vegetation produced. All measurements were taken primarily to analyze the growth from period to period.

Oven-dry weight was determined by placing the samples in small racks in a forced-air oven at 140°F. for 24 hours. The samples were removed from the oven and weighed immediately. The yield of vegetation is recorded in grams per four inch pot as shown in Appendix Table I.

TABLE I: PLANTING DATE, CHEMICAL, RATES, AND ATMOSPHERIC CONDITIONS AT TIME OF APPLICATION OF CCC AND AMAB TO FOUR TURF-TYPE BERMUDAGRASSES.

Planted: June 20, 1960

Application Dates	Temperature (C°)	Relative Humidity (%)
March 19, 1961	22	53
March 26, 1961	22	48
April 2, 1961	19	53

Rates of Application:

Chemical	Rates
AMAB	10^{-4}, 10^{-3}, and 10^{-2} molar
CCC	10^{-4}, 10^{-3}, and 10^{-2} molar

TABLE II: PLANTING DATE, CHEMICAL, RATES, AND ATMOSPHERIC CONDITIONS AT TIME OF APPLICATION OF MH-30 AND AMO-1618 TO FOUR TURF-TYPE BERMUDAGRASSES.

Planted: May 22, 1961, as terminal five nodes from stolons from established sod.

Application Date	Temperature (C°)	Relative Humidity (%)
May 28, 1961	30	46

Rates of Application:

Chemical	Rates
MH-30	2,4, and 8 pounds active per acre
Amo-1618	50, 100, and 150 pounds active per acre

TABLE III: MEASUREMENT DATES AND PERIODS BETWEEN MEASUREMENTS OF FOUR TURF-TYPE BERMUDAGRASSES.

CCC and AMAB measurement dates and periods.

Period I	March 19 - April 16
Period II	April 16 - May 8
Period III	May 8 - May 22

MH-30, Amo-1618 and CCC, AMAB residual measurement dates and periods.

Period I	May 22 - May 28*
Period II	May 28 - June 9
Period III	June 9 - June 24

*Reference measurement for the stolon internode length.

CHAPTER IV

RESULTS AND DISCUSSION

This study was conducted to determine the effect of four growth retarding chemicals on four commercially important turf-type bermudagrass varieties.

The results from this study tend to point to the fact that bermudagrass can be at least temporarily suppressed by use of growth regulating chemicals.

It appears that the two chemicals AMAB and CCC are the most effective of the chemicals studied to reduce the length of stolons, internodes, and plant height without damaging the plant tissue. MH-30 appears to reduce cell division but permits normal elongation of plant cells thereby suppressing plant growth. However, a slight to severe burning effect was apparent at all rates. Amo-1618 appeared to be variable in effect, in that growth suppression of U-3 was found only at the 100 pound rate of active material per acre. The 150 pound rate reduced the stolon length but not to the extent of the 100 pound rate. Growth promotion occurred at the 100 pound rate on common bermudagrass and there was little effect found upon Tifgreen and Sunturf at any rate.

Study of the Effect of CCC and AMAB Upon Established Bermudagrass

Treatments of AMAB and CCC were applied to established bermudagrass sod in the greenhouse. It was desirable to evaluate these two chemicals

on established bermudagrass sod rather than young plants because it was believed from previous work that established sod would be more resistant to chemical action than seedlings. However, a visual effect of growth suppression was found at all rates two weeks after the first application.

Effects of (2-chloroethyl) trimethylammonium chloride (CCC)

It was found that three weekly applications of 10^{-4}, 10^{-3}, and 10^{-2} molar solutions of CCC gave a linear reduction of length of internode (Figure 1) except in the case of U-3 and Tifgreen at the 10^{-3} molar concentrations. The number of nodes per stolon was linearly increased (Figures 2, 3, and 4) in all grasses except Tifgreen at the 10^{-3} molar concentration. Plant height was reduced as shown in Figures 3, 4, 5, and 6, at all concentrations on all grasses. It was also apparent that the higher concentrations of 10^{-3} and 10^{-2} reduced the stolon length (Figures 5 and 6). It might appear that since node formation was increased and length of stolons and internodes decreased, cell division was being carried on at a normal rate, whereas, cell elongation was suppressed.

At the 10^{-2} molar rate the grass appeared to be darker green in color and there was an increase in the number of upright stems. It would seem that the darker, intense green color of the treated plants might have been developed in some way by the nitrogen from the trimethylammonium compound. However, later use of the quaternary ammonium compound Amo-1618, which also contains the trimethylammonium group, showed no increased green color. It appeared that CCC had a greater suppressing effect on all grasses, as shown by an increased number of nodes and reduction of internode length, than AMAB (Figures 1 and 2). The 10^{-2} molar concentration showed the greatest suppressing activity of any concentration. After ten weeks, when the terminal sections were cut

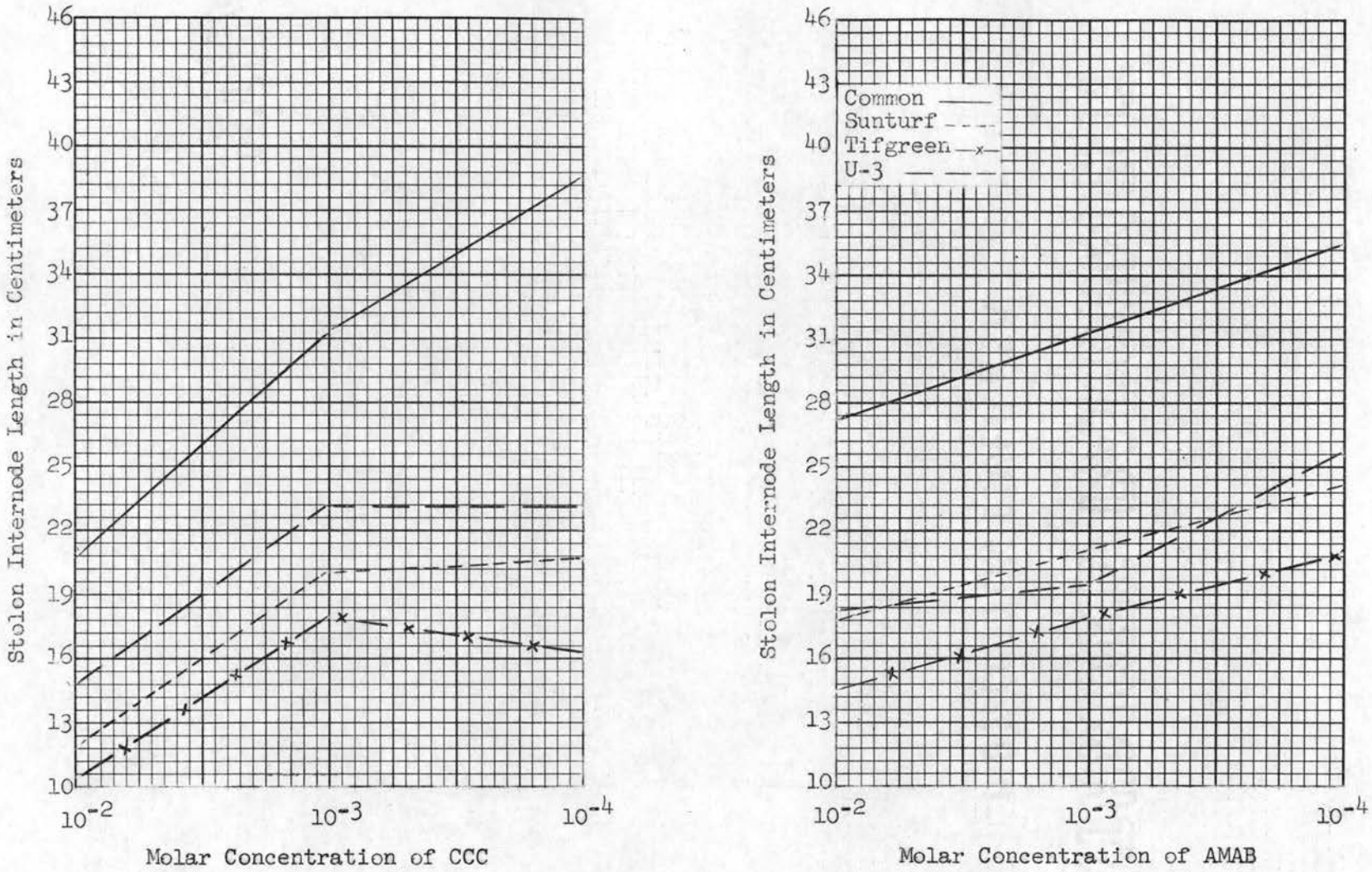
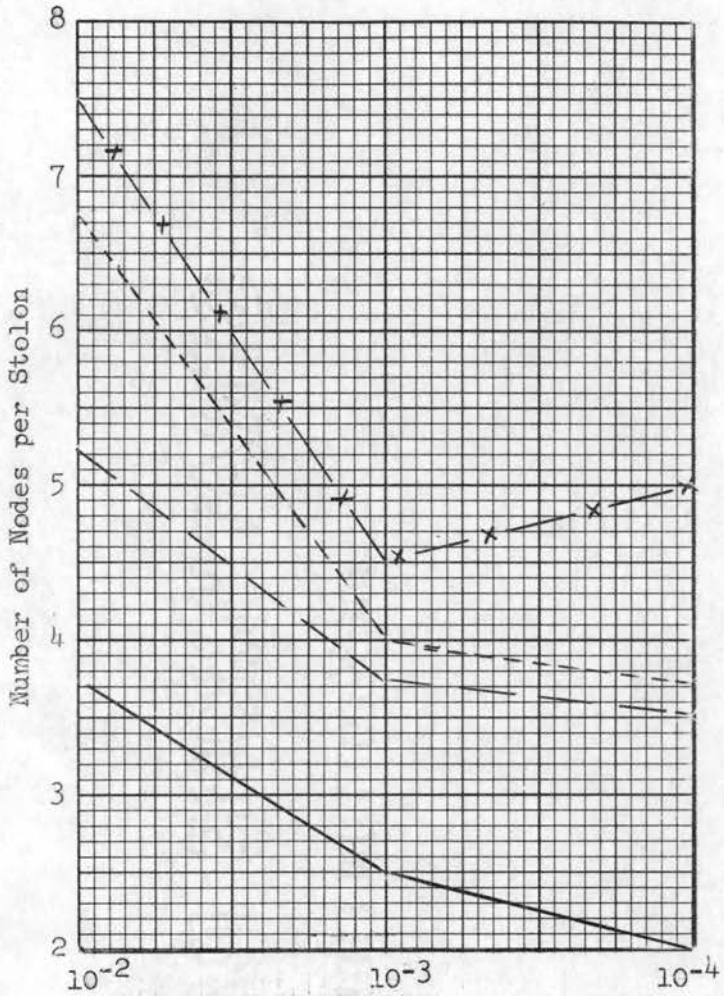


Figure 1. The Effect of Two Growth Suppressant Chemicals at Three Concentrations upon the Growth of Stolon Internodes of Four Turf-type Bermudagrasses.



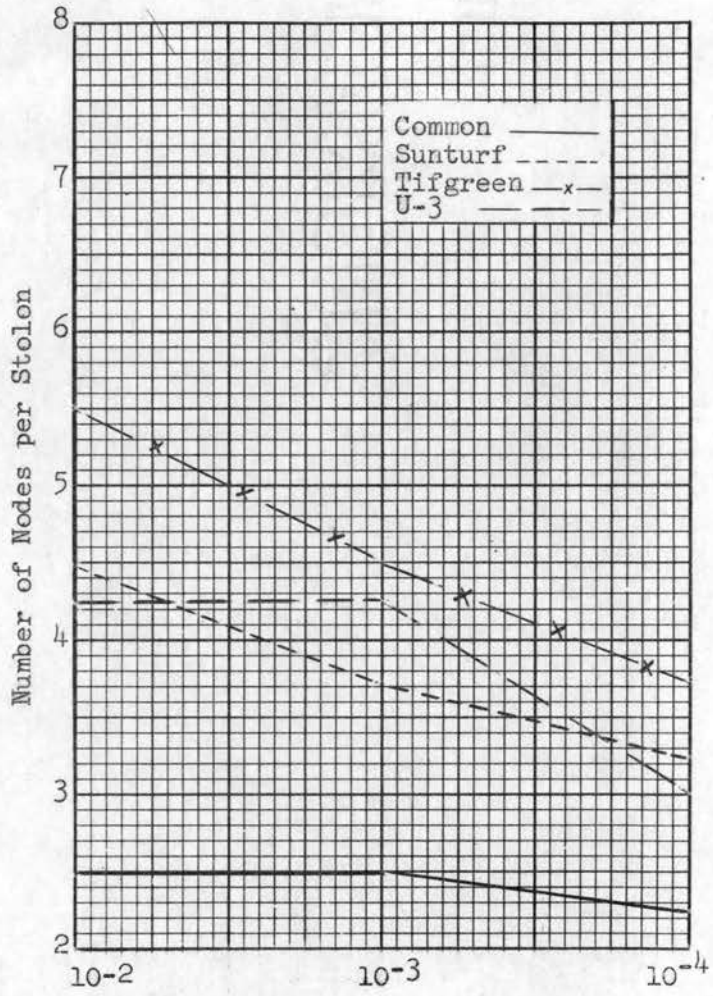
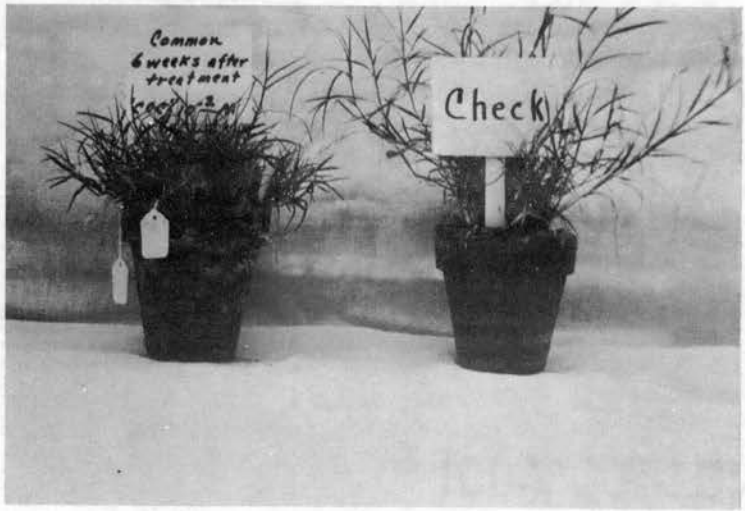


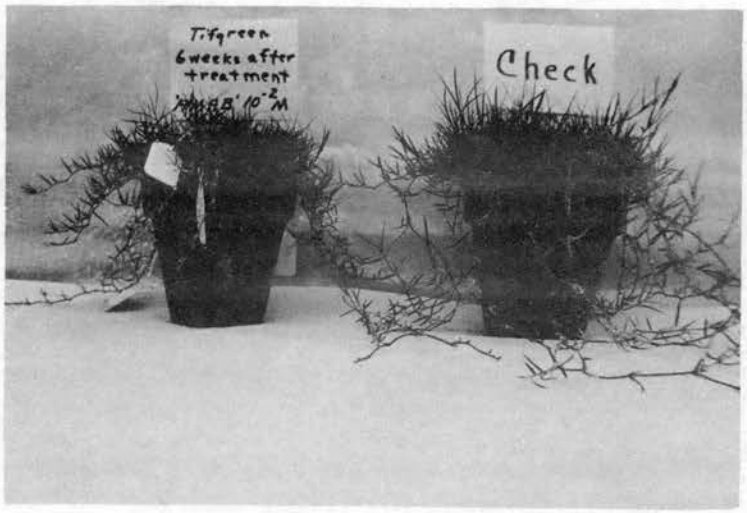
Figure 2. The Effect of Two Growth Suppressant Chemicals at Three Concentrations upon the Number of Nodes per Stolon of Four Turf-type Bermudagrasses.

Sunturf, six weeks after treatment; CCC, 10^{-2} molar and check



Common, six weeks after treatment; CCC, 10^{-2} molar and check

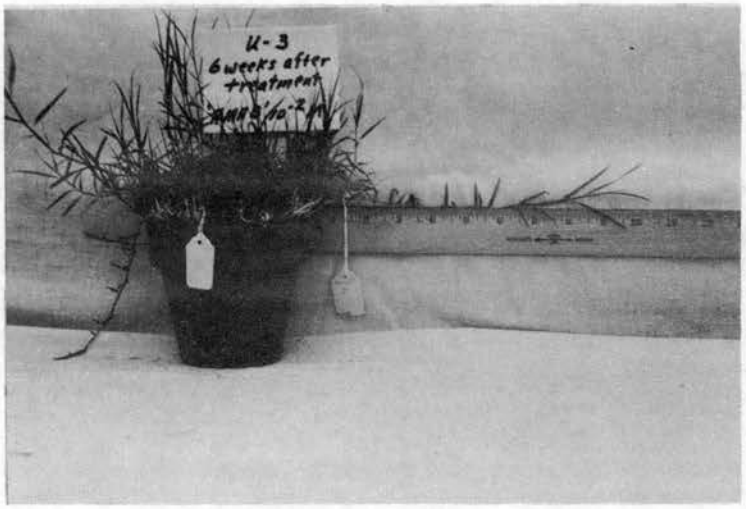
Figure 3. Growth suppression in plant height and stolon length as produced by CCC at one rate on two turf-type bermudagrasses.



