INFLUENCE OF TWO FUNGICIDES AND FOUR DATE OF TREATMENT COMBINATIONS ON CONTROL OF A DISEASE OF BERMUDAGRASS (<u>CYNODON</u> L. C. RICH SPECIES), SPRING DEAD SPOT

By

JOHN JERRY COLLINS

Bachelor of Science
Oklahoma State University
Stillwater, Oklahoma
1964

Master of Science
Oklahoma State University
Stillwater, Oklahoma
1969

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Thesis Approved:

Wayne W. Huffine
Thesis Adviser

Robert D Morrison

J. Q. Lynd

Harry ... Young

Norman N. Durham
Dean of the Graduate College

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CHAPTER I

INTRODUCTION

All known varieties or kinds of bermudagrasses (*Cynodon* L. C. Rich spp.) that have been tested are susceptible to a disease commonly referred to as spring dead spot. It was first noticed in Stillwater, Oklahoma, in the early 1950s. The disease had probably been present for several years prior to this, but it went unnoticed due to confusion with other bermudagrass problems and to the fact that many bermudagrass areas received little attention at that time. The increased use and care of bermudagrass, especially home lawns, led to the discovery of the disease now known as spring dead spot of bermudagrass, which came to be regarded as the most important disease of bermudagrass in Oklahoma and the upper South.

Spring dead spot is known to occur only on bermudagrass and is characterized by circular, straw-colored, dead areas of turf. The dead spots appear in the spring when the surrounding healthy bermudagrass starts to green-up. There is no evidence that the disease is active during the growing season of the bermudagrass. There is also no evidence of activity during dormancy, but the following year the dead spots from the previous year may be as much as twice as large as they were. This sequence may continue until the dead spots coalesce to form large, irregular areas of dead turf which can ruin the appearance of lawns and destroy the beauty and usefulness of golf course fairways as well as other bermudagrass areas. In a few areas, the bermudagrass may recover from the disease after several years, but the grass in the affected areas remains thin and less vigorous than surrounding healthy grass.

To date, the causal organism responsible for this disease has not been definitely established. Several studies have been conducted, which will be discussed in the following chapter. Most researchers have proceeded along the line that the causal organism is fungal in origin, and several different genera of fungi have been investigated. Also, no consistently effective method of control has been established. Some chemicals seem to work partially, part of the time. Destruction of the existing bermudagrass along with thorough tillage of the soil and reestablishment of bermudagrass through seeding or sprigging may eliminate the disease, for a few years. However, this is a very costly and time-consuming method of dealing with the disease, especially when it is considered that spring dead spot will probably reappear several years later. For these reasons this study was undertaken, using two chemical compounds with proven fungicidal properties in conjunction with four different application date combinations for each compound, applied during the dormant season of the bermudagrass when the disease is thought to be active. In this way the most effective fungicide and dates of application can be determined.

CHAPTER II

REVIEW OF LITERATURE

Spring dead spot of bermudagrass was first reported as a disease by Wadsworth and Young in 1960 (22). They had observed the disease on a bermudagrass lawn in Stillwater, Oklahoma, during the spring of 1954. The disease may have been present as early as 1936, but escaped detection due to confusion with other bermudagrass problems and the fact that bermudagrass areas received little attention. The increase in disease prevalence may have been the result of greater use of bermudagrass turf for home lawns and public areas, since the disease is found primarily in well-cared-for turf.

Spring dead spot is known to occur only on bermudagrass (24). Hybrids, particularly U-3, appear to be more susceptible to spring dead spot than common bermudagrass (7). The disease is characterized by circular, straw-colored, dead areas of turf. The dead spots appear in the spring when the surrounding healthy bermudagrass begins to green-up. The stolons and root systems of the dead grass are black and rotted.

From the time the disease appears in the early spring until the grass becomes dormant in the fall, there is no evidence that the disease is active. The dead spots do not enlarge, and healthy bermudagrass generally does not invade or reestablish in the dead areas. Other grasses and weeds usually fill in the dead spots and become an important characteristic of the disease.

During dormancy, there is also no evidence that the disease is active. However, when the grass greens up in the spring, the old dead spots of the previous spring may be as much as twice as large as before. This sequence continues until the dead spots coalesce to form large, irregular areas of dead turf. A few areas have been known to recover after the disease has run its course over a period of years, but the grass in recovered areas remained thin and low in vigor.

According to Frederiksen (8) spring dead spot occurs in the northern tier of states in which bermudagrass is adapted, on a line from Tulsa, Oklahoma, to Kansas City, to St. Louis, to Indianapolis, to Philadelphia, to central New Jersey, and to the south of this line. The disease appears to be more severe in northern regions where the host is adapted and undergoes a long dormant period; it is less severe as the length of dormancy decreases (23).

Various organisms have been suggested as possible causal organisms of spring dead spot. They include the genera of fungi Helminthosporium (10) (13) (24), Ophiobolus (18), Leptosphaeria (19), Fusarium, and Rhizoctonia (26). Mycoplasmas, which means "fungus form", have also been investigated (12). Leptosphaeria and Ophiobolus belong to the class Ascomycetes. Helminthosporium, Fusarium, and Rhizoctonia belong in the form-class Deuteromycetes. General descriptions of these genera may be found in Alexopoulos (1).

Wadsworth (24) and McCoy (13) carried out extensive studies on the genus of fungi, Helminthosporium, concentrating primarily on Helminthosporium spiciferum. H. cynodontis and Ophiobolus were also included in their investigations. They reportedly were able to produce symptoms similar to those found in spring dead spot in greenhouse studies, but were unable to produce the disease in the field. Wadsworth found that the genus Ophiobolus was present in spring dead spot areas in California where it was a more severe root-rotting pathogen than any species of Helminthosporium. However, observations and isolations from spring dead spot in Oklahoma have failed to detect Ophiobolus. H. spiciferum has been recovered from the crowns and roots of foliage-inoculated plants. This suggests that the inoculum potential and distribution of the pathogen may result from its ability to attack aerial plant parts, thus leading to infection of underground plant parts (25).