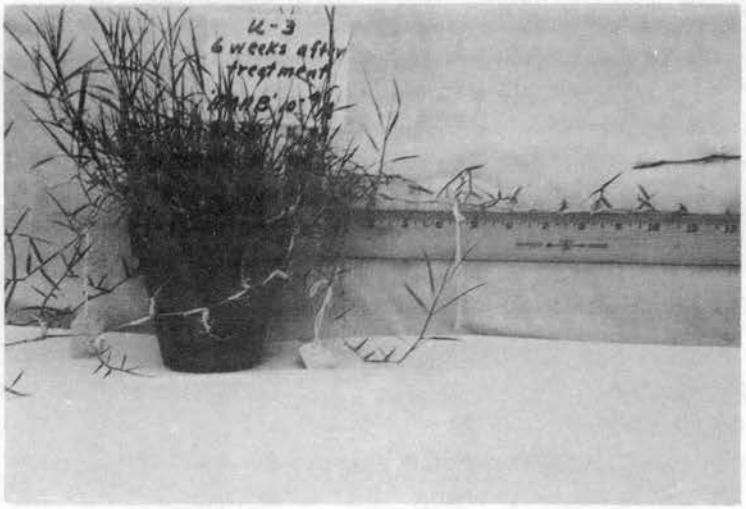
Tifgreen, six weeks after treatment; AMAB, 10^{-2} molar and check

U-3, six weeks after treatment; AMAB, 10^{-2} molar concentration

Figure 4. Growth suppression in plant height and stolon length as produced by AMAB at one rate on two turf-type bermudagrasses.

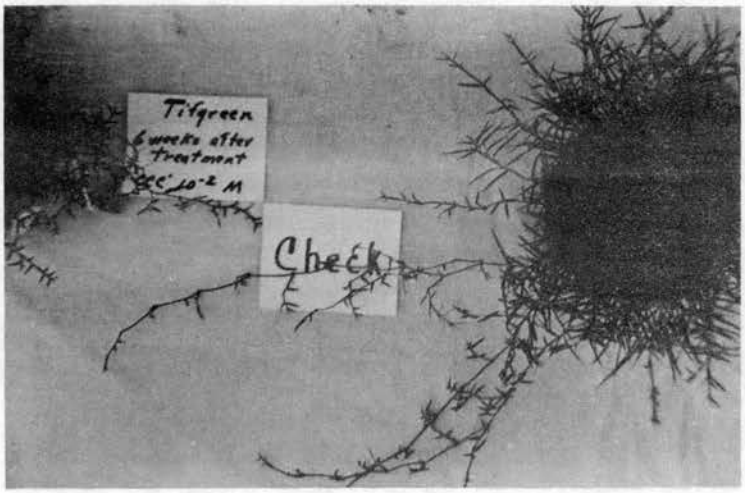


U-3, six weeks after treatment; AMAB, 10^{-2} molar and check

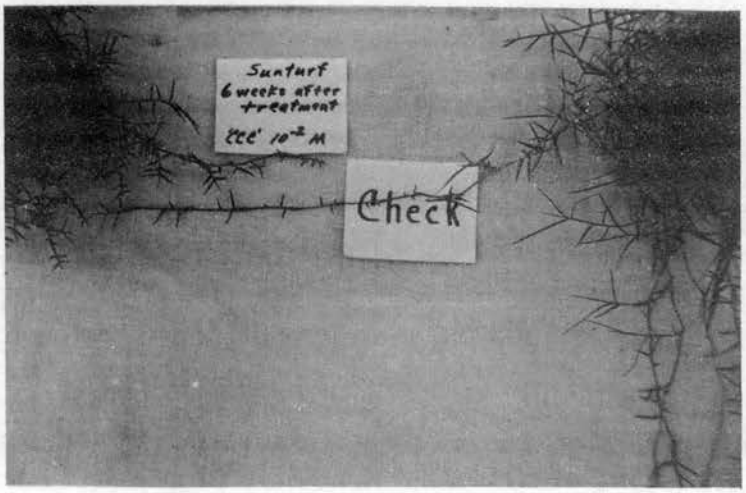


U-3, six weeks after treatment; AMAB, 10^{-4} molar concentration

Figure 5. Growth suppression of the stolon length by AMAB at two rates on U-3 bermudagrass.



Tifgreen, six weeks after treatment; CCC, 10^{-2} molar concentration and check



Sunturf, six weeks after treatment; CCC, 10^{-2} molar concentration and check

Figure 6. Growth suppression of the stolon length by CCC at the 10^{-2} molar concentration on two turf-type bermudagrasses.

from the stolons and were planted in the field study, it was found that there was no significant reduction of stolon length on any grass.

Effects of allyl trimethylammonium bromide (AMAB)

The chemical AMAB gave a linear reduction of internode length (Figure 1) and linear increase in the number of nodes (Figure 2) in all four grasses. However, in both cases, the magnitude of change was not as great as that produced by CCC. The plant height was reduced (Figures 4 and 5) and at the rate of 10^{-2} molar solution the plants appeared to have a deeper green color. It was found that the variety U-3 gave a linear and also a quadratic response to the different chemical rates. In this instance it was found that 10^{-3} molar concentration increased the number of nodes, however, there was no further increase in the number of nodes at the 10^{-2} concentration. The effect upon the internode length, however, showed greater suppression at 10^{-3} and 10^{-2} than 10^{-4} molar concentrations. Since significance of measurements was reduced after nine weeks from first application, it was concluded that the residual effect was declining at the 10^{-4} and 10^{-3} molar concentrations. It might appear that since node formation was increased and length of stolons and internodes were decreased normal cell division was being conducted, whereas, cell elongation was suppressed.

A Study of the Effects of Maleic Hydrazide and Amo-1618 and the Residual Effects of CCC and AMAB Upon Bermudagrass

In this experiment, the chemicals maleic hydrazide (MH-30) and Amo-1618 were applied to the plants started from the terminal five node section of stolons. The other two chemicals AMAB and CCC, were not

applied to these stolons since they had been applied earlier to the established plants. This experiment was designed to test the effect of MH-30 and Amo-1618 upon the stolon length, internode length, number of nodes, and dry weight per plant, and the residual effect of CCC and AMAB on plant growth.

Effects of (2-chloroethyl) trimethylammonium chloride (CCC)

It was found that CCC linearly reduced the internode length for fourteen weeks on Tifgreen and for ten weeks on Sunturf (Figure 7). However, after ten weeks the 10^{-4} molar concentrations appeared to be the only concentrations suppressing Sunturf. Also the number of nodes of Sunturf were found to be significantly increased ten weeks after application (Figures 8 and 9). Common bermudagrass showed a reduction of the internode length from 10^{-4} to 10^{-3} molar concentration but did not show suppressant action at the 10^{-2} molar concentration, thus forming a significant quadratic response (Figure 10). It appeared that the dry weight of the plant was increased slightly at the highest concentration of the chemical (Figure 11). This appeared to be due to the increased number of upright stems rather than increased height of plant. It also appeared that, since significance of measurements were reduced after about ten weeks from application, the residual effect of CCC was declining.

Effects of allyl trimethylammonium bromide (AMAB)

Tifgreen showed a quadratic response of the stolon length in the first period and the internode length in the second period (Figures 12 and 13) thus showing a retention of suppression at the 10^{-3} molar concentration but not at 10^{-2} or 10^{-4} concentrations. Sunturf showed a linear reduction of internode length in the second and third periods (Figure 13). Stolon length was also reduced at all rates fourteen weeks after

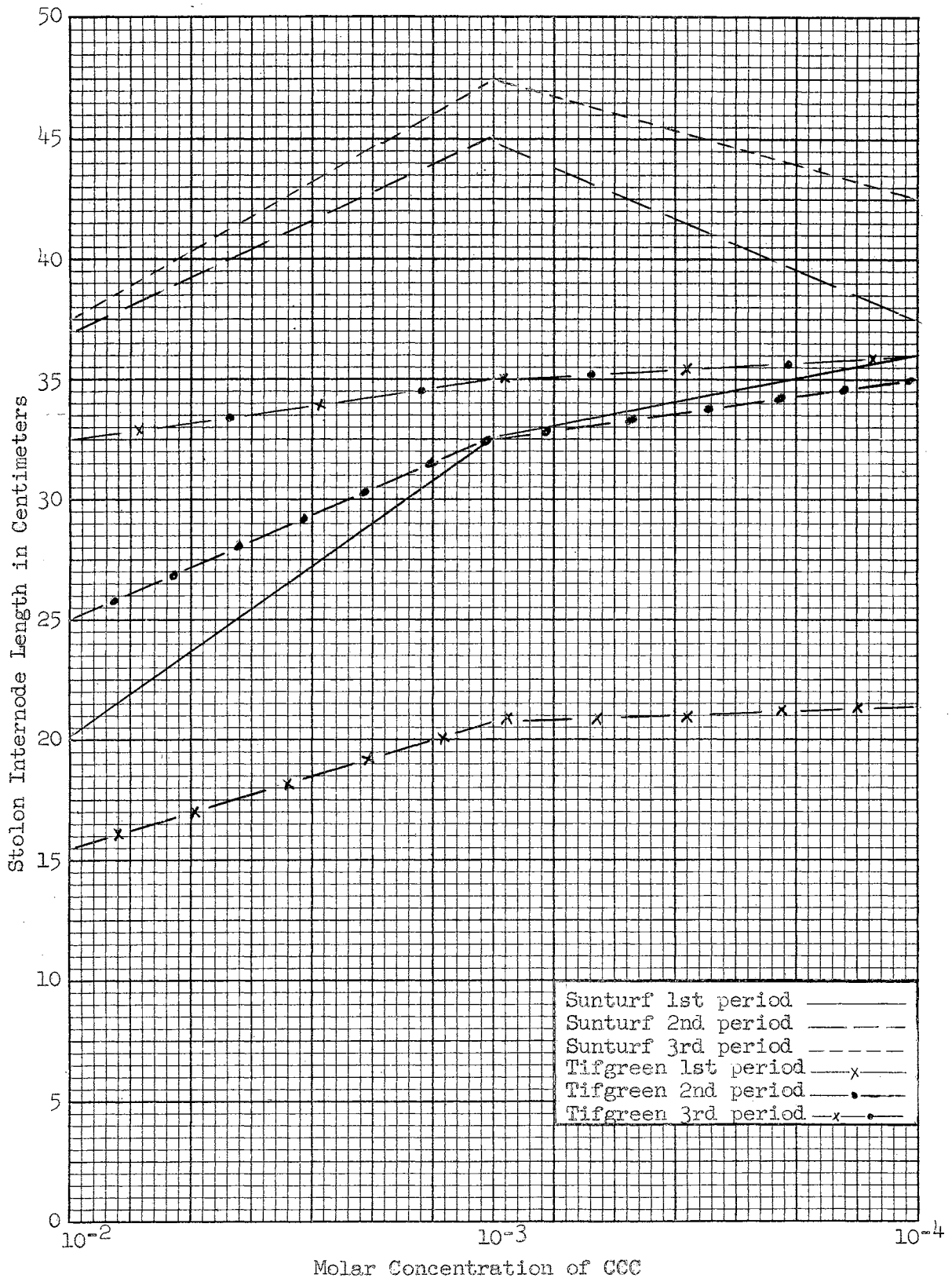


Figure 7. The Effect of CCC at Three Concentrations on Internode Length of Two Turf-type Bermudagrasses 10 to 14 Weeks After Treatment.

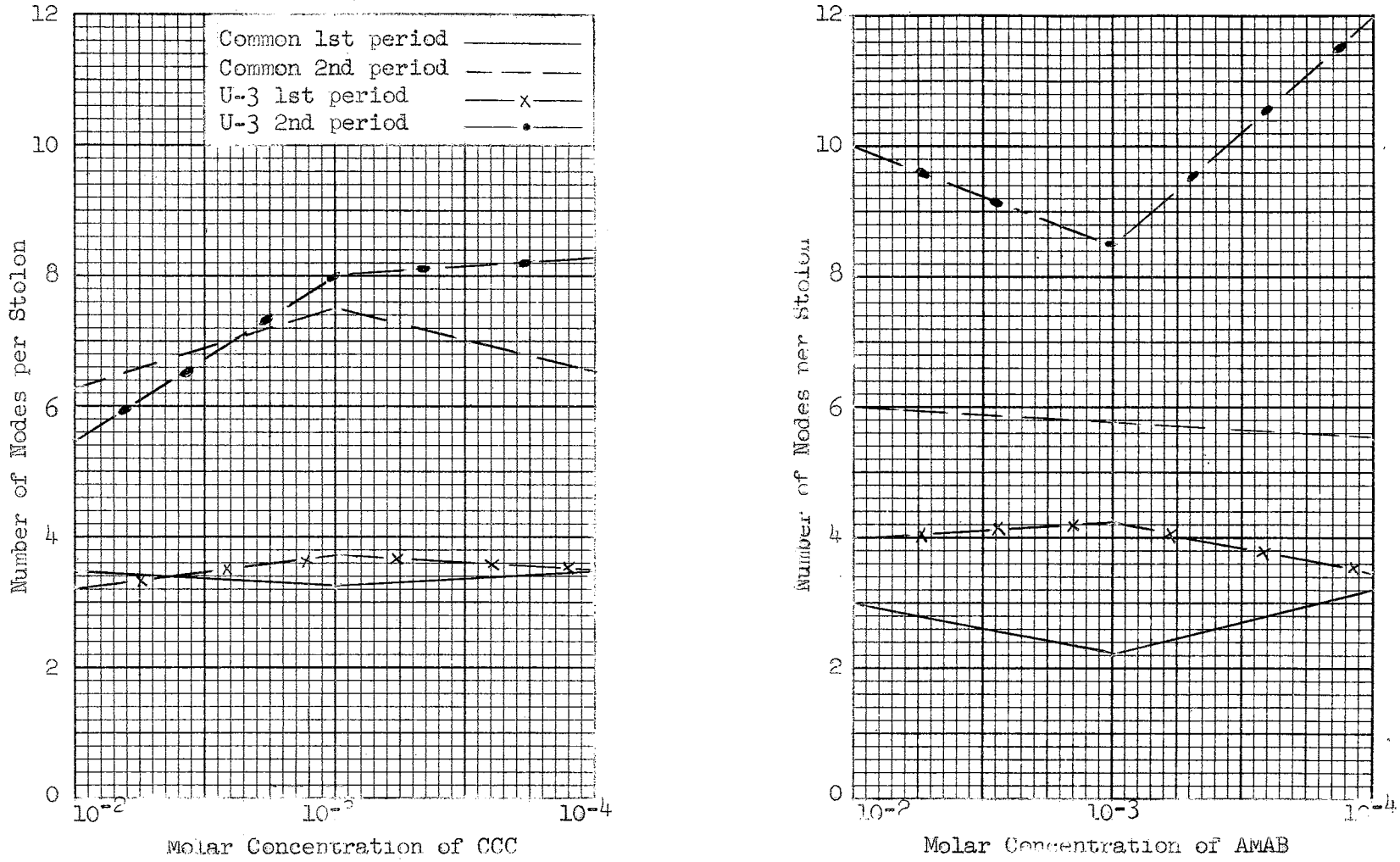


Figure 8. The Effect of Two Growth Suppressant Chemicals at Three Concentrations upon the Number of Nodes per Stolon of Two Turf-type Bermudagrasses from 10 to 14 Weeks After Treatment.

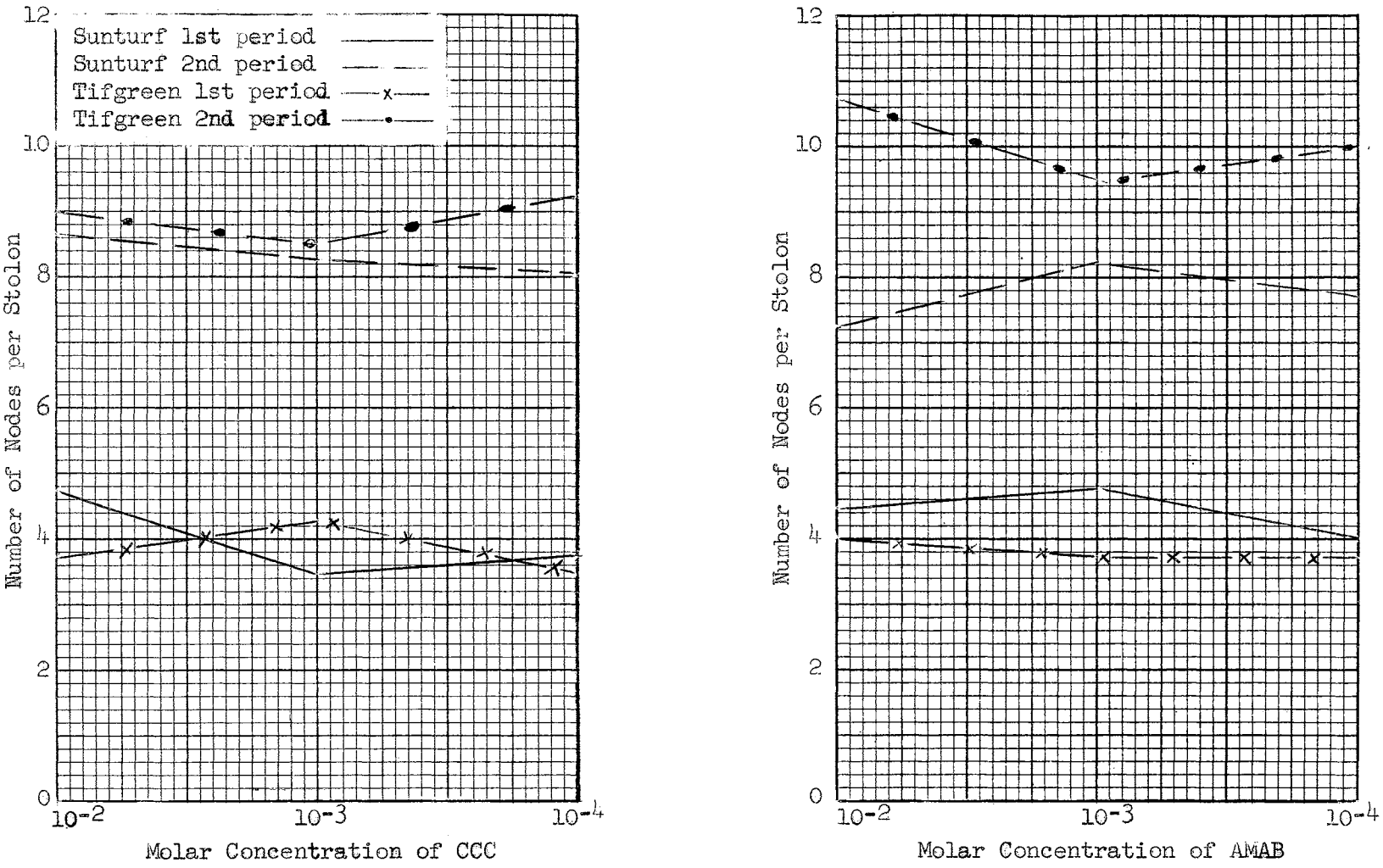


Figure 9. The Effect of Two Growth Suppressant Chemicals at Three Concentrations upon the Number of Nodes per Stolon of Two Turf-type Bermudagrasses from 10 to 14 Weeks After Treatment.

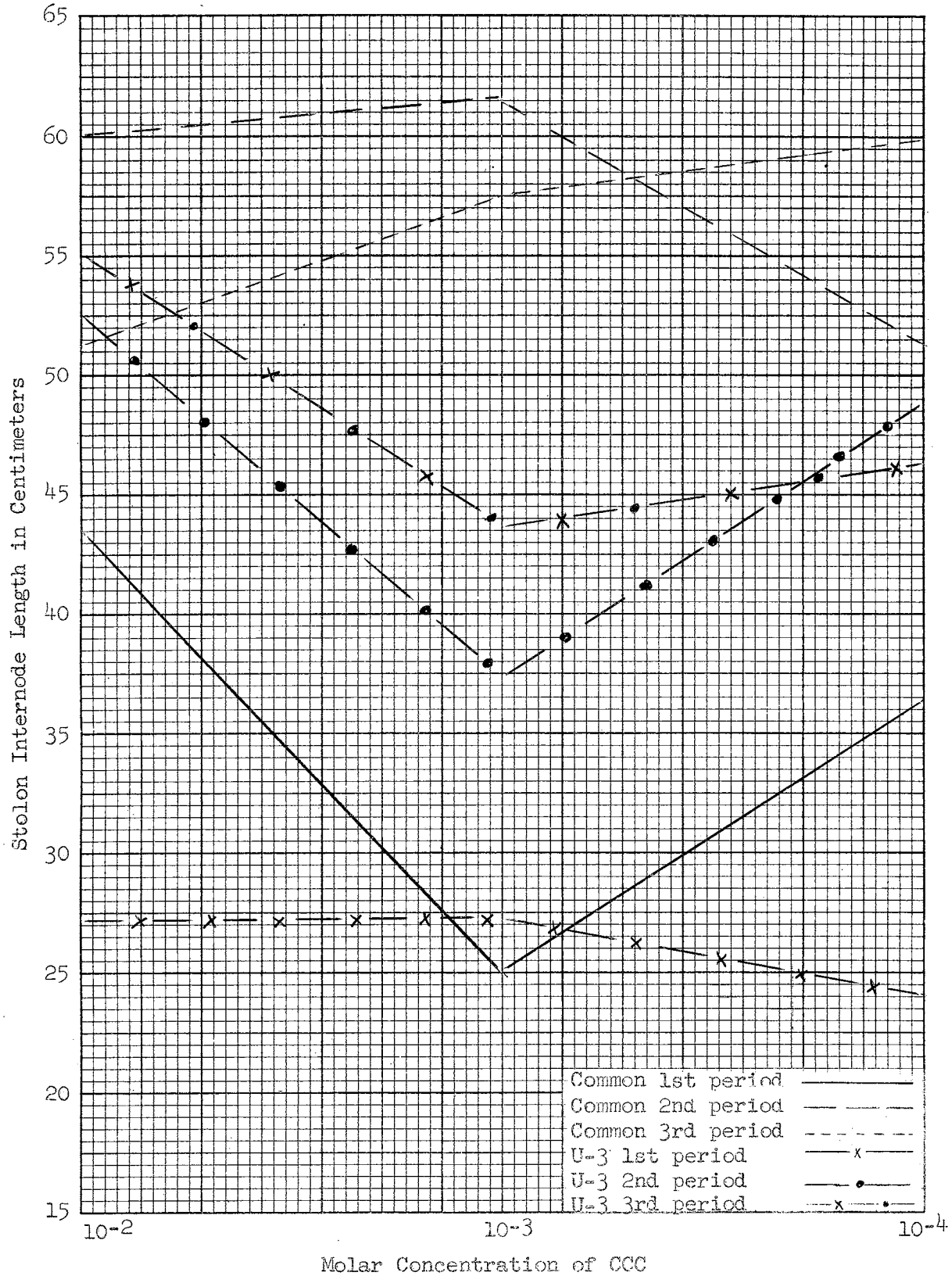


Figure 10. The Effect of CCC at Three Concentrations upon the Internode Length in Centimeters of Two Turf-type Bermudagrasses from 10 to 14 Weeks After Treatment.

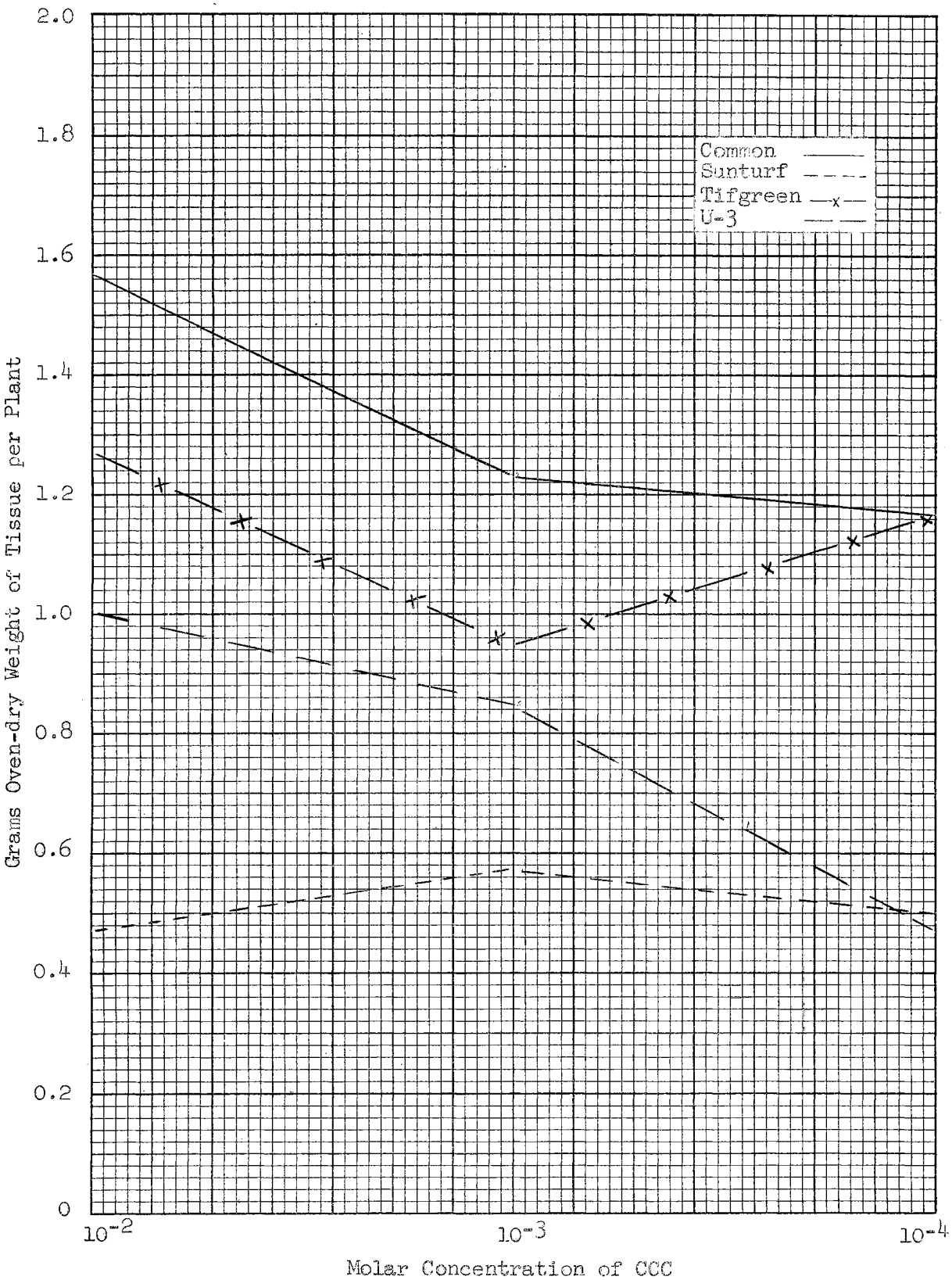


Figure 11. The Effect of CCC at Three Concentrations upon the Oven-dry Weight in Grams of Plant Tissue from Four Turf-type Bermudagrasses 14 Weeks After Treatment.

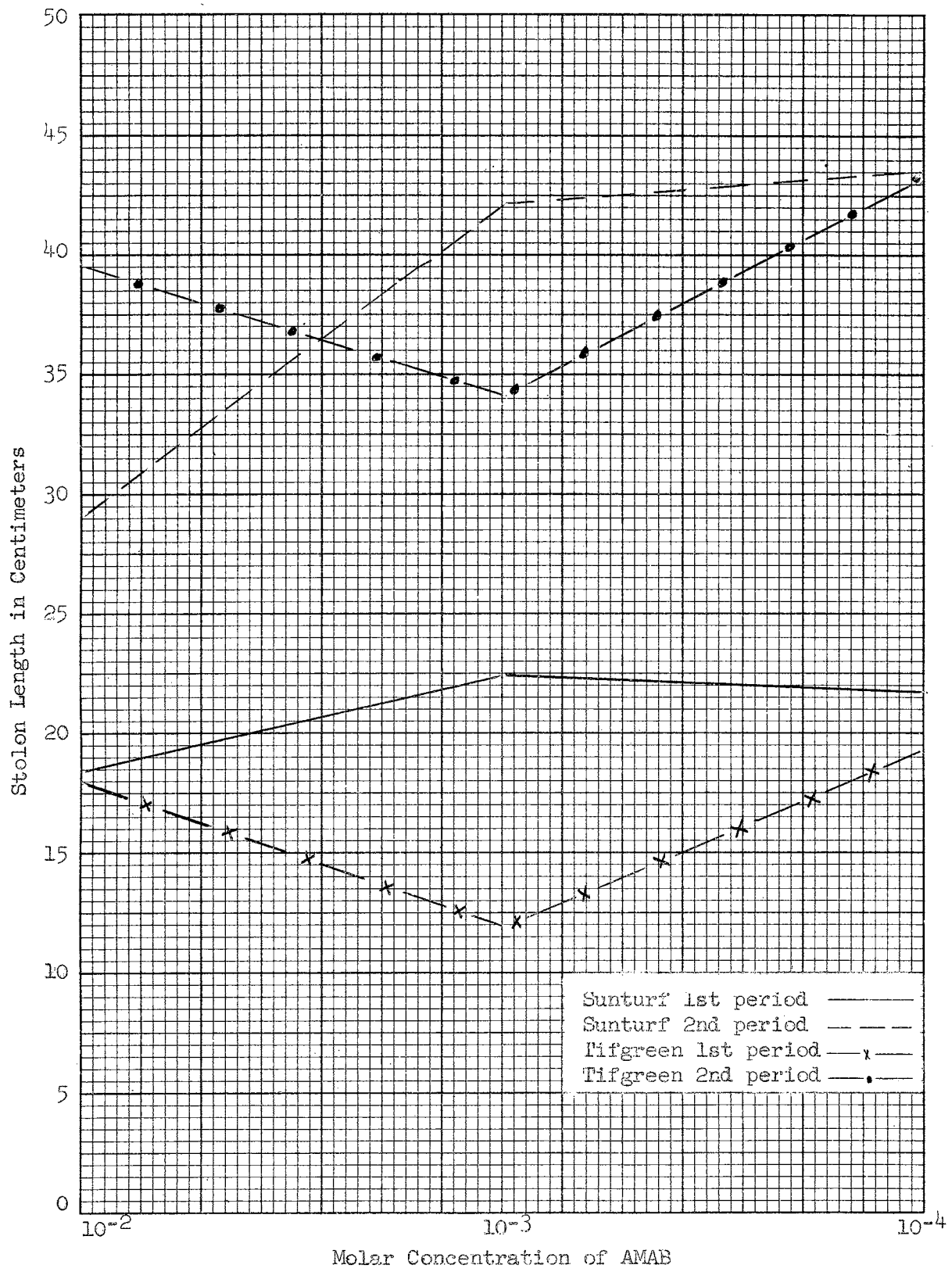


Figure 12. The Effect of AMAB at Three Concentrations upon the Length of Stolons in Centimeters of Four Turf-type Bermudagrasses from 10 to 14 Weeks After Treatment.

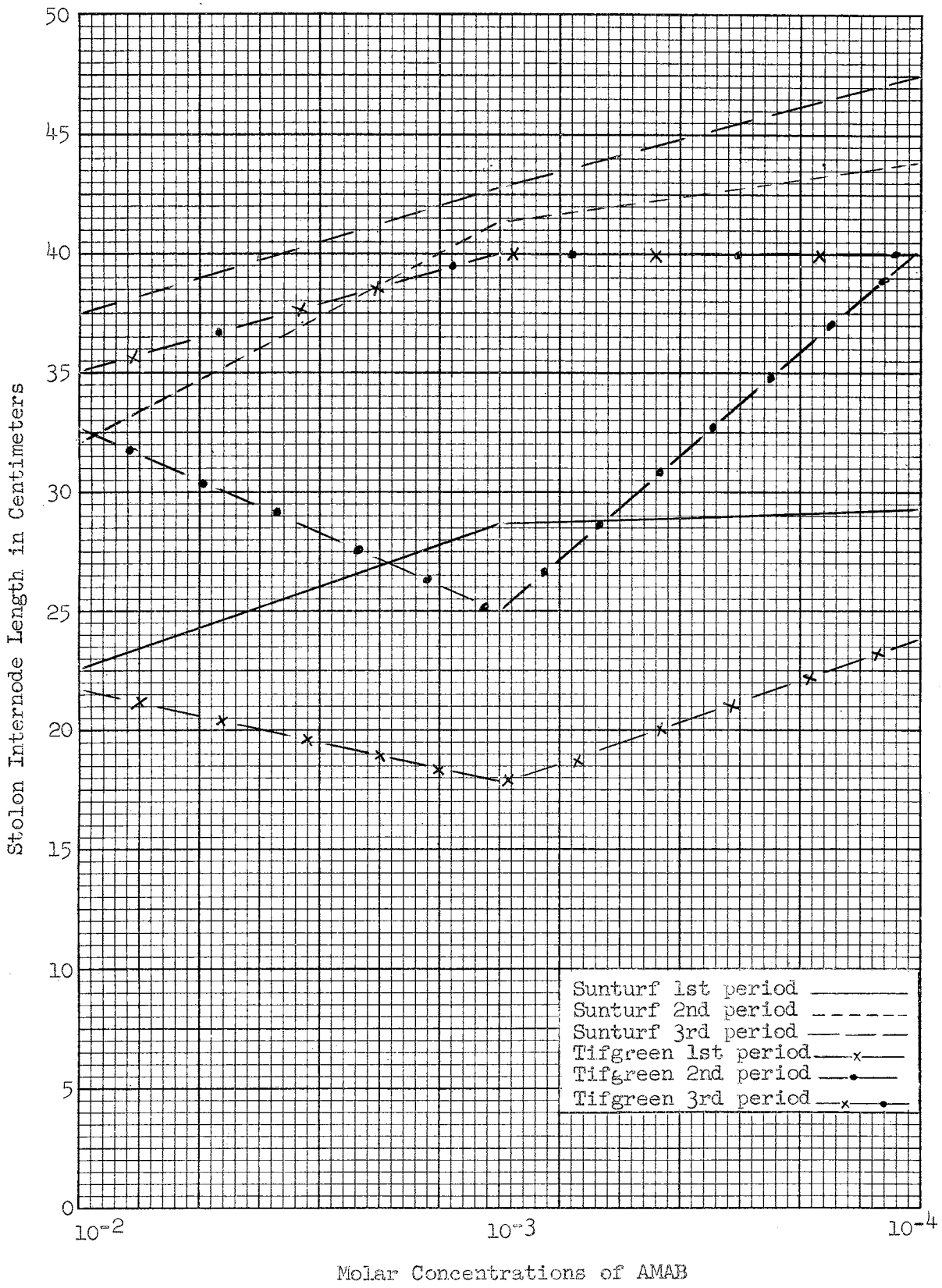


Figure 13. The Effect of AMAB at Three Concentrations upon Stolon Internode Length in Centimeters of Four Turf-type Bermudagrasses from 10 to 14 Weeks After Treatment.

treatment on Sunturf (Figure 12).

AMAB appeared to increase oven-dry weight (Figure 14) at the higher concentration. This, however, seemed to be due to the increased number of upright stems, rather than height of plant.

The growth suppressing effect from AMAB seemed to subside ten weeks after application. The stolon length of Sunturf was the only grass showing much suppression when this study was terminated fourteen weeks after the first application.

Effects of Maleic Hydrazide

The analysis of the first period or at the time of chemical application is used as a reference point for the stolon internode length to determine whether suppression occurred. The other analyses are shown as the growth or formation of nodes from one measurement date to the following measurement date. The measurement taken on May 28 was subtracted from the measurement on June 9 to analyze the amount of growth. Also the June 9 measurement was subtracted from the June 24 measurement to analyze growth during that period. These are referred to as first and second periods.