Smith (18) identified the fungus Ophiobolus herpotrichus as the causal organism of spring dead spot of couch (bermuda) grass in New South Wales in 1965. He was able to produce symptoms in the greenhouse which were identical to those found in the field. However, in subsequent work, he identified the causal organism as a fungus Leptosphaeria *narmari* J. Walker and A. M. Smith (19). He made this conclusion because this fungus was consistently isolated from diseased specimens in the field and, under experimental conditions, caused a root and basal stem rot of couch grass and produced symptoms on established turf identical to those caused by spring dead spot in the field.

A research project to study spring dead spot of bermudagrass in all its aspects was initiated in the Department of Plant Pathology and Plant Genetics at the University of Georgia in 1965 (12). The fungi and nematodes associated with spring dead spot were surveyed, and mycoplasmas were investigated.

Helminthosporium, *Pythium*, *Fusarium*, and *Curvularia* isolates were inoculated onto Tifway and Tifgreen bermudagrass either singly or in combinations in the greenhouse and in the field, but no symptoms of the disease could be induced. Several genera of nematodes were found, but were judged to be of no consequence.

Filtrates from *Helminosporium spiciferum* were applied to three-year-old healthy sod. Results showed a reduction in topgrowth. It was concluded that the leachate apparently contained a toxin, or toxins, which seemed to substantially reduce the respiration rate. The source of the toxin(s) is not known, but it may be a metabolite of a fungus, of the fungus and host, or from dead plant material. Other researchers have also pointed out that toxins may be involved (13) (14) (17) (24) (25).

Kozelnicky (12) stated that gypsum ($CaSO_4$) may be instrumental in reducing spring dead spot in the field. Tests revealed that the disease was less in soil with the highest percentage of gypsum application on clay soils, but the reverse was true in sandy loam soil.

Mycoplasmas have been shown to be a factor in such diseases of bermudagrass as bermudagrass yellow leaf (3) and white leaf diseases (4), but the Georgia investigations indicated that mycoplasma were not causal agents (12). Tetracyclines have been used to control mycoplasma diseases (2), but experiments indicate the following limitations:

1. Tetracyclines cause temporary remission but not permanent cure of plant diseases suspected of being caused by mycoplasma-like agents.
2. Antibiotics other than tetracyclines have been found to be ineffective.
3. In plants showing full symptoms, particularly older plants, the effect of tetracyclines is much less.
4. Tetracyclines are absorbed more readily from roots than from foliage.
5. Symptoms once suppressed reappear occasionally even with repeated applications.
6. The effectiveness of various tetracyclines differs only slightly and according to different diseases.

Observations by Young, et al (27) indicate that heavy soils, or soils high in clay content, are more conducive to disease development than lighter soils with lesser clay fractions. In their experiments, the clay content of soil samples taken from diseased spots ranged from 15.0 to 22.3 percent, while the clay content of soil samples taken from the same locale in disease-free areas ranged from 12.5 to 12.6 percent. However, the first report of spring dead spot in Georgia on golf turf came from sandy greens (12).

Chisam (5) conducted a study in 1964 in which he applied six different treatments to twenty-one infected areas. These treatments were ammonium sulfate, chitin, ammonium sulfate with N-serve, N-serve, manure, and sulfur. He also performed physical and chemical analyses. The fertility treatments resulted in increased growth of vegetation, but most of the vegetation consisted of crabgrass and knotweed. The results of the mechanical analysis were: 1. clay, 24.0%; 2. sand, 49.7%; 3. silt, 26.1%. Colloidal clay (<.001 mm) averaged 20.9 percent. All pH readings were approximately neutral. The results of the remaining analyses were: 1. soluble salts, 30.6%; 2. percent organic matter, 0.57% to 3.92%; 3. percent total nitrogen, 0.30; 4. available phosphorus, 31.8; 5. cation exchange capacity, 18.3; 6. exchangeable potassium, 0.74; 6. exchangeable calcium, 4.9; 7. exchangeable magnesium, 12.1; 8. sodium, 0.51; 9. rate of ammonification, 43.3; 10. rate of nitrification, 0.06.

Thatch is also thought to be conducive to the incidence of spring dead spot (11) (13) (21) (26). Thatch may accumulate rapidly, particularly when clippings are not collected, and spring dead spot is found to occur most frequently in areas containing rather heavy thatch accumulations. Several factors may be involved in the apparent correlation between disease incidence and organic matter accumulation: 1) the organic matter may serve as a medium for the growth of certain parasites; 2) organic matter may alter the microbial population of the soil or rhizosphere which may favor certain parasites; 3) soil nutrients may be depleted during microbial decomposition of the added organic residue; 4) the organic residues or their decomposition products may be phytotoxic (6).

Several studies have been made in an effort to find an effective control for spring dead spot. One of the first was made by Wadsworth (23) using chemical drenches. He used Sulforon (wettable sulfur, 97%), Parzate (zineb, 65%), liquid Dieldrin (dieldrin, 1.5 E.), PMAS (phenyl mercuric acetate, 10%), Elgetol (sodium dinitro-ortho-cresol, 19%), plus sodium butyl naphthalene sulfonate, 5%, plus sodium chromate, 2%), and Actidione R-Z (cycloheximide, 1.3%, plus pentachloronitrobenzene, 75%). The treatments, with one exception, were made at approximately two-week intervals from late August to early December. Satisfactory control was obtained only in those plots receiving Dieldrin.