From the data obtained, it would appear that maleic hydrazide will reduce the length of stolons, internodes, and reduce the oven-dry weight of clippings from bermudagrass plants. Plants appeared to be suppressed in such a manner that the cell elongation and cell division were suppressed, thus suppressing the formation of nodes (Figures 15 and 16). The 8 pound rate gave the greatest suppression, however, three of the four replications of this treatment showed a severe burning effect, with a slight purple coloration of leaves, which could be an indication of anthocyanin accumulation. The data indicate that 8 pounds of MH-30

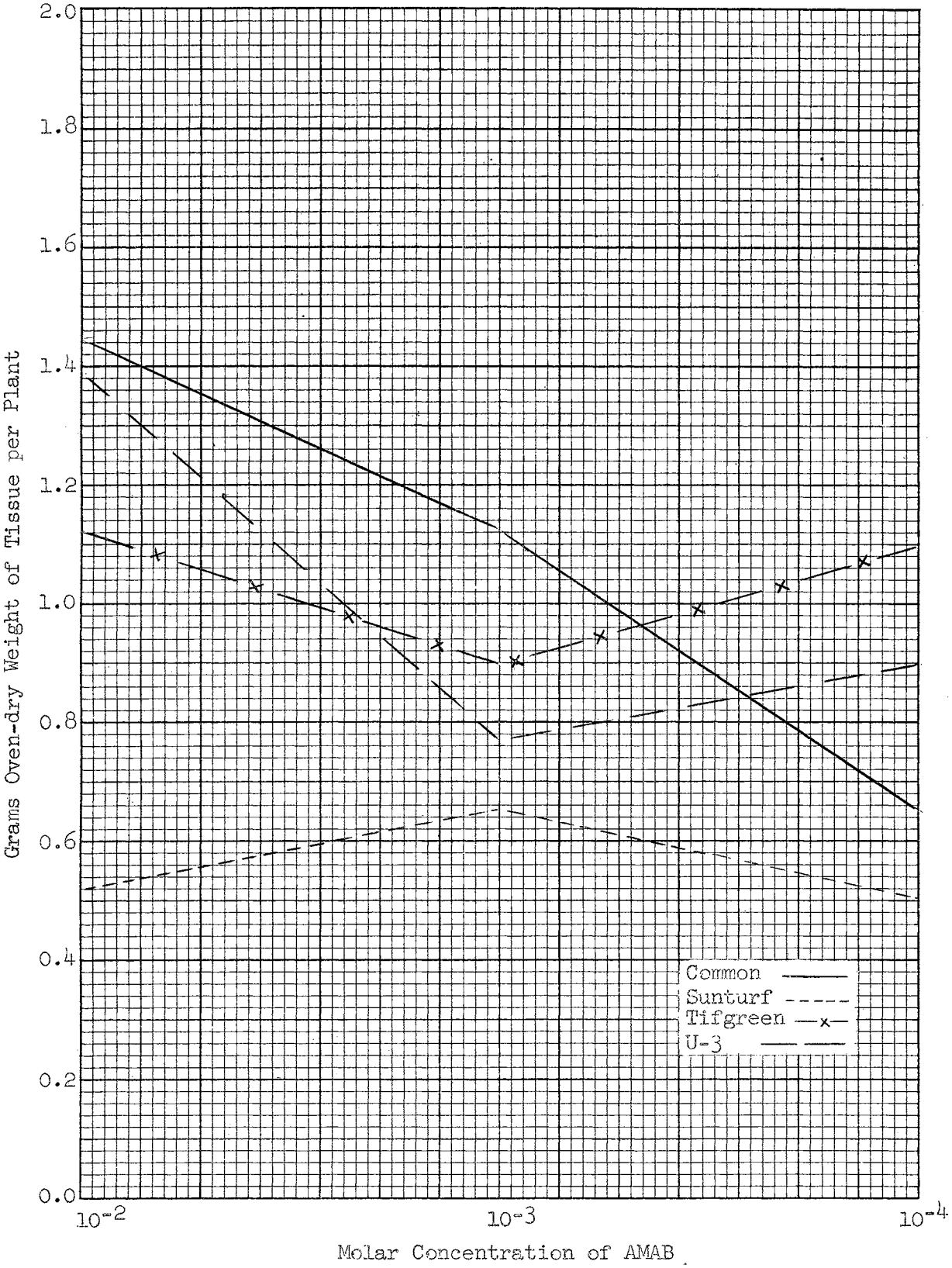


Figure 14. The Effect of AMAB at Three Concentrations upon the Oven-dry Weight in Grams of Plant Tissue of Four Turf-type Bermudagrasses 14 Weeks After Treatment.

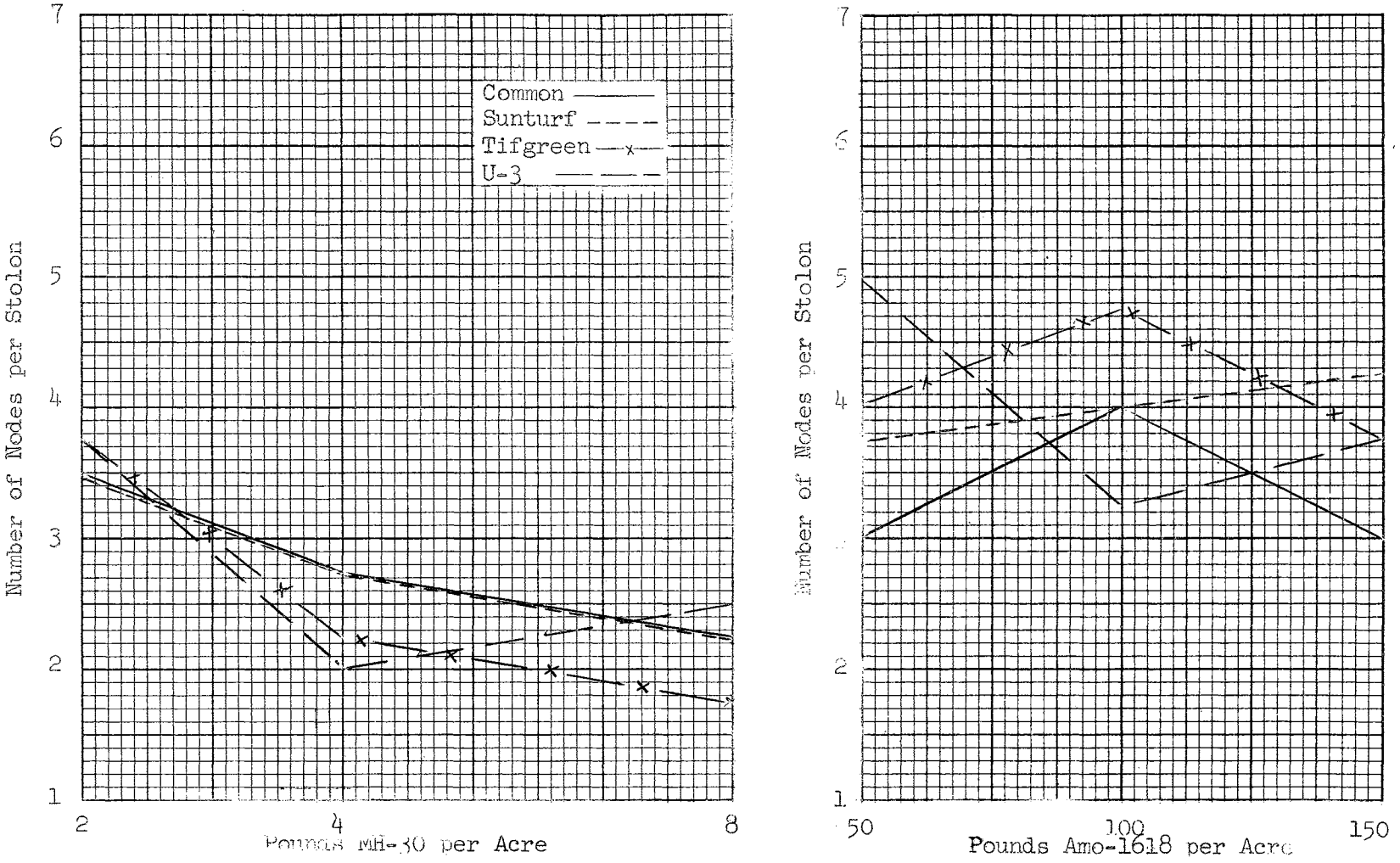


Figure 15. The Effect of Two Growth Suppressant Chemicals at Various Rates upon the Number of Nodes per Stolon of Four Turf-type Bermudagrasses 2 Weeks After Treatment.

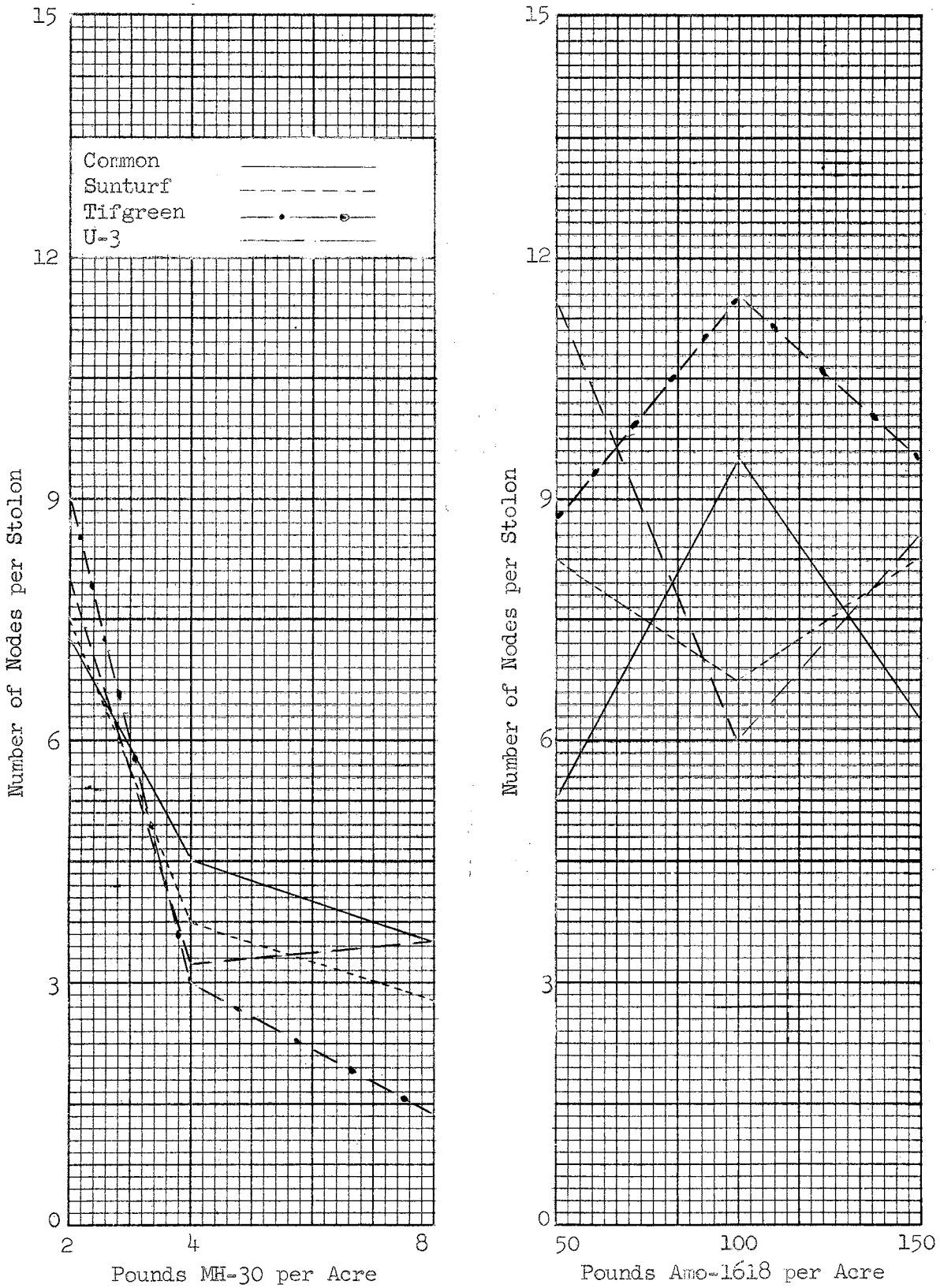


Figure 16. The Effect of Two Growth Suppressant Chemicals at Various Rates upon the Number of Nodes per Stolon of Four Turf-type Bermudagrasses 4 Weeks After Treatment.

reduced the size of plants (Figures 17, 18, 19 and 20). This probably is the result of burning of the plant.

The data show a significant linear reduction of length of stolon (Figure 19), and internodes (Figure 18) of Tifgreen after two weeks from application at the 2, 4, and 8 pound rates of maleic hydrazide. It was found that at four weeks after application the formation of nodes was suppressed greatly at the 4 pound rate. More suppression was found at the 8 pound rate but not in proportion to the suppression from the 2 and 4 pound rates. In the third period or four weeks after application the internode length was significantly reduced (Appendix Table XXXVII). The growth of stolons and formation of nodes were linearly suppressed for the first two weeks after application. For the remaining two weeks it appeared that the 4 pound rate suppressed node formation at about the same magnitude as that of the 8 pound rate. Oven-dry weight of clippings was linearly reduced from the low rate of 2 pounds to 8 pounds active material, except common bermudagrass where the 4 pound rate reduced the oven-dry weight more than the 2 or 8 pound rate (Figure 21).

Maleic hydrazide linearly reduced the internode length of U-3 (Appendix Table XXXIX), and the length of stolons of common bermudagrass about four weeks after application.

It would appear that maleic hydrazide starts to act shortly after application and is more effective upon the finer leaved grasses such as Tifgreen and Sunturf than the medium to coarse textured U-3 and common bermudagrasses.

It might appear since the formation of nodes was suppressed as well as the length of stolons and internodes that cell division was suppressed, whereas, cell elongation was normal.

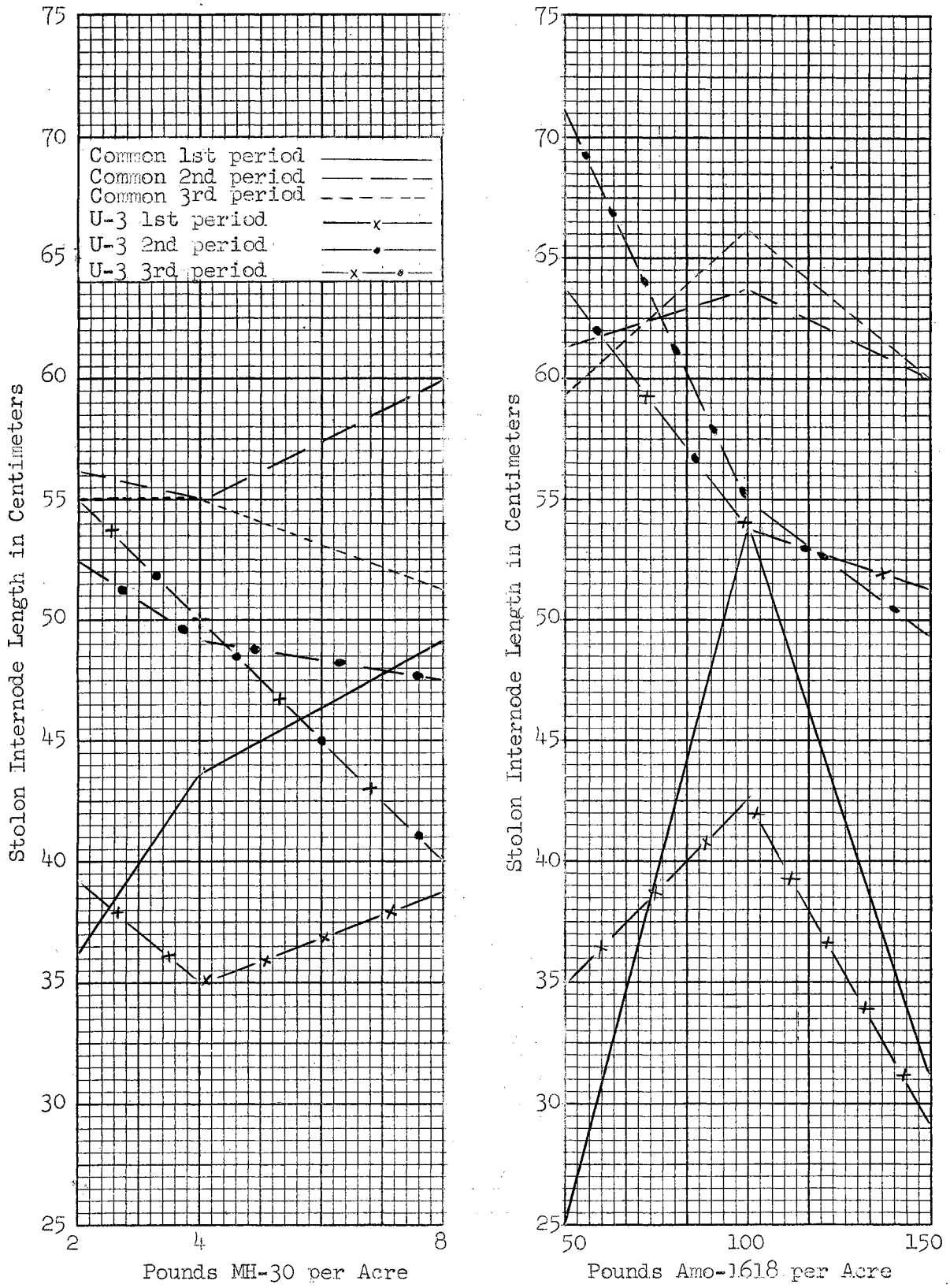


Figure 17. The Effect of Two Growth Suppressant Chemicals at Various Rates upon the Stolon Internode Length in Centimeters from Four Turf-type Bermudagrasses 2 and 4 Weeks After Treatment.