A test involving ten different chemicals was started in 1964 on the campus at Oklahoma State University, Stillwater, Oklahoma, in an established stand of common bermudagrass where dead spot was severe (11). The chemicals were TL-90 (20 oz./1,000 ft.^{2}), Daconil 2787 (20 oz./1,000 ft.^{2}), Ortho 781 (12 oz./1,000 ft.^{2}), Ortho Lawn and Turf (20 oz./1,000 ft.^{2}), Duter (6 oz./1,000 ft.^{2}), TCNA (12 oz./1,000 ft.^{2}), Spring Bak (16 oz./1,000 ft.^{2}), Memmi (6 oz./1,000 ft.^{2}), Polycide (20 oz./1,000 ft.^{2}), and Dieldrin (22 oz./1,000 ft.^{2}). A wetting agent, "958" of Vineland Chemical Company, was used with the chemicals, and was also applied to one-half of each plot at 3 oz. per 1,000 ft.^{2} prior to each spray application. Two applications of treatments were made, one in the spring and one in October, 1964. The results of this test were inconclusive, although Duter, Spring-Bak, Polycide, and Dieldrin gave some degree of control. The use of the wetting agent improved the results with Duter and Spring-Bak. Some phytotoxicity was observed with TL-90, Duter, and Spring-Bak, but no lasting effects were noted.

Another test in an established Sunturf bermudagrass lawn was started in the spring of 1964 (11). The lawn was divided in half, north and south. The south half was fertilized with Milorganite three times during the summer of 1964 at a rate of 1.75 pounds of actual nitrogen per 1,000 ft.^{2} The north half was fertilized with ammonium nitrate three times at a rate of 1.64 pounds of actual nitrogen per 1,000 ft.^{2} The lawn was further divided east and west. The east half was sprayed with Dieldrin at 22 oz. per 1,000 ft.^{2} in May and October. The west half was not sprayed. Although no new spots appeared in the spring of 1965, the old spots reappeared after having healed during the summer of 1964. There was no apparent difference between the various treatment combinations. They concluded that possibly the disease itself had been controlled, but the grass in the diseased spots may have rooted too late in the summer of 1964 to survive the following winter.

Sayed, et al (16), conducted a test on the Fort Hays College grounds in 1967 on U-3 bermudagrass containing a severe infection of spring dead spot. Fifteen fungicides were used. They were Orthocide 50, Difolton 80 W, Parazate C, Tersan OM, Spring-Bak, Panogen, Fore, Captan 50 WP, Zineb 75 W, Actidione RZ, Actidione-Thiram, Vita Vax, Velsicol 2-1, Velsicol PMA 10, and Memmi 8 EC. All fungicides controlled the disease to some degree, but the most beneficial were Teresan OM, 75% control; Spring-Bak, 73% control; Panogen, 72% control; Actidione-Thiram, 68% control; Orthocide 50, 67% control.

Smith (20) conducted a test in New South Wales on couch grass turf in 1971. He applied five chemicals to 10 ft. by 10 ft. plots, replicated four times. The chemicals were Thiram, Nabam, Mercuric chloride, Phenyl mercury acetate, and Methyl arsine oxide. All were applied in 30 gallons of water per 1,000 $ft.^2$, then washed down with another 30 gallons of water per 1,000 $ft.^2$ He achieved control with Nabam (30% w/v) at 17 oz. per 1,000 $ft.^2$ and Thiram (80% w/v) at 4.5 oz. per 1,000 ft. applied every four weeks from February through September.

Wilcoxen (26) conducted a test in 1973 at the Cherokee Town and Country Club, Dunwoody, Georgia. He used Actidione-Thiram and Daconil 2787 at three ounces of fungicide per 1,000 ft.^{2} One area was sprayed in the spring, fall, and winter. Another area was sprayed in the fall and winter. On another area, Spring-Bak was used at the recommended rate and time (8). The results were: 1) the Spring-Bak-treated areas showed no reduction in the number of diseased spots; 2) the other two areas treated showed a great reduction in the number of diseased areas; 3) the diseased areas treated in the spring healed much quicker than the untreated area.

Another test was conducted on a bermudagrass lawn using Daconil 2787 at three ounces per 1,000 ft.^{2} Fungicide was applied to one area in April and May, one area was treated in June and July, and a third area received fungicide during August and September. A fourth area served as a check area. Applications were made every other week during the respective treatment periods. Every area except the June-July area and the check showed a drastic reduction in the number of spots. He concluded that spring dead spot is a disease complex, as had other researchers (13) (24), and through the combination of several different pathogens attacking the plant at different times of the year plus environmental stress, the plant fails to green-up the following spring. By using a broad-spectrum fungicide at the proper times, the effects of the disease should be reduced.

Kozelnicky (12) stated the spring dead spot of bermudagrass is a root rot which appears because the grass is predisposed to one or a group of fungal organisms by factors of management. Control should consist of preventive maintenance through the use of the following practices:

1. Apply only enough nitrogen to maintain the grass.
2. Keep thatch to a minimum by not overfertilizing, verticutting, and topdressing.
3. Prevent compaction.
4. Use water sensibly.
5. Use a preventive schedule of fungicides for control of all turf diseases.

Sturgeon (21) reported that thatch should be removed in the spring, followed by fertilization, aerification, application of a soil fungicide and possibly gypsum. Improving the soil texture and providing adequate drainage was also recommended.

CHAPTER III

MATERIALS AND METHODS

This study was conducted at the Stillwater Golf and Country Club on the number six fairway. The country club is two miles west and one-half mile south of the west edge of Stillwater, Oklahoma. The sixth fairway is in the southwest corner of the club.

The study was begun in February, 1974 during the dormant season of the bermudagrass. Since spring dead spot cannot be easily reproduced artificially, three large areas on the fairway were selected. Each area contained large areas of the disease. Nine treatments were used, and each area was blocked off using a randomized complete block split plot factorial statistical design, each area containing the nine treatments, and each replicated three times. Each plot was also split into two equal parts. One-half of each plot was aerified at the beginning of each season and the other half was left unaerified. The method of choosing which half to aerify and which half not to aerify was at random. All areas sloped from east to west and were west-facing, with the exception of replication three in area two. This replication sloped from west to east and was east-facing. The slope was greater in areas one and two than in area three.

All slopes were uniform. That is to say that the slope was directly up and down the fairway and in line with the treatment areas. No cross slope existed. The plot size of area one was 2.1 m (7 ft.) in width and 12.9 m (75 ft.) long; area two was 3.0 m (10 ft.) wide and 38.1 m (125 ft.) long; area three was 2.1 m (7 ft.) wide and 15.3 m (50 ft.) long. The area treated included 13.2 are^2 (14,175 sq. ft.) in area one, 31.4 are^2 (33,750 sq. ft.) in area two, and 8.8 are^2 (9,450 sq. ft.) in area three, totaling 53.3 are^2 (57,375 sq. ft).

The two chemical compounds used in this study were sodium azide granular, manufactured and furnished by PPG Industries, and Spring-Bak (disodium ethylene bisdithiocarbamate), manufactured by Mallinckrodt Chemical Works. Disodium ethylene bisdithiocarbamate is commonly called nabam. Sodium azide (NaN_3) may be used as a fungicide, nematocide, or insecticide. It has an acute oral LD_{50} rating of 60-80 mg/kg and an acute dermal LD_{50} rating of 37 mg/kg. Nabam $\left(\begin{array}{l} CH_2 - NH - LS - S - Na \\ \| \\ CH_2 - NH - LS - S - Na \end{array}\right)$ is used as a fungicide and has an acute oral LD_{50} rating of 395 mg/kg.

Each chemical compound was used in four different treatment combinations. Sodium azide was applied at a rate of 13.6 kg/0.405 ha (30 lbs./A), and Spring-Bak was applied at 226.8 gm/are^2 (8 oz./1,000 $ft.^2$). Each treatment was applied at approximately the middle of the month. The treatment date combinations are shown in Table I. The sodium azide was

TABLE I

TREATMENTS AND DATES OF APPLICATION OF THE TWO CHEMICAL COMPOUNDS, SODIUM AZIDE AND NABAM

Treatment	Treatment Number	Date of Application
Nabam	1	October 15 November 15 December 15 January 15 February 15 March 15
Nabam	2	October 15 November 15 December 15
Nabam	3	February 15 March 15
Nabam	4	October 15 March 15
Sodium Azide	5	October 15 November 15 December 15 January 15 February 15 March 15
Sodium Azide	6	October 15 November 15 December 15
Sodium Azide	7	February 15 March 15
Sodium Azide	8	October 15 March 15
Check	9	No Treatment

applied with a 91.4 cm (36 in.) Lawn Beauty fertilizer spreader, and the Spring-Bak was applied with a John Bean tractor-mounted Model 55K sprayer at 2.07 bar (30 psi) pressure and size TK-55-3 flood nozzles. Wind speeds were measured at the time of each treatment, and treatment was deferred whtn the constant wind speed exceeded 16.1 km (10 mi.) per hour. These treatments were than applied as soon as possible after treating, using the fairway sprinkling system. Four rain gauges were positioned in various positions in the treatment areas to provide an indication of the amount of water applied, with 2.54 cm (1 in.) being the recommended amount to satisfy the water requirement of the chemical compound, sodium azide. Nabam requires 0.25 to 1.27 cm (.1 to .5 in.) of water, depending on the amount of thatch present.

The method of evaluating the degree of control achieved in this study was through the use of ocular estimation. A scale of one to ten was employed, with one indicating no recovery of the bermudagrass from the effects of the disease, two represented 20 percent recovery, three represented 30 percent recovery, four indicated 40 percent recovery, etc., and 10 indicated complete, or 100 percent, recovery from the disease. Area maps were made of each plot to show the number and location of the diseased spots contained in the plot.

A relatively new test, Murphy's studentized maximum gap test, was used in the analysis of the data. Reference to this test is found in the literature citations (15).

CHAPTER IV

RESULTS AND DISCUSSION

Three ocular readings were made using the procedure discussed in the previous chapter, and these readings provided the data which was used in the statistical analysis. The three reading dates were 3 June 1974, 21 July 1975, and 22 September 1975. These three reading dates are referred to as recovery 1, recovery 2, and recovery 3, respectively. Since recovery 1 did not include the fall treatments, and recovery 2 and recovery 3 were made at two different times of the year, they are not equal and should not be compared one with the other.

An analysis of variance was computed for each recovery reading in each area. They are found in Appendix Tables II through X.

There were no significant differences in or among treatments in area one, recovery observation one. Fungicide, management, and the fungicide X management interaction were all non-significant at the five percent level using the F values. Aerification had no effect. The treatment means shown in Appendix Table XI indicate no differences in treatments or aerification.

The analysis of variance for area one, recovery observation two, indicated a significant difference at the five percent level in treatment, and it further indicated that this difference was in the management (treatment date combinations) portion. The LSD at the five percent level in Appendix Table XIV showed significant differences in the means within treatment using the same fungicide. Treatments one and four were significantly different from two and three, and treatments seven and eight were significantly different from treatments five and six. Murphy's studentized maximum gap test at the five percent level of significance using the table of critical values of the studentized maximum gap indicated that the October, March treatments for both nabam and sodium azide, treatments four and eight, respectively, were significantly different from the rest of the treatment date combinations. This is shown in Appendix Table XXV.

A significant difference was noted in the treatment in area one, recovery observation three. This time the differences were in the fungicide X management interaction and the check versus the others. The LSD at the five percent level showed that treatment seven, sodium azide applied in February and March, was significantly different from treatments five and six, as well as treatments two and three. Appendix Table XXVI of Murphy's studentized maximum gap test did not indicate a significant difference between the means of the various treatments, but it did rank the treatment using nabam applied from October through March first. This same combination of treatment dates using sodium azide was ranked last, with the February and March dates ranked first.

The analysis of variance for area two, recovery observation one, indicated a significant difference at the five percent level for management and the fungicide X management interaction. The LSD at the five percent level in Appendix Table XII showed that treatment two, nabam applied in October, November, and December, was significantly better than treatments four, five, eight, and nine. Murphy's studentized maximum gap test in Appendix Table XXVII indicated that the October, March treatments of both fungicides was significantly lower than all other treatments.