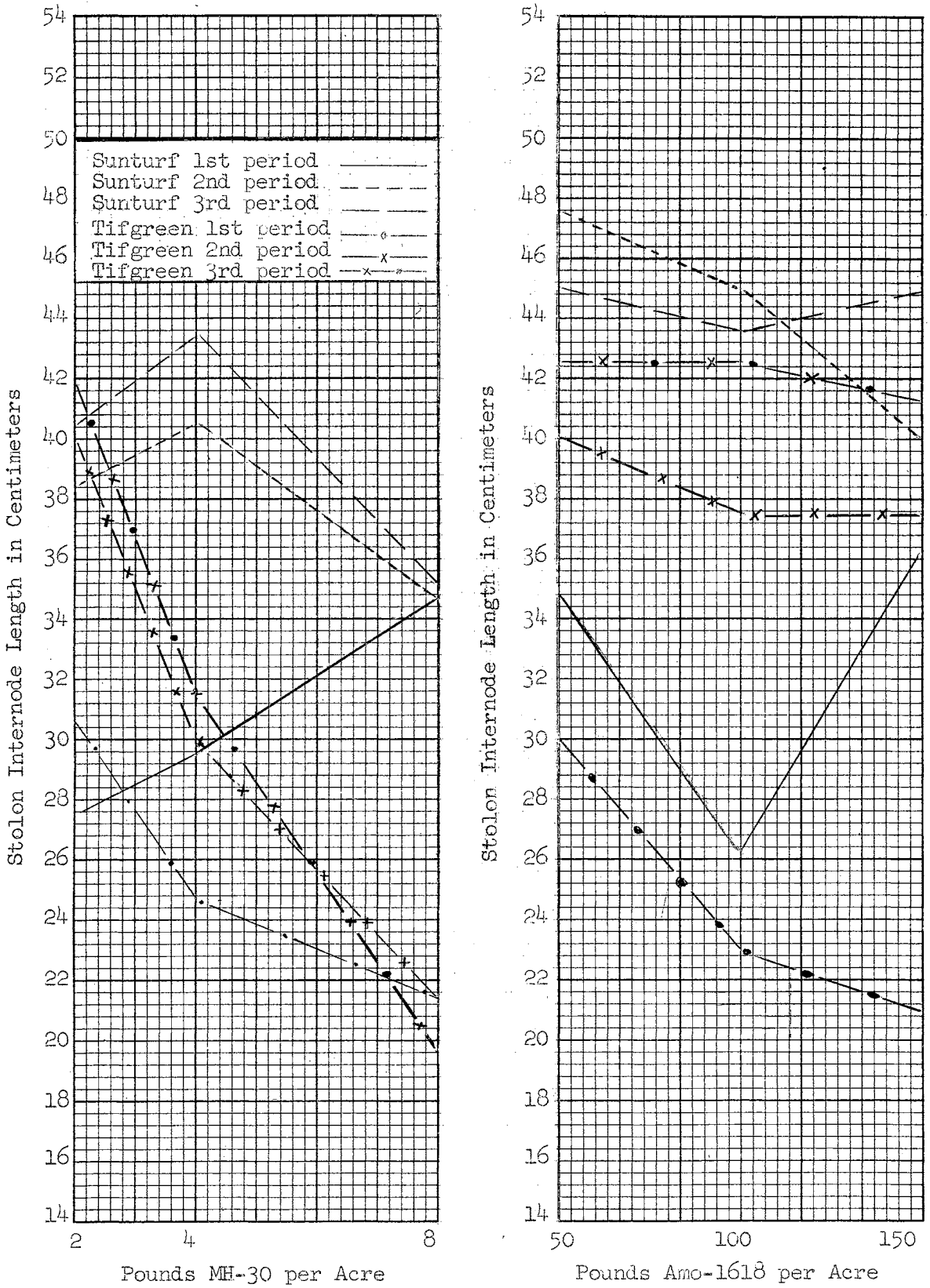


Figure 18. The Effect of Two Growth Suppressants at Various Rates upon the Stolon Internode Length in Centimeters of Two Turf-type Bermudagrasses 2 and 4 Weeks After Treatment.

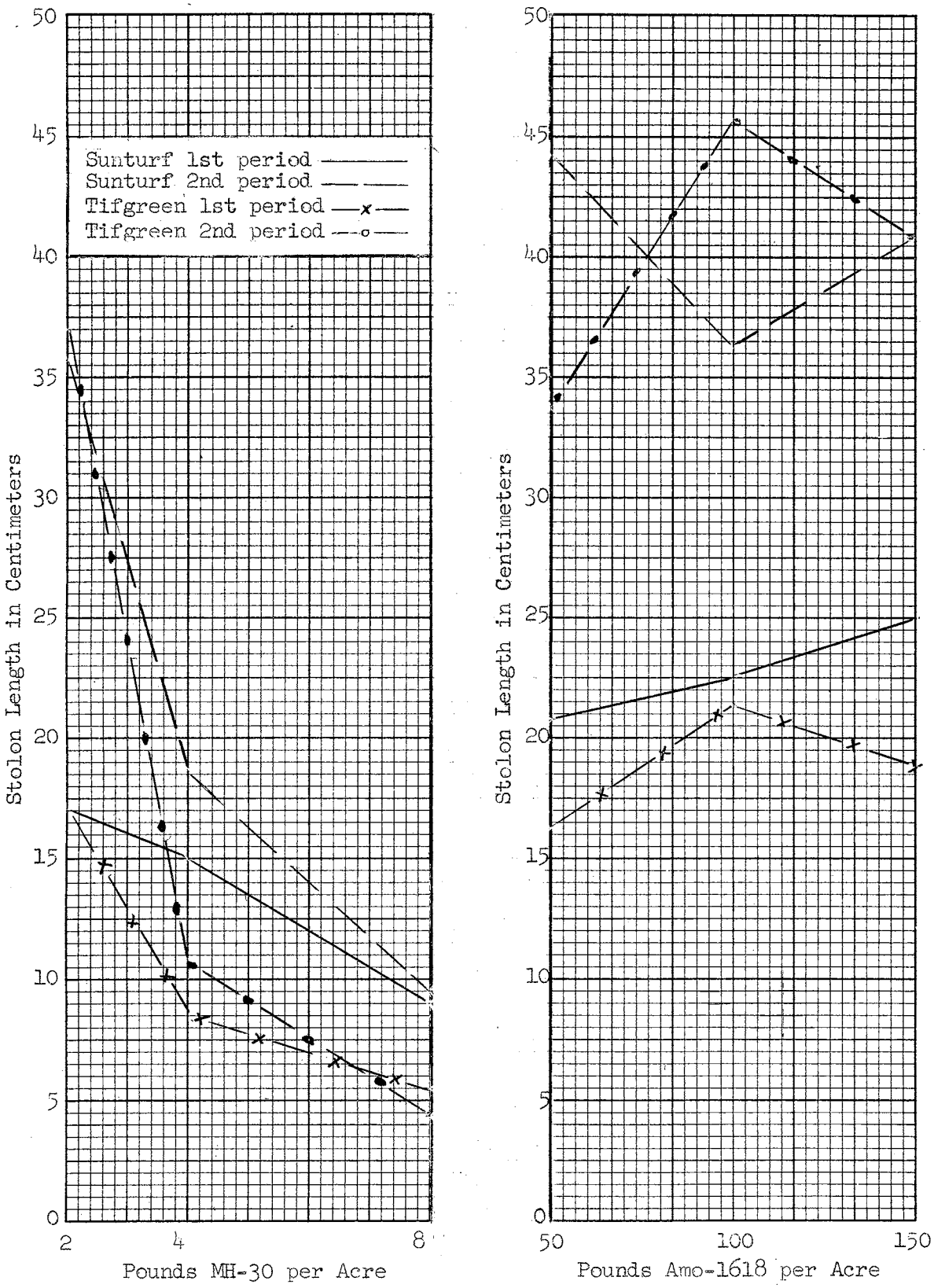


Figure 19. The Effect of Two Growth Suppressant Chemicals at Various Rates upon the Stolon Length in Centimeters of Two Turf-type Bermudagrasses 2 and 4 Weeks After Treatment.

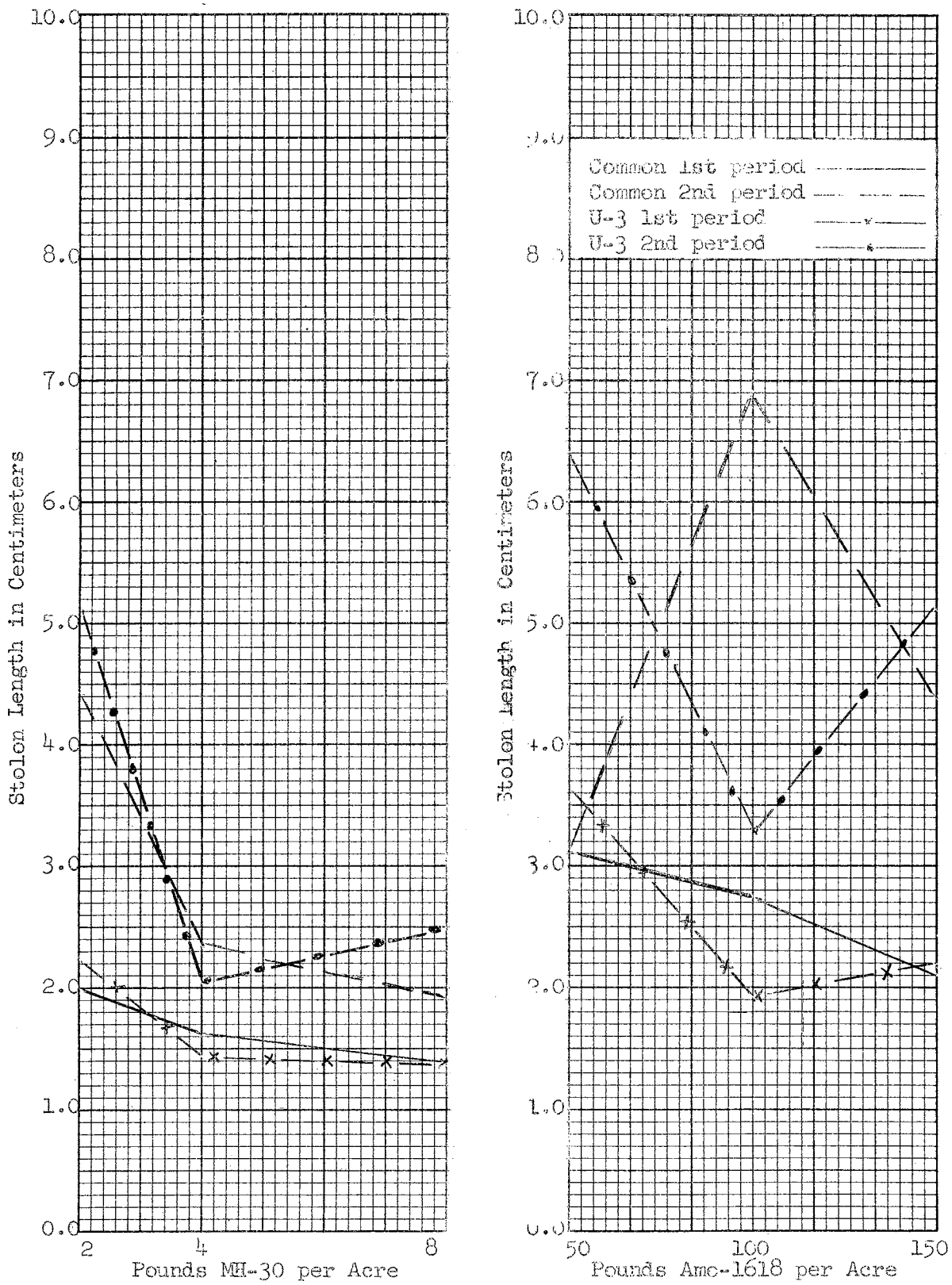


Figure 20. The Effect of Two Growth Suppressant Chemicals at Various Rates upon the Stolon Length in Centimeters of Two Turf-type Bermudagrasses 2 and 4 Weeks After Treatment.

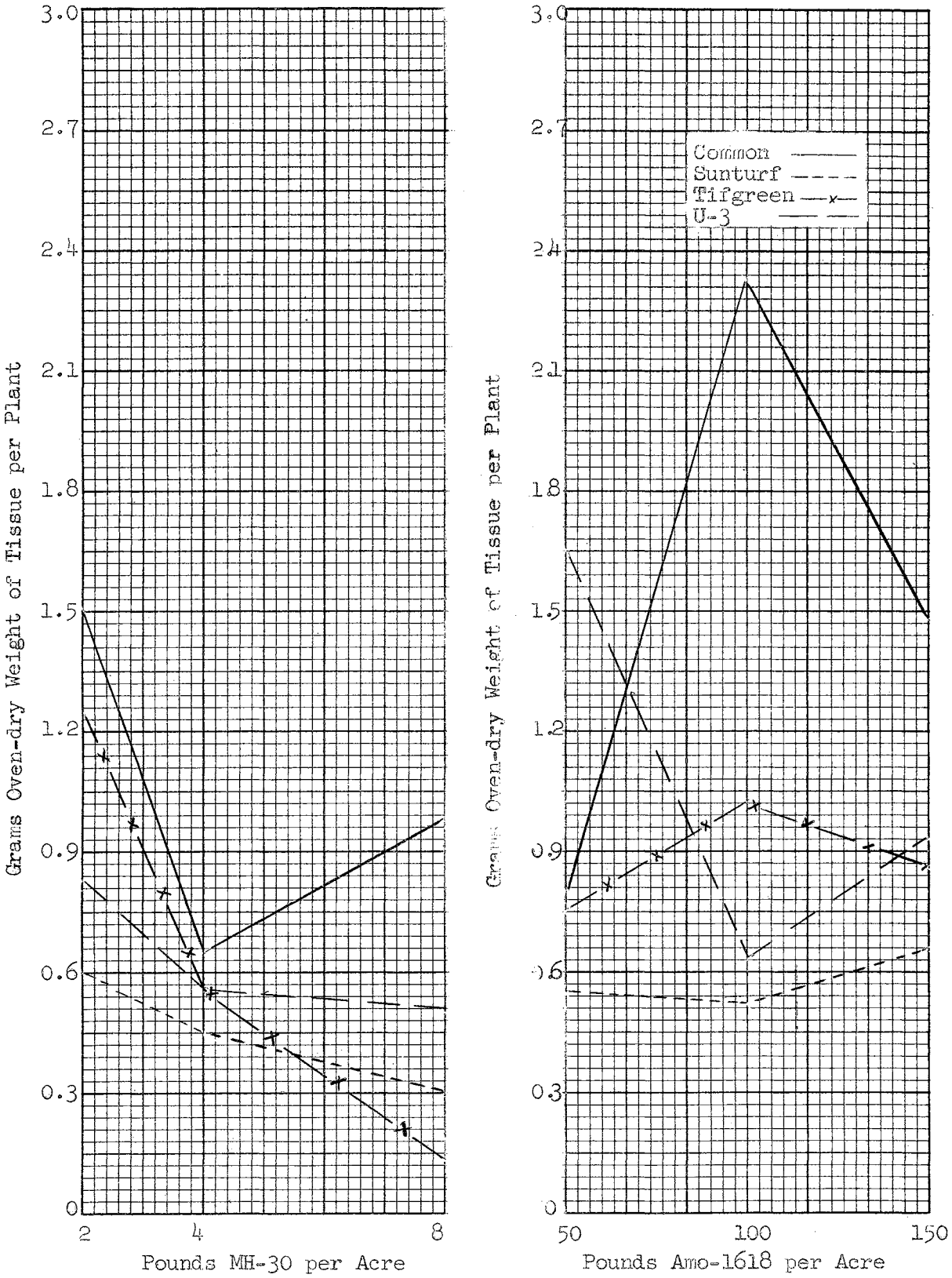


Figure 21. The Effect of Two Growth Suppressant Chemicals at Various Rates upon the Oven-dry Weight of Plant Tissue of Four Turf-type Bermudagrasses 4 Weeks After Treatment.

Effects of Amo-1618

Action of Amo-1618 on bermudagrass was analyzed using the same procedure as with MH-30, in that the first period, or at the time of application, the stolon internode length was used as a reference to determine whether growth was suppressed at later measurement dates.

It was found that, at the end of the study or 27 days after treatment, the 100 pound rate gave what appeared to be a growth promoting effect on Tifgreen and common bermudagrass.

U-3 tended to have the reverse effect in that the 100 pound rate suppressed the growth of internodes, stolon length and reduced the dry weight. About 4 weeks after application U-3 gave a linear reduction of the internode length with the 150 pound rate giving the greatest suppression (Figure 17).

As shown in Figures 15 and 16, Amo-1618 did not show any suppression, at any rate, of the formation of nodes on any of the four turf-type bermudagrasses. However, the growth of the length of internode appeared to be slowed after application (Figures 17 and 18).

CHAPTER V

SUMMARY AND CONCLUSIONS

Two studies to determine the effect of four growth suppressing substances upon four commercially important turf-type bermudagrasses were conducted at the Agronomy Research Station, west of Stillwater, Oklahoma. One study was to test the effect of AMAB and CCC upon established bermudagrass plants. The second study concerned the residual effects of these chemicals upon plants started from stolons of treated plants and the effects of MH-30 and Amo-1618 upon plants started from untreated stolons.

The growth suppression was analyzed by measurements of the length of the stolons and internodes, number of nodes per stolon and dry weight of the plant.