A highly significant difference was shown for treatments, the fungicide, and fungicide X management interaction, in the analysis of variance for area two, recovery observation two. The LSD at the five percent level in Appendix Table XV indicated that treatment five, sodium azide applied from October through March, was significantly lower than all other treatments with the exception of treatment six, sodium azide applied in October, November, and December. Treatment six was also significantly lower than all treatments using nabam as well as the sodium azide treatments seven and eight. Murphy's studentized maximum gap test, Appendix Table XXVIII, ranked the treatment date combinations the same for both fungicides. The average percent of control was higher for nabam than for sodium azide. Though there was a reasonably large gap between the top-ranked treatment date combination and the bottom-ranked one for nabam, no significant differences were declared.

The analysis of variance for area two, recovery observation three, showed no significant differences at the five percent level, although a significant difference was noted for fungicide at the 10 percent level. The LSD at five percent is shown in Appendix Table XVIII indicated that treatment one, nabam applied from October through March, was significantly higher than treatments five and six, sodium azide applied from October through March and in October, November and December, respectively.

The analysis of variance for area three, recovery observation one, showed no significant differences at the five percent level. The check versus the other treatments showed a significant difference at the 10 percent level. The LSD at the five percent level in Appendix Table XIII indicated that treatment two, nabam applied in October, November, and December, and treatment six, sodium azide applied in October, November, and December, were significantly lower than the rest of the treatments.

The fungicide treatment was shown to be significant at the five percent level in the analysis of variance for area three, recovery observation two. The fungicide X management was significant at the 10 percent level. The LSD in Appendix Table XVI indicated that treatments five and six, sodium azide applied from October through March and in October, November, and December, respectively, were significantly lower than the rest of the treatments.

The analysis of variance for area three, recovery observation three, showed a significant difference in the fungicide treatment at the five percent level. The LSD in Appendix Table XIX indicated that treatment five, sodium azide applied from October through March, was significantly lower than all of the treatments using nabam as well as treatment seven, sodium azide applied in February and March.

A summary table of all treatment means for nabam and sodium azide is included in Appendix Table XX. Overall, treatment five, sodium azide applied from October through March, was lower than all other treatments. The average recovery reading was 4.36 for nabam and 3.68 for sodium azide.

Appendix Tables XXI through XXIII show the means for the three recovery observations in the three treatment areas. In area one, the nabam treatments applied in October and March had the highest average, while the sodium azide treatments applied in February and March averaged the highest. Overall average for nabam was 5.0 and for sodium azide, 4.89. In area two, the nabam treatments applied from October through March averaged the highest, while the sodium azide treatments applied in October and March had the highest average. Overall average for nabam was 4.2, and 3.26 for sodium azide. In area three, the nabam treatments applied in October and March again had the highest average, while the sodium azide treatments applied in February and March averaged the highest. The overall average for nabam was 3.9, and 2.9 for sodium azide. A summary of means for the three recovery observations averaged over the three locations is presented in Appendix Table XXIV. Nabam applied from October through March averaged the highest, while sodium azide applied in February and March had the highest average. The overall average for Nabam was 4.36, and for sodium azide, 3.68.

Figure 1 graphically represents the effect of nabam and sodium azide applied from October through March averaged over the three areas. Nabam increased in recovery 20 percent from the first recovery reading to the second, then leveled off. Sodium azide dropped 12 percent from the first reading to the second, then increased 15.5 percent from the second reading to the third.

Figure 2 shows the effect of nabam and sodium azide applied in October, November, and December. Nabam increased 10 percent from the first reading to the second, and 4 percent from the second reading to the third. Sodium azide remained steady at approximately 30 percent recovery from the first reading until the second, then increased 13 percent from the second reading to the third.

Figure 3 depicts the effect of nabam and sodium azide applied in February and March averaged over the three treatment areas. Nabam increased 6 percent from the first reading to the second, and 4 percent from the second reading to

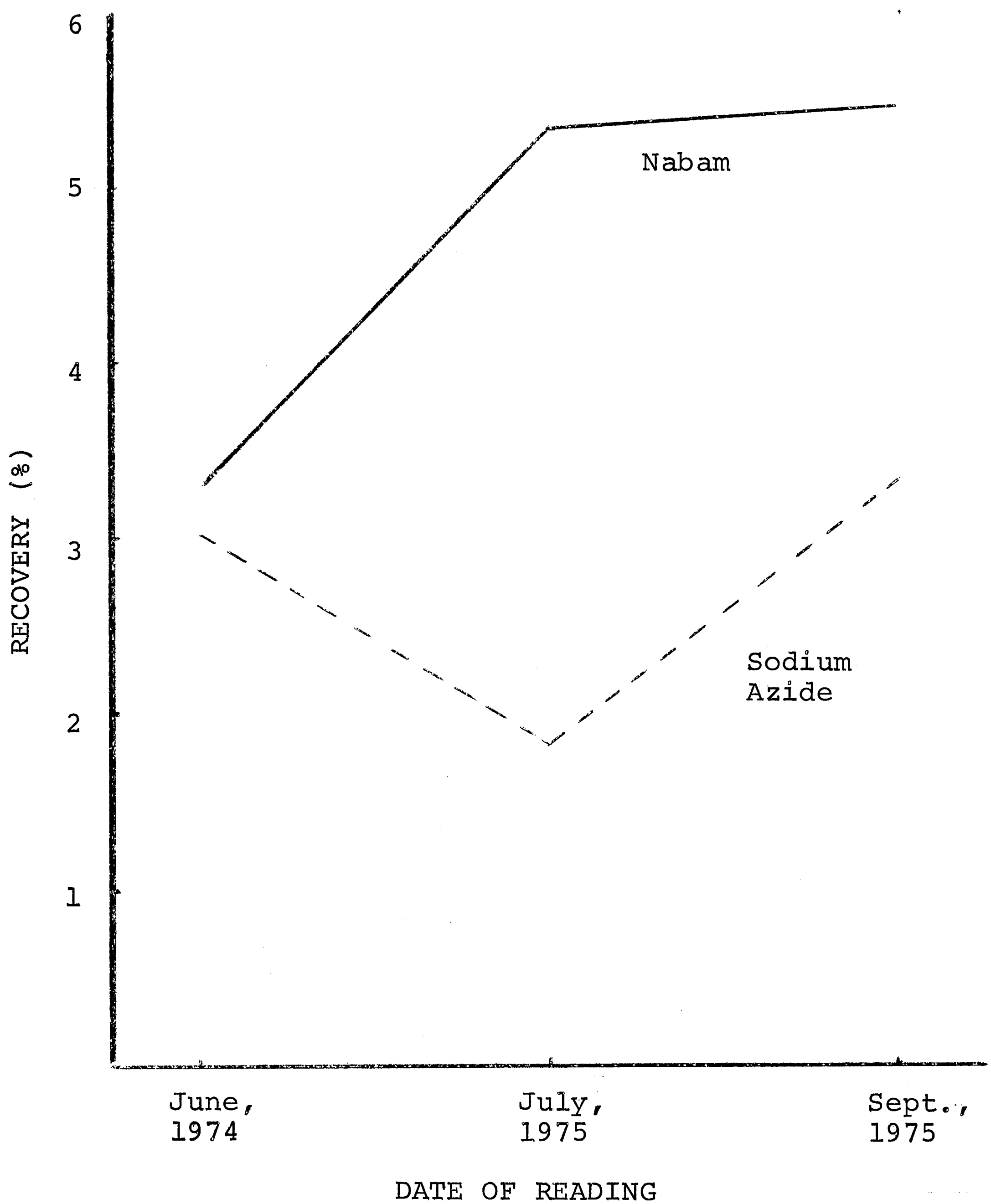

Figure 1. The Effect of Nabam and Sodium Azide Applied from October Through March Averaged Over Three Areas

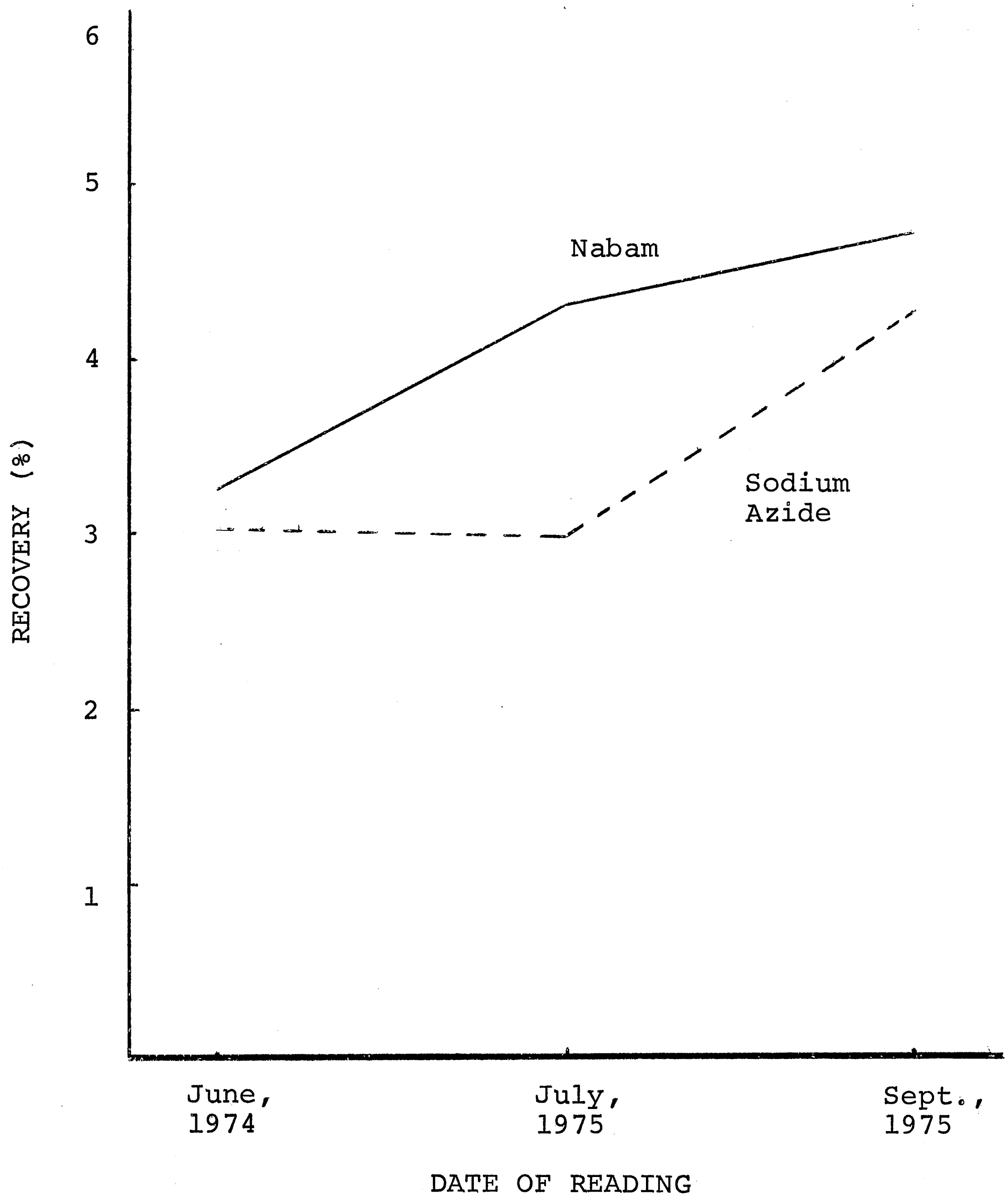

Figure 2. The Effect of Nabam and Sodium Azide Applied in October, November, and December Averaged Over Three Areas.