All grasses were suppressed after application of CCC or AMAB at the 10^{-3} and 10^{-2} molar concentrations. Tifgreen and Sunturf were also suppressed with the 10^{-4} concentration. The highest concentration, 10^{-2} molar, of both CCC and AMAB gave the best response by reducing the stolon length, internode length, and increasing the number of nodes per stolon. Visual observations throughout the study detected a deeper green color and seemingly, an increased number of upright stems on all plants treated with CCC or AMAB. The number of upright stems was not counted nor measured in any way. Both chemicals tended to lose some of their growth suppression effect about ten weeks after application. After fourteen weeks growth of the plants treated with AMAB and CCC were about

equal to the checks and, in some comparisons, such as dry weight, exceeded the check plants. It would appear that as AMAB and CCC lose their suppressing effects they might act as growth promoters.

Maleic hydrazide, when used on plants grown from stolons reduced growth drastically. Plant growth tended to be slowed or to cease about two weeks after treatment. At the 8 pound rate a very slow growth rate was observed and plants tended to burn or turn a purplish color which appeared to be an indication of an anthocyanin accumulation. Two and four pound concentrations were effective in growth suppression for the duration of this study, or four weeks, and did not give any noticeable burn at two pounds and only slight discoloration at the four pound rate.

There seemed to be a large amount of variability within the different rates of Amo-1618 and also between grasses. The results obtained from the Amo-1618 treatments tend to show very little growth suppressing ability. As shown in Figure 14, an increased stolon length was produced at the 150 pound rate per acre compared to the 50 pound rate on all grasses except U-3. Growth suppression of stolon length was found in U-3 primarily at the 100 pound rate.

The author is of the opinion that MH-30 reduced cell division and at the same time maintained normal cell elongation. A suppression of cell division such as stated here might be substantiated by Esau (4) in work upon other grasses such as oats and barley. The effect of CCC and AMAB were the reverse in that the number of nodes formed was increased and in the meantime the length of stolons and internodes were decreased. This would appear to be a suppression of the cell elongation, whereas, the cell division remains unaffected.

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APPENDIX

TABLE I

AVERAGE OVEN-DRY WEIGHT IN GRAMS OF PLANT TISSUE FROM TREATED STOLONS*

Treatments	Tifgreen	Sunturf	U-3	Common
CCC**				
10^{-4} M.	1.17	0.50	0.47	1.17
10^{-3} M.	0.92	0.57	0.85	1.22
10^{-2} M.	1.27	0.47	1.00	1.55
AMAB**				
10^{-4} M.	1.07	0.50	0.90	0.65
10^{-3} M.	0.90	0.65	0.77	1.12
10^{-2} M.	1.12	0.52	1.32	1.45
MH-30***				
2#	1.25	0.60	0.82	1.50
4#	0.52	0.45	0.52	0.62
8#	0.12	0.30	0.50	0.97
Amo-1618***				
50#	0.75	0.55	1.65	0.80
100#	1.12	0.52	0.62	2.32
150#	0.87	0.67	0.95	1.47
Check ****				
1	1.32	0.55	0.70	0.75
2	1.22	0.52	1.27	0.82
3	1.37	0.47	1.25	0.87

*Average from four replications.
**Clippings from plants fourteen weeks after treatment.
***Clippings from plants five weeks after treatment.
****Clippings from plants grown from transplanted stolons.

TABLE II

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE GROWTH OF TIFGREEN STOLONS FROM THE FIRST TO SECOND PERIOD IN THE GREENHOUSE

Source	DF	SS	MS	"F"
Total	35	536.000		
Treatments	8	207.000	25.875	2.12
Chemical	1	0.000	0.000	0.00
Rate	2	30.000	15.000	1.23
Chem. x Rate	2	7.000	3.500	1.29
Residual	3	170.000	5.667	1.47
Ck. vs. others	(1)	168.000	168.000	13.79**
Within check	(2)	2.000	1.000	0.08
Within Chem. I	2	27.167	13.583	1.12
Linear	(1)	3.515	3.515	0.29
Quadratic	(1)	23.652	23.652	1.94
Within Chem. II	2	9.500	4.750	0.39
Linear	(1)	1.116	1.116	0.09
Quadratic	(1)	8.384	8.384	0.69
Error	27	329.000	12.185	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE III

ANALYSIS IF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE INTERNODE LENGTH OF TIFGREEN STOLONS IN THE FIRST PERIOD IN THE GREENHOUSE

Source	DF	SS	MS	"F"
Total	35	758.000		
Treatments	8	547.000	68.375	8.75
Chemical	1	57.000	57.000	7.30*
Rate	2	191.000	95.500	12.22**
Chem. x Rate	2	30.000	15.000	1.92
Residual	3	269.000	89.667	11.48**
Ck. vs. others	(1)	253.800	253.800	32.48**
Within check	(2)	15.200	7.600	0.97
Within Chem. I	2	123.167	61.583	7.09**
Linear	(1)	111.905	111.905	14.32**
Quadratic	(1)	11.262	11.262	1.44
Within Chem. II	2	98.002	49.001	6.27**
Linear	(1)	80.121	80.121	10.25**
Quadratic	(1)	17.881	17.881	2.29
Error	27	211.000	7.814	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE IV

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE INTERNODE LENGTH OF SUNTURF STOLONS IN THE FIRST PERIOD IN THE GREENHOUSE

Source		DF	SS	MS	"F"
Total		35	963.000		
Treatments		8	769.000	96.125	13.38
Chemical	1		67.000	67.000	9.33**
Rate	2		270.000	135.000	18.79**
Chem. x Rate	2		29.000	14.500	2.02
Residual	3		409.000	136.333	18.98**
Ck. vs. others	(1)		397.800	397.800	55.37**
Within check	(2)		11.200	5.600	0.78
Within Chem. I		2	220.500	110.250	16.72**
Linear	(1)		219.679	219.679	30.57**
Quadratic	(1)		0.821	0.821	0.01
Within Chem. II		2	78.167	39.083	5.44**
Linear	(1)		62.486	62.486	8.70**
Quadratic	(1)		15.681	15.681	2.18
Error		27	194.000	7.185	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE V

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE INTERNODE LENGTH OF U-3 STOLONS IN THE FIRST PERIOD IN THE GREENHOUSE

Source		DF	SS	MS	"F"
Total		35	687.000		
Treatments		8	402.000	50.250	4.76
Chemical	1		3.000	3.000	0.28
Rate	2		220.000	110.000	10.42**
Chem. x Rate	2		55.000	27.500	2.61
Residual	3		124.000	41.333	3.92*
Ck. vs. others	(1)		110.500	110.500	10.47**
Within check	(2)		13.500	6.750	0.64
Within Chem. I		2	160.167	80.083	7.58**
Linear	(1)		159.084	159.084	15.07**
Quadratic	(1)		1.083	1.083	1.03
Within Chem. II		2	114.667	57.333	5.43**
Linear	(1)		52.998	52.998	5.02*
Quadratic	(1)		61.669	61.669	5.84*
Error		27	285.000	10.556	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE VI

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE INTERNODE LENGTH OF COMMON STOLONS IN THE FIRST PERIOD IN THE GREENHOUSE

Source		DF	SS	MS	"F"
Total		35	1819.000		
Treatments		8	1063.000	132.875	4.75
Chemical	1		5.000	5.000	0.18
Rate	2		640.000	320.000	11.43**
Chem. x Rate	2		79.000	39.500	1.41
Residual	3		339.000	113.000	4.04*
Ck. vs. others	(1)		275.500	275.500	9.84**
Within check	(2)		63.500	31.750	1.13
Within Chem. I	2		582.167	291.083	10.39**
Linear	(1)		511.219	511.219	18.26**
Quadratic	(1)		70.948	70.948	2.53
Within Chem. II	2		136.167	68.083	2.43
Linear	(1)		109.459	109.459	3.91
Quadratic	(1)		26.708	26.708	0.95
Error		27	756.000	28.000	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE VII

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE INTERNODE LENGTH OF TIFGREEN STOLONS IN THE SECOND PERIOD IN THE GREENHOUSE

Source		DF	SS	MS	"F"
Total		35	570.000		
Treatments		8	411.000	51.375	8.72
Chemical	1		43.000	43.000	7.30*
Rate	2		79.000	39.500	6.71**
Chem. x Rate	2		4.000	2.000	0.34
Residual	3		285.000	95.000	16.13**
Ck. vs. others	(1)		272.800	272.800	46.32**
Within check	(2)		12.200	6.100	1.04
Within Chem. I	2		50.667	25.333	4.30*
Linear	(1)		39.405	39.405	6.69*
Quadratic	(1)		11.262	11.262	1.91
Within Chem. II	2		32.667	16.333	2.77
Linear	(1)		32.445	32.445	5.51*
Quadratic	(1)		0.222	0.222	0.04
Error		27	159.000	5.889	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE VIII

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE NUMBER OF NODES PER STOLON OF TIFGREEN IN THE FIRST PERIOD IN THE GREENHOUSE

Source		DF	SS	MS	"F"
Total		35	62.000		
Treatments		8	51.000	6.375	15.66
Chemical	1		7.000	7.000	17.20**
Rate	2		23.000	11.500	28.26**
Chem. x Rate	2		4.000	2.000	4.91*
Residual	3		17.000	5.667	13.92**
Ck. vs. others	(1)		16.300	16.300	40.05**
Within check	(2)		0.700	0.350	0.86
Within Chem. I	2		20.667	10.333	25.39**
Linear	(1)		19.513	19.513	47.94**
Quadratic	(1)		1.154	1.154	2.84
Within Chem. II	2		6.167	3.083	7.58**
Linear	(1)		5.405	5.405	13.28**
Quadratic	(1)		0.762	0.762	1.87
Error		27	11.000	0.407	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE IX

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE NUMBER OF NODES PER STOLON OF SUNTURF IN THE FIRST PERIOD IN THE GREENHOUSE

Source		DF	SS	MS	"F"
Total		35	54.000		
Treatments		8	47.000	5.875	22.68
Chemical	1		6.000	6.000	23.17**
Rate	2		20.000	10.000	38.61**
Chem. x Rate	2		5.000	2.500	9.65**
Residual	3		16.000	5.333	20.59**
Ck. vs. others	(1)		15.800	15.800	61.00**
Within check	(2)		0.200	0.100	0.39
Within Chem. I	2		22.167	11.083	42.79**
Linear	(1)		22.165	22.165	85.58**
Quadratic	(1)		0.002	0.002	0.01
Within Chem. II	2		3.167	1.583	6.11**
Linear	(1)		2.841	2.841	10.97**
Quadratic	(1)		0.326	0.326	1.26
Error		27	7.000	0.259	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE X

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE NUMBER OF NODES PER STOLON OF U-3 IN THE FIRST PERIOD IN THE GREENHOUSE

Source		DF	SS	MS	"F"
Total		35	25.000		
Treatments		8	17.000	2.125	7.18
Chemical	1		1.000	1.000	3.38
Rate	2		9.000	4.500	1.52
Chem. x Rate	2		2.000	1.000	3.38*
Residual	3		5.000	1.667	5.63**
Ck. vs. others	(1)		4.500	4.500	15.20**
Within check	(2)		0.500	0.250	0.85
Within Chem I	2		7.167	3.583	12.11**
Linear	(1)		7.148	7.148	24.12**
Quadratic	(1)		0.019	0.019	0.07
Within Chem II	2		4.167	2.083	7.04**
Linear	(1)		1.351	1.351	4.56*
Quadratic	(1)		2.816	2.816	9.51**
Error		27	8.000	0.296	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XI

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE NUMBER OF NODES PER STOLON OF COMMON IN THE FIRST PERIOD IN THE GREENHOUSE

Source		DF	SS	MS	"F"
Total		35	19.000		
Treatments		8	11.000	1.375	4.65
Chemical	1		0.000	0.000	0.00
Rate	2		6.000	3.000	10.14**
Chem. x Rate	2		2.000	1.000	3.38*
Residual	3		3.000	1.000	3.38*
Ck. vs. others	(1)		2.800	2.800	9.46**
Within check	(2)		0.200	0.100	0.34
Within Chem I	2		6.500	3.250	10.98**
Linear	(1)		6.246	6.246	21.10**
Quadratic	(1)		0.254	0.254	0.86
Within Chem II	2		1.167	0.583	1.97
Linear	(1)		1.094	1.094	3.70
Quadratic	(1)		0.073	0.073	0.25
Error		27	8.000	0.296	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XII

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE NUMBER OF NODES PER STOLON OF TIFGREEN IN THE SECOND PERIOD IN THE GREENHOUSE

Source		DF	SS	MS	"F"
Total		35	55.000		
Treatments		8	28.000	3.500	3.50
Chemical	1		12.000	12.000	12.00**
Rate	2		8.000	4.000	4.00*
Chem. x Rate	2		1.000	0.500	0.50
Residual	3		7.000	2.333	2.33
Ck. vs. other	(1)		6.900	6.900	6.90**
Within check	(2)		0.100	0.050	0.05
Within Chem. I	2		4.667	2.333	2.33
Linear	(1)		3.905	3.905	3.90
Quadratic	(1)		0.762	0.762	0.76
Within Chem. II	2		4.500	2.250	2.25
Linear	(1)		3.679	3.679	3.68
Quadratic	(1)		0.821	0.821	0.82
Error		27	27.000	1.000	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XIII

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE GROWTH OF STOLONS OF TIFGREEN FROM THE FIRST TO SECOND PERIOD IN THE FIELD

Source		DF	SS	MS	"F"
Total		59	1777.000		
Replications		3	30.000	10.000	0.63
Treatments		14	1080.000	77.142	4.86
Chemical	3		446.000	148.667	9.36**
Rate	2		0.500	40.000	2.52
Chem. x Rate	6		400.000	66.667	3.95**
Residual	3		154.000	51.333	3.23
Ck. vs. others	(1)		16.000	16.000	1.01
Within check	(2)		138.000	69.000	4.34
Within Chem. I		2	28.500	14.250	0.89
Linear	(1)		22.165	22.165	1.39
Quadratic	(1)		6.335	6.335	0.40
Within Chem. II		2	120.167	60.083	3.78
Linear	(1)		9.534	9.534	0.60
Quadratic	(1)		110.633	110.633	6.97**
Within Chem. III		2	281.167	140.583	8.85**
Linear	(1)		248.842	248.842	15.67**
Quadratic	(1)		32.325	32.325	2.04
Within Chem. IV		2	50.160	25.080	1.58
Linear	(1)		15.125	15.125	0.95
Quadratic	(1)		35.035	35.035	2.21
Error		42	667.000	15.881	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XIV

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE GROWTH OF STOLONS OF SUNTURF FROM THE FIRST TO SECOND PERIOD IN THE FIELD

Source		DF	SS	MS	"F"
Total		59	1638.000		
Replications		3	70.000	23.333	1.40
Treatments		14	867.000	61.929	3.71
Chemical	3		543.000	181.000	10.85**
Rate	2		32.000	16.000	0.96
Chem. x Rate	6		245.000	40.833	2.45*
Residual	3		47.000	15.660	0.94
Ck. vs. others	(1)		31.800	31.800	1.91
Within check	(2)		15.200	7.600	0.46
Within Chem. I	2		42.667	21.333	1.28
Linear	(1)		10.976	10.976	0.66
Quadratic	(1)		31.691	31.691	1.89
Within Chem. II	2		43.167	21.583	1.29
Linear	(1)		41.625	41.625	1.49
Quadratic	(1)		1.542	1.542	0.09
Within Chem. III	2		148.167	74.083	4.44*
Linear	(1)		144.293	144.293	8.65**
Quadratic	(1)		3.874	3.874	0.23
Within Chem. IV	2		45.500	22.750	1.36
Linear	(1)		36.125	36.125	2.16
Quadratic	(1)		9.125	9.125	0.55
Error		42	701.000	16.690	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XV

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE GROWTH OF STOLONS OF U-3 FROM THE FIRST TO SECOND PERIOD IN THE FIELD

Source		DF	SS	MS	"F"
Total		59	4735.000		
Replications		3	55.000	18.333	0.35
Treatments		14	2507.000	179.071	3.46
Chemical	3		692.000	230.667	4.46**
Rate	2		550.000	225.000	5.32**
Chem. x Rate	6		454.000	75.667	1.46
Residual	3		811.000	270.333	5.23**
Ck. vs. others	(1)		767.800	767.800	14.84**
Within check	(2)		43.200	21.600	0.42
Within Chem. I	2		8.167	4.083	0.10
Linear	(1)		8.111	8.111	0.19
Quadratic	(1)		0.056	0.056	0.00
Within Chem. II	2		56.168	28.084	0.68
Linear	(1)		0.165	0.165	0.04
Quadratic	(1)		56.003	56.003	1.36
Within Chem. III	2		210.167	105.083	2.56
Linear	(1)		118.870	118.870	2.89
Quadratic	(1)		91.297	91.297	2.22
Within Chem. IV	2		730.167	365.083	8.89**
Linear	(1)		450.000	450.000	10.96**
Quadratic	(1)		280.167	280.167	6.82*
Error		42	1725.000	41.071	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XVI

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE GROWTH OF STOLONS OF COMMON FROM THE FIRST TO SECOND PERIOD IN THE FIELD

Source		DF	SS	MS	"F"
Total		59	2440.000		
Replications		3	91.000	30.333	0.74
Treatments		14	624.000	44.571	1.09
Chemical	3		296.000	98.667	2.40*
Rate	2		37.000	18.500	0.45
Chem. x Rate	6		232.000	38.667	0.94
Residual	3		59.000	19.667	0.48
Ck. vs. others	(1)		4.800	4.800	0.12
Within check	(2)		54.200	27.100	0.66
Within Chem. I	2		1.166	0.583	0.01
Linear	(1)		0.000	0.000	0.00
Quadratic	(1)		1.166	1.166	0.03
Within Chem. II	2		12.500	6.250	0.15
Linear	(1)		0.084	0.084	0.00
Quadratic	(1)		12.416	12.416	0.30
Within Chem. III	2		85.167	42.583	1.04
Linear	(1)		78.363	78.363	1.91
Quadratic	(1)		6.804	6.804	0.16
Within Chem. IV	2		170.168	85.084	2.07
Linear	(1)		15.125	15.125	0.37
Quadratic	(1)		55.043	55.043	1.34
Error		42	1725.000	41.071	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XVII