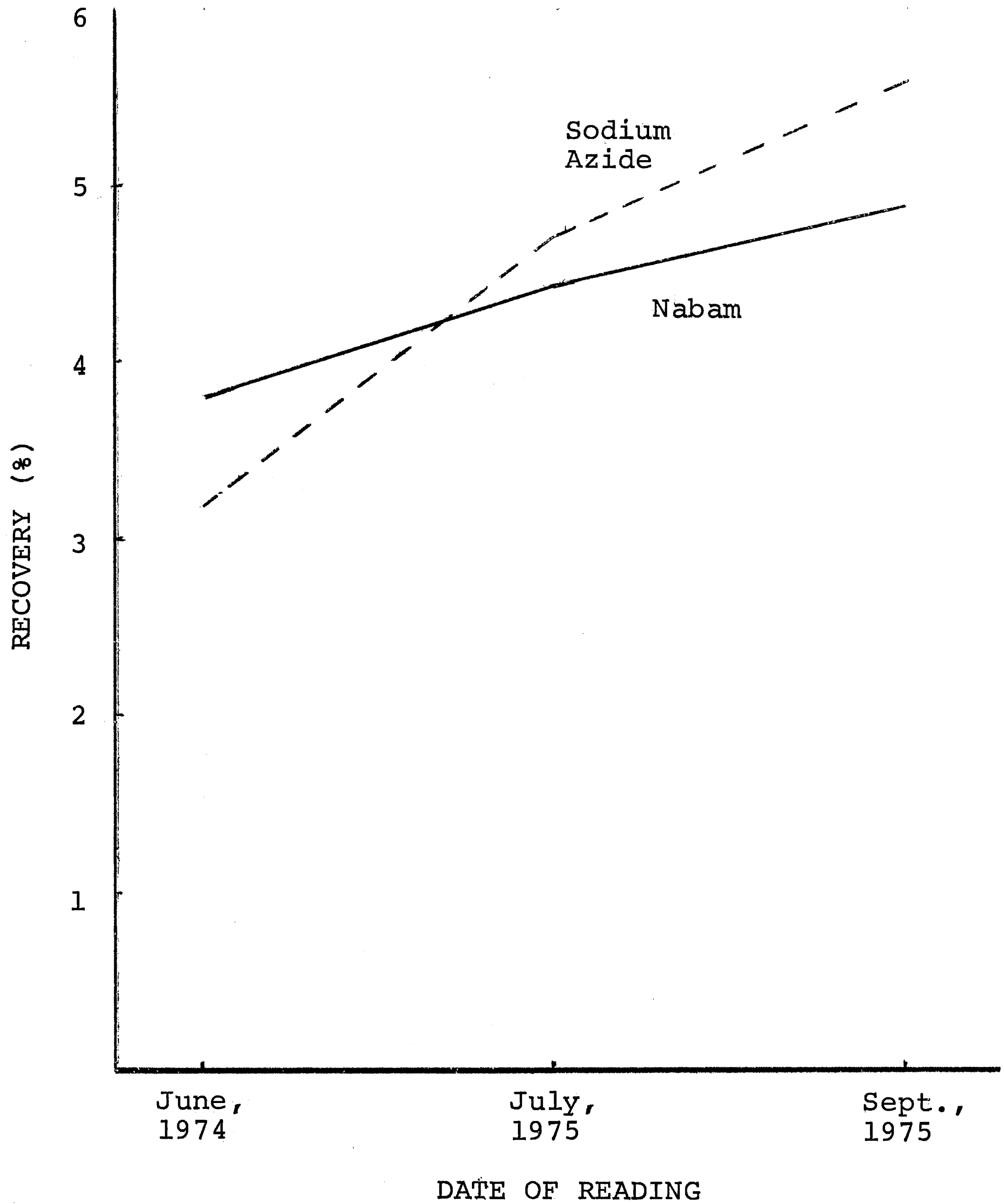

Figure 3. The Effect of Nabam and Sodium Azide Applied in February and March Averaged Over Three Areas.

the third. Sodium azide increased 15 percent from the first reading to the second, and 8 percent from the second to the third. This was the only treatment combination in which sodium azide outperformed nabam.

Figure 4 shows the effects of nabam and sodium azide applied in October and March. Nabam increased 18 percent from the first reading to the second, and 3 percent from the second reading to the third. Sodium azide increased 19 percent from the first reading to the second, and leveled off between the second recovery reading and the third.

In all treatment date combinations, nabam had the highest initial recovery reading. This held true for all second and third recovery readings with the exception of the February and March applications. In this treatment, sodium azide was 3 percent higher than nabam on the second reading, and finished 7.5 percent higher on the third reading.