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE NUMBER OF NODES PER STOLON OF TIFGREEN FROM THE FIRST TO SECOND PERIOD IN THE FIELD

Source		DF	SS	MS	"F"
Total		59	76.000		
Replications		3	4.000	1.333	1.37
Treatments		14	31.000	2.214	2.27
Chemical	3		17.000	5.667	5.81**
Rate	2		2.000	1.000	1.03
Chem. x Rate	6		10.000	1.667	1.71
Residual	3		5.000	1.667	1.71
Ck. vs. others	(1)		4.200	4.200	4.30*
Within check	(2)		0.200	0.100	0.10
Within Chem. I		2	1.167	0.583	0.59
Linear	(1)		0.014	0.014	0.01
Quadratic	(1)		1.153	1.153	1.18
Within Chem. II		2	0.167	0.083	0.09
Linear	(1)		0.165	0.165	0.17
Quadratic	(1)		0.002	0.002	0.00
Within Chem. III		2	8.667	4.333	4.44
Linear	(1)		6.749	6.749	6.91*
Quadratic	(1)		1.918	1.918	1.96
Within Chem. IV		2	2.167	1.083	1.11
Linear	(1)		0.125	0.125	0.13
Quadratic	(1)		2.042	2.042	2.09
Error		42	41.000	0.976	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XVIII

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE NUMBER OF NODES PER STOLON OF SUNTURF FROM THE FIRST TO SECOND PERIOD IN THE FIELD

Source		DF	SS	MS	"F"
Total		59	52.000		
Replications		3	4.000	1.333	2.54
Treatments		14	26.000	1.857	3.54
Chemical	3		16.000	5.333	10.18**
Rate	2		0.000	0.000	0.00
Chem. x Rate	6		9.000	1.500	2.86*
Residual	3		1.000	0.333	0.64
Ck. vs. others	(1)		1.000	1.000	1.91
Within check	(2)		0.000	0.000	0.00
Within Chem. I		2	3.500	1.750	3.34*
Linear	(1)		3.250	3.250	6.20*
Quadratic	(1)		0.250	0.250	0.48
Within Chem. II		2	1.167	0.583	1.11
Linear	(1)		0.084	0.084	0.16
Quadratic	(1)		1.083	1.083	2.07
Within Chem. III		2	3.167	1.583	3.02
Linear	(1)		2.823	2.823	5.39*
Quadratic	(1)		0.344	0.344	0.66
Within Chem. IV		2	5.000	2.500	4.77**
Linear	(1)		0.500	0.500	0.95
Quadratic	(1)		0.000	0.000	0.00
Error		42	22.000	0.524	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XIX

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE NUMBER OF NODES PER STOLON OF U-3 FROM THE FIRST TO SECOND PERIOD IN THE FIELD

Source		DF	SS	MS	"F"
Total		59	138.000		
Replications		3	2.000	0.667	0.26
Treatments		14	30.000	2.143	0.85
Chemical	3		12.000	4.000	1.59
Rate	2		5.000	2.500	0.99
Chem. x Rate	6		10.000	1.667	0.66
Residual	3		3.000	1.000	0.40
Ck. vs. others	(1)		0.800	0.800	0.32
Within check	(2)		2.200	1.100	0.44
Within Chem. I		2	5.000	2.500	0.99
Linear	(1)		0.003	0.003	0.00
Quadratic	(1)		4.997	4.997	1.98
Within Chem. II		2	3.500	1.750	0.69
Linear	(1)		0.976	0.976	0.39
Quadratic	(1)		2.524	2.524	1.00
Within Chem. III		2	6.500	3.250	1.29
Linear	(1)		1.927	1.927	0.76
Quadratic	(1)		4.573	4.573	1.81
Within Chem. IV		2	6.500	3.250	1.29
Linear	(1)		3.126	3.126	1.24
Quadratic	(1)		3.374	3.374	1.34
Error		42	106.000	2.524	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XX

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE NUMBER OF NODES PER STOLON OF COMMON FROM THE FIRST TO SECOND PERIOD IN THE FIELD

Source		DF	SS	MS	"F"
Total		59	52.000		
Replications		3	5.000	1.667	2.06
Treatments		14	13.000	0.929	1.15
Chemical	3		3.000	1.000	1.24
Rate	2		0.000	0.000	0.00
Chem. x Rate	6		8.000	1.333	1.65
Residual	3		2.000	0.667	0.82
Ck. vs. others	(1)		1.333	1.333	1.65
Within check	(2)		0.667	0.333	0.41
Within Chem. I		2	0.167	0.083	0.10
Linear	(1)		0.030	0.030	0.04
Quadratic	(1)		0.137	0.137	0.17
Within Chem. II		2	2.167	1.083	1.34
Linear	(1)		0.041	0.041	0.05
Quadratic	(1)		2.126	2.126	2.62
Within Chem. III		2	3.167	1.583	1.96
Linear	(1)		2.876	2.876	3.55
Quadratic	(1)		0.289	0.289	0.36
Within Chem. IV		2	2.667	1.333	1.65
Linear	(1)		0.000	0.000	0.00
Quadratic	(1)		2.667	2.667	3.29
Error		42	34.000	0.810	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XXI

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE INTERNODE LENGTH OF TIFGREEN STOLONS IN THE FIRST PERIOD IN THE FIELD

Source		DF	SS	MS	"F"
Total		59	2226.000		
Replications		3	114.000	38.000	1.31
Treatments		14	890.000	63.571	2.19
Chemical	3		327.000	109.000	3.75
Rate	2		358.000	179.000	6.15**
Chem. x Rate	6		143.000	23.833	0.82
Residual	3		62.000	20.667	0.71
Ck. vs. others	(1)		0.000	0.000	0.00
Within check	(2)		62.000	31.000	1.07
Within Chem. I	2		81.167	40.583	1.39
Linear	(1)		81.165	81.165	2.79
Quadratic	(1)		0.002	0.002	0.00
Within Chem. II	2		74.667	37.333	1.28
Linear	(1)		18.059	18.059	0.62
Quadratic	(1)		56.608	56.608	1.95
Within Chem. III	2		166.167	83.083	2.86
Linear	(1)		146.608	146.608	5.04*
Quadratic	(1)		19.559	19.559	0.67
Within Chem. IV	2		178.667	89.333	3.07
Linear	(1)		162.000	162.000	5.57*
Quadratic	(1)		16.667	16.667	0.57
Error		42	1222.000	29.095	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XXII

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE INTERNODE LENGTH OF SUNTURF STOLONS IN THE FIRST PERIOD IN THE FIELD

Source		DF	SS	MS	"F"
Total		59	3120.000		
Replications		3	276.000	92.000	2.45
Treatments		14	1265.000	90.357	2.40
Chemical	3		186.000	62.000	1.65
Rate	2		103.000	51.500	1.37
Chem. x Rate	6		916.000	152.667	4.06**
Residual	3		60.000	20.000	0.53
Ck. vs. others	(1)		0.000	0.000	0.00
Within check	(2)		60.000	30.000	0.80
Within Chem.I		2	585.167	292.583	7.78
Linear	(1)		576.246	576.246	15.33**
Quadratic	(1)		8.921	8.921	0.24
Within Chem.II		2	104.667	52.333	1.39
Linear	(1)		104.649	104.649	2.78
Quadratic	(1)		0.018	0.018	0.00
Within Chem.III		2	93.167	46.583	1.24
Linear	(1)		92.999	92.999	2.47
Quadratic	(1)		0.168	0.168	0.01
Within Chem.IV		2	236.167	118.083	3.14
Linear	(1)		8.000	8.000	0.22
Quadratic	(1)		228.167	228.167	6.07*
Error		42	1579.000	37.595	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XXIII

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE INTERNODE LENGTH OF U-3 STOLONS IN THE FIRST PERIOD IN THE FIELD

Source	DF	SS	MS	"F"
Total	59	4883.000		
Replications	3	5.000	1.667	0.02
Treatments	14	1763.000	125.929	1.70
Chemical 3		953.000	317.667	4.28*
Rate 2		164.000	82.000	1.11
Chem. x Rate 6		352.000	5.866	0.08
Residual 3		294.000	98.000	1.32
Ck. vs. others (1)		40.500	40.500	0.55
Within check (2)		253.500	126.750	1.71
Within Chem. I 2		28.167	14.083	0.19
Linear (1)		27.976	27.976	0.38
Quadratic (1)		0.191	0.191	0.00
Within Chem. II 2		78.000	39.000	0.53
Linear (1)		32.612	32.612	0.44
Quadratic (1)		45.388	45.388	0.61
Within Chem. III 2		57.167	28.583	0.38
Linear (1)		1.129	1.129	0.02
Quadratic (1)		56.038	56.038	0.76
Within Chem. IV 2		353.167	176.584	2.38
Linear (1)		66.126	66.126	0.89
Quadratic (1)		287.041	287.041	3.87
Error	42	3115.000	74.167	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XXIV

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE INTERNODE LENGTH OF COMMON STOLONS IN THE FIRST PERIOD IN THE FIELD

Source		DF	SS	MS	"F"
Total		59	10801.000		
Replications		3	475.000	158.333	1.20
Treatments		14	4793.000	342.357	2.60
Chemical	3		706.000	235.333	1.79
Rate	2		786.000	393.000	2.98
Chem. x Rate	6		3113.000	518.833	3.94**
Residual	3		188.000	62.667	0.48
Ck. vs. others	(1)		8.900	8.900	0.07
Within check	(2)		179.100	89.550	0.68
Within Chem. I	2		712.500	356.250	2.70
Linear	(1)		0.754	0.754	0.01
Quadratic	(1)		711.446	711.446	5.40*
Within Chem. II	2		1004.167	502.083	3.81
Linear	(1)		379.138	379.138	2.15
Quadratic	(1)		625.029	625.029	3.54
Within Chem. III	2		353.167	176.583	1.34
Linear	(1)		328.540	328.540	2.49
Quadratic	(1)		24.627	24.627	0.18
Within Chem. IV	2		1829.167	914.583	6.94**
Linear	(1)		78.126	78.126	0.59
Quadratic	(1)		1751.041	1751.041	13.29**
Error		42	5533.000	131.738	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XXV

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE GROWTH OF STOLONS OF TIFGREEN FROM THE SECOND TO THIRD PERIOD IN THE FIELD

Source	DF	SS	MS	"F"
Total	59	11628.000		
Replications	3	264.000	88.000	0.13
Treatments	14	8463.000	604.500	0.88
Chemical 3		3657.000	1219.000	1.77
Rate 2		526.000	263.000	0.38
Chem. x Rate 6		2275.000	379.160	0.55
Residual 3		2005.000	688.333	0.97
Ck. vs. others (1)		1696.800	1696.800	2.46
Within check (2)		308.200	154.100	0.22
Within Chem. I 2		18.167	9.083	0.01
Linear (1)		16.084	16.084	0.02
Quadratic (1)		2.083	2.083	0.00
Within Chem. II 2		166.167	83.083	0.12
Linear (1)		0.976	0.976	0.00
Quadratic (1)		165.191	165.191	0.24
Within Chem. III 2		2290.167	1145.083	1.66
Linear (1)		19.127	19.127	0.02
Quadratic (1)		2271.040	2271.040	3.29
Within Chem. IV 2		326.167	163.083	0.24
Linear (1)		98.000	98.000	0.14
Quadratic (1)		228.167	228.167	0.33
Error	42	2901.000	690.714	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XXVI

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE GROWTH OF STOLONS OF SUNTURF FROM THE SECOND TO THIRD PERIOD IN THE FIELD

Source		DF	SS	MS	"F"
Total		59	8283.000		
Replications		3	306.000	102.000	0.14
Treatments		14	4924.000	351.714	0.48
Chemical	3		2680.000	893.333	1.23
Rate	2		980.000	490.000	0.67
Chem. x Rate	6		1152.000	192.000	0.26
Residual	3		112.000	37.333	0.05
Ck. vs. others	(1)		0.000	0.000	0.00
Within check	(2)		112.000	56.000	0.08
Within Chem. I		2	88.667	44.333	0.06
Linear	(1)		21.622	21.622	0.03
Quadratic	(1)		67.045	67.045	0.09
Within Chem. II		2	460.500	230.250	0.32
Linear	(1)		460.003	460.003	0.63
Quadratic	(1)		0.497	0.497	0.00
Within Chem. III		2	1429.167	714.583	0.98
Linear	(1)		410.727	410.727	0.57
Quadratic	(1)		1018.440	1018.440	1.40
Within Chem. IV		2	153.500	76.750	0.11
Linear	(1)		32.000	32.000	0.04
Quadratic	(1)		121.500	121.500	0.17
Error		42	3053.000	726.904	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XXVII

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE GROWTH OF STOLONS OF U-3 FROM THE SECOND TO THIRD PERIOD IN THE FIELD

Source		DF	SS	MS	"F"
Total		59	35025.000		
Replications		3	1825.000	608.333	2.33
Treatments		14	13923.000	994.500	2.17
Chemical	3		4178.000	1392.667	3.03*
Rate	2		1879.000	939.333	2.05
Chem. x Rate	6		2994.000	499.000	1.09
Residual	3		4872.000	1624.000	3.54*
Ck. vs. others	(1)		2912.000	2912.000	6.35*
Within check	(2)		1960.000	980.000	2.14
Within Chem. I		2	302.167	151.083	0.33
Linear	(1)		81.165	81.165	0.18
Quadratic	(1)		221.002	221.002	0.48
Within Chem. II		2	370.667	185.333	0.40
Linear	(1)		140.594	140.594	0.31
Quadratic	(1)		230.073	230.073	0.50
Within Chem. III		2	2307.167	1153.583	2.51
Linear	(1)		994.990	994.990	2.17
Quadratic	(1)		1312.177	1312.177	2.85
Within Chem. IV		2	1893.167	946.583	2.06
Linear	(1)		276.126	276.126	0.60
Quadratic	(1)		1617.041	1617.041	3.52
Error		42	19277.000	458.976	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XXVIII

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE GROWTH OF STOLONS OF COMMON FROM THE SECOND TO THIRD PERIOD IN THE FIELD

Source	DF	SS	MS	"F"
Total	59	18314.000		
Replications	3	1858.000	619.333	3.21
Treatments	14	8348.000	596.284	3.09
Chemical 3		2823.000	94.100	0.49
Rate 2		793.000	396.500	2.05
Chem. x Rate 6		3915.000	652.500	3.38**
Residual 3		817.000	272.333	1.41
Ck. vs. others (1)		798.300	798.300	4.14*
Within check (2)		18.668	9.334	0.05
Within Chem. I 2		129.500	64.750	0.34
Linear (1)		0.084	0.084	0.00
Quadratic (1)		129.416	129.416	0.67
Within Chem. II 2		32.167	16.083	0.08
Linear (1)		23.838	23.838	0.12
Quadratic (1)		8.329	8.329	0.04
Within Chem. III 2		1554.167	777.083	4.03*
Linear (1)		1151.547	1151.547	5.97*
Quadratic (1)		402.620	402.620	2.09
Within Chem. IV 2		2992.167	1496.083	7.75**
Linear (1)		325.126	325.126	1.68
Quadratic (1)		2667.041	2667.041	13.82**
Error	42	8108.000	193.048	

*Significant at the .05 level of confidence.
**Significant at the .05 level of confidence.

TABLE XXIX

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE NUMBER OF NODES PER STOLON OF TIFGREEN FROM THE SECOND TO THIRD PERIOD IN THE FIELD

Source		DF	SS	MS	"F"
Total		59	592.000		
Replications		3	16.000	5.333	1.53
Treatments		14	430.000	30.714	8.84
Chemical	3		239.000	79.667	22.92**
Rate	2		19.000	9.500	2.73
Chem. x Rate	6		122.000	20.333	5.85**
Residual	3		50.000	16.667	4.80**
Ck. vs. others	(1)		18.500	18.500	5.32*
Within check	(2)		31.500	15.750	4.53*
Within Chem. I	2		1.167	0.583	0.17
Linear	(1)		0.014	0.014	0.01
Quadratic	(1)		1.153	1.153	0.33
Within Chem. II	2		3.167	1.583	0.46
Linear	(1)		2.463	2.463	0.71
Quadratic	(1)		0.704	0.704	0.20
Within Chem. III	2		120.167	60.830	17.50**
Linear	(1)		87.089	87.089	25.05**
Quadratic	(1)		33.078	33.078	9.52**
Within Chem. IV	2		16.167	8.083	2.33
Linear	(1)		1.125	1.125	0.32
Quadratic	(1)		15.042	15.042	4.33*
Error		42	146.000	3.476	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XXX

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE NUMBER OF NODES PER STOLON OF SUNTURF FROM THE SECOND TO THIRD PERIOD IN THE FIELD

Source		DF	SS	MS	"F"
Total		59	300.000		
Replications		3	13.000	4.333	1.66
Treatments		14	177.000	12.643	4.84
Chemical	3		106.000	35.333	13.54
Rate	2		11.000	5.500	2.11
Chem. x Rate	6		55.000	9.167	3.51**
Residual	3		5.000	1.667	0.64
Ck. vs. others	(1)		0.000	0.000	0.00
Within check	(2)		5.000	2.500	0.90
Within Chem. I		2	1.167	0.583	0.22
Linear	(1)		1.102	1.102	0.42
Quadratic	(1)		0.065	0.065	0.02
Within Chem. II		2	8.667	4.333	1.66
Linear	(1)		3.459	3.459	1.33
Quadratic	(1)		5.208	5.208	1.99
Within Chem. III		2	50.167	25.083	9.61**
Linear	(1)		38.066	38.066	14.58**
Quadratic	(1)		12.101	12.101	4.64*
Within Chem. IV		2	6.002	3.001	1.15
Linear	(1)		0.000	0.000	0.00
Quadratic	(1)		6.002	6.002	2.30
Error		42	110.000	2.610	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XXXI

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE NUMBER OF NODES PER STOLON OF U-3 FROM THE SECOND TO THIRD PERIOD IN THE FIELD

Source		DF	SS	MS	"F"
Total		59	967.000		
Replications		3	88.000	29.333	2.38
Treatments		14	361.000	25.785	2.09
Chemical	3		180.000	60.000	4.87**
Rate	2		45.000	22.500	1.82
Chem. x Rate	6		116.000	19.333	1.57
Residual	3		20.000	6.667	0.54
Ck. vs. others	(1)		9.500	9.500	0.77
Within check	(2)		10.500	5.250	0.43
Within Chem. I		2	18.500	9.250	0.75
Linear	(1)		7.460	7.460	0.60
Quadratic	(1)		11.040	11.040	0.90
Within Chem. II		2	24.667	12.337	1.00
Linear	(1)		3.411	3.411	0.28
Quadratic	(1)		21.256	21.258	1.72
Within Chem. III		2	57.167	28.584	2.32
Linear	(1)		29.982	29.982	2.43
Quadratic	(1)		27.185	27.185	2.20
Within Chem. IV		2	60.667	30.333	2.46
Linear	(1)		18.000	18.000	1.46
Quadratic	(1)		42.667	42.667	3.46
Error		42	518.000	12.333	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XXXII

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE NUMBER OF NODES PER STOLON OF COMMON FROM THE SECOND TO THIRD PERIOD IN THE FIELD

Source		DF	SS	MS	"F"
Total		59	241.000		
Replications		3	35.000	11.667	5.44
Treatments		14	116.000	8.286	3.87
Chemical	3		29.000	7.333	3.42*
Rate	2		15.000	7.500	3.50*
Chem. x Rate	6		58.000	9.667	4.51**
Residual	3		14.000	4.667	2.18
Ck. vs. others	(1)		13.500	13.500	6.30*
Within check	(2)		0.500	0.250	0.12
Within Chem. I	2		3.500	1.750	0.82
Linear	(1)		0.216	0.216	0.10
Quadratic	(1)		3.284	3.284	1.53
Within Chem. II	2		0.500	0.250	0.12
Linear	(1)		0.409	0.409	0.19
Quadratic	(1)		0.091	0.091	0.04
Within Chem. III	2		30.167	15.083	7.39**
Linear	(1)		24.360	24.360	11.37**
Quadratic	(1)		5.807	5.807	2.71
Within Chem. IV	2		39.500	18.750	8.75**
Linear	(1)		2.000	2.000	0.93
Quadratic	(1)		37.500	37.500	17.49**
Error		42	90.000	2.143	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XXXIII

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE INTERNODE LENGTH OF TIFGREEN IN THE SECOND PERIOD IN THE FIELD

Source	DF	SS	MS	"F"
Total	59	3393.000		
Replications	3	10.000	3.333	0.13
Treatments	14	2306.000	164.714	6.42
Chemical 3		451.000	150.333	4.86**
Rate 2		751.000	375.500	14.64**
Chem. x Rate 6		553.000	92.167	3.59**
Residual 3		551.000	183.667	7.16**
Ck. vs. others (1)		496.840	996.840	19.38**
Within check (2)		54.160	27.080	1.06
Within Chem. I 2		216.667	108.333	4.23*
Linear (1)		211.148	211.148	8.23**
Quadratic (1)		5.519	5.519	0.22
Within Chem. II 2		454.167	227.083	8.86**
Linear (1)		0.084	0.084	0.00
Quadratic (1)		454.083	454.083	17.71**
Within Chem. III 2		616.667	308.333	12.02**
Linear (1)		571.578	571.578	22.29**
Quadratic (1)		45.089	45.089	1.76
Within Chem. IV 2		16.667	8.333	0.33
Linear (1)		12.500	12.500	0.49
Quadratic (1)		4.167	4.167	0.16
Error	42	1077.000	25.643	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XXXIV

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE INTERNODE LENGTH OF SUNTURF IN THE SECOND PERIOD IN THE FIELD

Source	DF	SS	MS	"F"
Total	59	3065.000		
Replications	3	35.000	11.667	0.36
Treatments	14	1665.000	118.928	3.66
Chemical 3		665.000	221.667	6.82**
Rate 2		313.000	156.500	4.82**
Chem. x Rate 6		400.000	66.667	2.95
Residual 3		287.000	95.667	2.94*
Ck. vs. others (1)		132.800	132.800	4.09*
Within check (2)		154.200	77.100	2.37
Within Chem. I 2		216.667	108.333	3.33
Linear (1)		86.486	86.486	2.66
Quadratic (1)		130.181	130.181	4.01
Within Chem. II 2		350.000	175.000	5.38**
Linear (1)		345.945	345.945	10.64*
Quadratic (1)		4.055	4.055	0.12
Within Chem. III 2		116.667	58.333	1.79
Linear (1)		71.969	71.969	2.21
Quadratic (1)		44.698	44.698	1.37
Within Chem. IV 2		29.167	14.583	0.45
Linear (1)		3.125	3.125	0.09
Quadratic (1)		26.042	26.042	0.80
Error	42	1365.000	32.500	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XXXV

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE INTERNODE LENGTH OF U-3 IN THE SECOND PERIOD IN THE FIELD

Source	DF	SS	MS	"F"
Total	59	13305.000		
Replications	3	85.000	28.333	0.20
Treatments	14	6524.000	466.000	3.21
Chemical 3		997.000	332.333	2.29
Rate 2		755.000	377.500	2.60
Chem. x Rate 6		1563.000	260.500	1.80
Residual 3		3209.000	1069.667	7.37**
Ck. vs. others (1)		3179.800	3179.800	21.91**
Within check (2)		29.200	14.900	0.10
Within Chem. I 2		487.500	243.750	1.68
Linear (1)		19.004	19.004	0.13
Quadratic (1)		468.496	468.496	3.23
Within Chem. II 2		612.500	306.250	2.11
Linear (1)		121.959	121.959	0.84
Quadratic (1)		490.541	490.541	3.37
Within Chem. III 2		54.167	27.083	0.19
Linear (1)		42.971	42.971	0.29
Quadratic (1)		11.196	11.196	0.07
Within Chem. IV 2		1079.167	539.583	3.72
Linear (1)		1012.500	1012.500	6.97*
Quadratic (1)		66.667	66.667	0.46
Error	42	6696.000	145.143	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XXXVI

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE INTERNODE LENGTH OF COMMON IN THE SECOND PERIOD IN THE FIELD

Source		DF	SS	MS	"F"
Total		59	4098.000		
Replications		3	288.000	96.000	1.52
Treatments		14	1148.000	82.000	1.29
Chemical	3		418.000	139.333	2.20
Rate	2		204.000	102.000	1.61
Chem. x Rate	6		371.000	61.833	0.98
Residual	3		155.000	51.667	0.82
Ck. vs. others	(1)		142.500	142.500	2.25
Within check	(2)		12.500	6.250	0.20
Within Chem. I	2		237.500	118.750	1.87
Linear	(1)		228.797	228.797	3.61
Quadratic	(1)		8.703	8.703	0.14
Within Chem. II	2		254.167	127.083	2.01
Linear	(1)		186.570	186.570	2.94
Quadratic	(1)		67.597	67.597	1.07
Within Chem. III	2		54.167	27.083	0.43
Linear	(1)		37.502	37.502	0.59
Quadratic	(1)		15.665	15.665	0.25
Within Chem. IV	2		29.167	14.583	0.23
Linear	(1)		3.125	3.125	0.05
Quadratic	(1)		26.042	26.042	0.41
Error		42	2662.000	63.381	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XXXVII

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE INTERNODE LENGTH OF TIFGREEN IN THE THIRD PERIOD IN THE FIELD

Source	DF	SS	MS	"F"
Total	59	4200.000		
Replications	3	127.000	42.333	1.67
Treatments	14	3005.000	214.642	8.44
Chemical 3		938.000	312.667	12.30**
Rate 2		572.000	286.000	11.25**
Chem. x Rate 6		616.000	102.667	4.04**
Residual 3		879.000	293.000	11.52**
Ck. vs. others (1)		874.200	874.200	34.38
Within check (2)		4.800	2.400	0.09
Within Chem. I 2		29.167	14.583	0.57
Linear (1)		13.514	13.514	0.53
Quadratic (1)		15.653	15.653	0.62
Within Chem. II 2		66.667	33.333	1.31
Linear (1)		18.657	18.657	0.73
Quadratic (1)		48.010	48.010	1.88
Within Chem. III 2		1088.167	544.083	21.39**
Linear (1)		1074.371	1074.371	42.24**
Quadratic (1)		13.796	13.796	0.54
Within Chem. IV 2		4.167	2.083	0.08
Linear (1)		3.125	3.125	0.12
Quadratic (1)		1.042	1.042	0.04
Error	42	1068.000	25.429	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XXXVIII

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE INTERNODE LENGTH OF SUNTURF IN THE THIRD PERIOD IN THE FIELD

Source		DF	SS	MS	"F"
Total		59	2168.000		
Replications		3	35.000	11.667	0.37
Treatments		14	818.000	58.429	1.87
Chemical	3		155.000	51.667	1.65
Rate	2		319.000	159.500	5.09*
Chem. x Rate	6		219.000	36.500	1.17
Residual	3		125.000	41.667	1.33
Ck. vs. others	(1)		45.800	45.800	1.46
Within check	(2)		79.200	39.600	1.27
Within Chem. I		2	200.000	100.000	3.19
Linear	(1)		135.135	135.135	4.31*
Quadratic	(1)		64.865	64.865	2.07
Within Chem. II		2	204.167	102.083	3.26
Linear	(1)		186.570	186.570	5.96*
Quadratic	(1)		17.597	17.597	0.56
Within Chem. III		2	129.167	64.583	2.06
Linear	(1)		100.517	100.517	3.21
Quadratic	(1)		28.650	28.650	0.92
Within Chem. IV		2	4.167	2.083	0.07
Linear	(1)		0.000	0.000	0.00
Quadratic	(1)		4.167	4.167	0.13
Error		42	1315.000	31.310	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XXXIX

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE INTERNODE LENGTH OF U-3 IN THE THIRD PERIOD IN THE FIELD

Source		DF	SS	MS	"F"
Total		59	7025.000		
Replications		3	455.000	151.667	1.85
Treatments		14	3119.000	222.786	2.71
Chemical	3		546.000	182.000	2.23
Rate	2		1083.000	541.500	6.59**
Chem. x Rate	6		251.000	41.833	0.51
Residual	3		1239.000	413.000	5.03**
Ck. vs. others	(1)		1126.500	1126.500	13.71**
Within check	(2)		112.500	56.250	0.69
Within Chem. I		2	279.167	139.583	1.70
Linear	(1)		40.875	40.875	0.50
Quadratic	(1)		238.292	238.292	2.90
Within Chem. II		2	237.500	118.750	1.45
Linear	(1)		237.250	237.250	2.89
Quadratic	(1)		0.250	0.250	0.00
Within Chem. III		2	466.667	233.333	2.84
Linear	(1)		466.320	466.320	5.67*
Quadratic	(1)		0.347	0.347	0.01
Within Chem. IV		2	350.000	175.000	2.13
Linear	(1)		312.500	312.500	3.80
Quadratic	(1)		37.500	37.500	0.46
Error		42	3451.000	82.167	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XXXX

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE INTERNODE LENGTH OF COMMON IN THE THIRD PERIOD IN THE FIELD

Source	DF	SS	MS	"F"
Total	59	5165.000		
Replications	3	455.000	151.667	1.77
Treatments	14	1109.000	79.214	0.92
Chemical 3		560.000	186.667	2.18
Rate 2		129.000	64.500	0.75
Chem. x Rate 6		254.000	42.333	0.49
Residual 3		166.000	55.333	0.65
Ck. vs. others (1)		128.500	128.500	1.49
Within check (2)		37.500	18.750	0.22
Within Chem. I 2		162.500	81.250	0.95
Linear (1)		97.635	97.635	1.14
Quadratic (1)		64.865	64.865	0.76
Within Chem. II 2		54.168	27.084	0.32
Linear (1)		48.648	48.648	0.57
Quadratic (1)		5.520	5.520	0.06
Within Chem. III 2		37.500	19.750	0.23
Linear (1)		33.458	33.458	0.39
Quadratic (1)		4.042	4.042	0.05
Within Chem. IV 2		129.167	64.583	0.75
Linear (1)		3.126	3.126	0.04
Quadratic (1)		126.041	126.041	1.47
Error	42	3601.000	85.738	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XXXXI

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE OVEN-DRY WEIGHT OF PLANT TISSUE FROM TIFGREEN IN THE FIELD

Source		DF	SS	MS	"F"
Total		59	10.720		
Replications		3	1.590	0.530	0.80
Treatments		14	6.350	0.454	0.69
Chemical	3		1.640	0.547	0.83
Rate	2		0.440	0.220	0.33
Chem. x Rate	6		2.820	0.470	0.71
Residual	3		1.450	0.463	0.70
Ck. vs. others	(1)		1.403	1.403	2.12
Within check	(2)		0.047	0.024	0.04
Within Chem. I		2	2.600	1.300	1.96
Linear	(1)		0.114	0.114	0.17
Quadratic	(1)		1.486	1.486	2.25
Within Chem. II		2	0.112	0.056	0.08
Linear	(1)		0.041	0.041	0.06
Quadratic	(1)		0.069	0.069	0.01
Within Chem. III		2	2.602	1.301	1.97
Linear	(1)		2.285	2.285	3.45
Quadratic	(1)		0.317	0.317	0.48
Within Chem. IV		2	0.292	0.146	0.22
Linear	(1)		0.031	0.031	0.05
Quadratic	(1)		0.260	0.260	0.39
Error		42	2.780	0.662	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XXXXII

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE OVEN-DRY WEIGHT OF PLANT TISSUE FROM SUNTURF IN THE FIELD

Source		DF	SS	MS	"F"
Total		59	1.290		
Replications		3	0.000	0.000	0.00
Treatments		14	0.440	0.031	1.55
Chemical	3		0.120	0.040	1.98
Rate	2		0.020	0.010	0.49
Chem. x Rate	6		0.280	0.047	2.31
Residual	3		0.020	0.007	0.33
Ck. vs. others	(1)		0.008	0.008	0.41
Within check	(2)		0.012	0.006	0.29
Within Chem. I		2	0.022	0.011	0.53
Linear	(1)		0.009	0.009	0.04
Quadratic	(1)		0.013	0.013	0.64
Within Chem. II		2	0.052	0.026	1.28
Linear	(1)		0.004	0.004	0.20
Quadratic	(1)		0.048	0.048	2.35
Within Chem. III		2	0.180	0.090	4.44
Linear	(1)		0.173	0.173	8.57**
Quadratic	(1)		0.007	0.007	0.03
Within Chem. IV		2	0.047	0.024	1.17
Linear	(1)		0.031	0.031	1.54
Quadratic	(1)		0.016	0.016	0.79
Error		42	0.850	0.020	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XXXXIII

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE OVEN-DRY WEIGHT OF PLANT TISSUE FROM U-3 IN THE FIELD

Source	DF	SS	MS	"F"
Total	59	17.840		
Replications	3	1.640	0.557	2.42
Treatments	14	6.550	0.468	2.04
Chemical 3		1.540	0.513	2.23
Rate 2		0.710	0.355	1.55
Chem. x Rate 6		3.030	0.505	2.20
Residual 3		1.270	0.423	1.84
Ck. vs. others (1)		0.425	0.425	1.85
Within check (2)		0.845	0.422	1.84
Within Chem. I 2		0.585	0.293	1.73
Linear (1)		0.351	0.351	1.53
Quadratic (1)		0.134	0.134	0.58
Within Chem. II 2		0.665	0.333	1.45
Linear (1)		0.607	0.607	2.64
Quadratic (1)		0.058	0.058	0.25
Within Chem. III 2		0.262	0.131	1.55
Linear (1)		0.167	0.167	0.73
Quadratic (1)		0.095	0.095	0.41
Within Chem. IV 2		2.222	1.111	4.83*
Linear (1)		1.051	1.051	4.57*
Quadratic (1)		1.270	1.270	5.52*
Error	42	9.650	0.230	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

TABLE XXXXIV

ANALYSIS OF VARIANCE OF THE EFFECT OF GROWTH SUPPRESSANTS UPON THE OVEN-DRY WEIGHT OF PLANT TISSUE FROM COMMON IN THE FIELD

Source		DF	SS	MS	"F"
Total		59	27.770		
Replications		3	2.630	0.877	2.71
Treatments		14	11.540	0.824	2.55
Chemical	3		1.940	0.647	1.20
Rate	2		1.050	0.525	1.62
Chem. x Rate	6		6.800	1.133	3.50**
Residual	3		1.750	0.583	1.80
Ck. vs. others	(1)		1.718	1.718	5.31*
Within check	(2)		0.032	0.016	0.49
Within Chem. I		2	0.332	0.166	0.51
Linear	(1)		0.101	0.101	0.31
Quadratic	(1)		0.484	0.484	1.49
Within Chem. II		2	1.295	0.648	1.99
Linear	(1)		0.942	0.942	2.91
Quadratic	(1)		0.353	0.353	1.09
Within Chem. III		2	1.552	0.776	2.39
Linear	(1)		0.291	0.291	0.09
Quadratic	(1)		1.260	1.260	3.89
Within Chem. IV		2	4.672	2.336	7.21**
Linear	(1)		0.911	0.911	2.81
Quadratic	(1)		3.760	3.760	11.61**
Error		42	13.600	0.224	

*Significant at the .05 level of confidence.
**Significant at the .01 level of confidence.

VITA

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