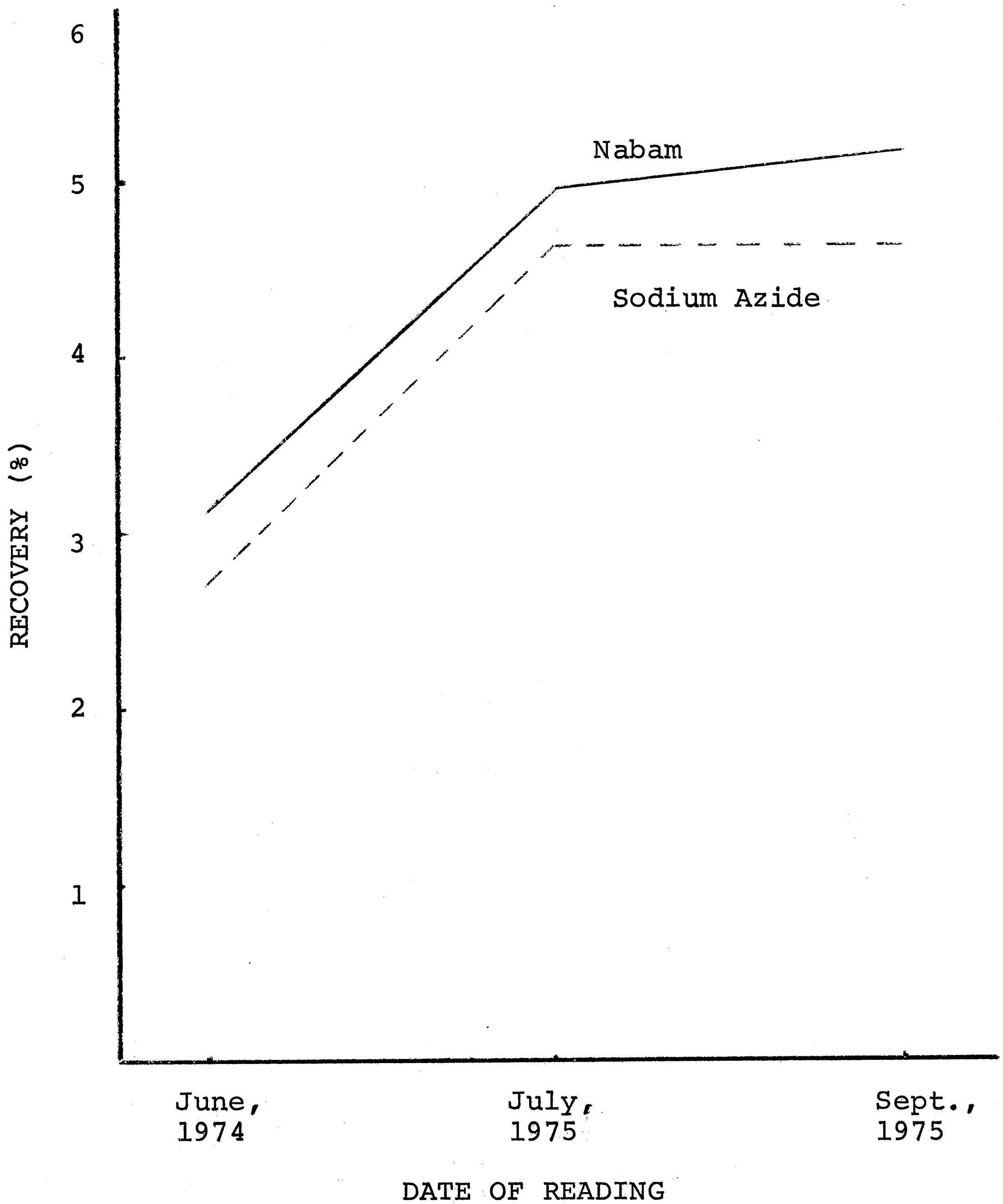

Figure 4. The Effect of Nabam and Sodium Azide Applied in October and March Averaged Over Three Areas.

CHAPTER V

SUMMARY AND CONCLUSIONS

The objective of this study was to evaluate two fungicides applied in varying treatment combinations for the control of the disease of bermudagrass, spring dead spot. In the nine analyses of variance computed for this study, significant treatment effects were found three times, significant management effects were found twice, and significant management X fungicide interaction effects were found three times.

Aerification did not seem to affect the action of nabam or sodium azide, either positively or negatively. In one analysis of variance the effect of aerification was zero, and in the remaining analyses of variance, aerification was never close to being a significant factor.

The tables of means and the LSD values indicated that the fungicide nabam applied from October through March generally had the highest percent recovery average, followed closely by nabam applied in October and March. Sodium azide applied in February and March generally had the highest percent of recovery for this fungicide. Sodium azide applied from October through March generally had the lowest percent of recovery.

The tables of means of the three recovery observations show that in most instances, the third recovery reading was generally the highest. This might be expected with the passage of time. There were five exceptions to this. They were area two, treatments two and three, and area three, treatments one, five and eight.

Murphy's studentized maximum gap test ranked the nabam treatments applied from October through November first twice, second once, and third once. The sodium azide treatments applied in October and March were ranked first twice, third once, and fourth once. The treatments applied in February and March were ranked first once and had the highest mean recovery reading.

According to these data, the sodium azide treatment applied in February and March had the highest mean recovery percent of all treatments, followed closely by nabam applied from October through March. Nabam applied in October and March was approximately two percent lower than the October through March applications. No other sodium azide treatment was closer than 9.5 percent of the top treatment.

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APPENDIX

TABLE II

ANALYSIS OF VARIANCE FOR THE EFFECT OF NABAM AND SODIUM AZIDE APPLIED IN FOUR DIFFERENT TREATMENT COMBINATIONS IN AREA ONE, RECOVERY ONE

Source	Degrees of Freedom	Mean Square	F
Replication	2	4.5185	
Aerification	1	-0.0000	
Rep. X Aer.	2	0.0000	
Treatment	8	0.1296	0.3374
Fungicide	(1)	0.0000	
Management	(3)	0.1111	0.2891
Fung. X Mgmt.	(3)	0.2222	0.5782
Check vs. Others	(1)	0.0370	0.0963
Treatment X Aerification	8	0.0000	
Fung. X Aer.	(1)	0.0000	
Mgmt. X Aer.	(3)	0.0000	
Fung. X Mgmt. X Aer.	(3)	0.0000	
Check vs. Other X Der.	(1)	0.0000	
Error	32	0.3843	
C.V. (%) Treatments		16.6	

TABLE III

ANALYSIS OF VARIANCE FOR THE EFFECT OF NABAM AND SODIUM AZIDE APPLIED IN FOUR DIFFERENT TREATMENT COMBINATIONS IN AREA ONE, RECOVERY TWO

Source	Degrees of Freedom	Mean Square	F
Replication	2	3.2407	
Aerification	1	0.0741	4.00
Rep. X Aer.	2	0.0185	
Treatment	8	4.1991	2.5442*
Fungicide	(1)	4.0833	2.4740
Management	(3)	6.2778	3.8036*
Fung. X Mgmt.	(3)	3.3611	2.0364
Check vs. Others	(1)	0.5927	0.3591
Treatment X Aerification	8	0.3657	0.2216
Fung. X Aer.	(1)	0.3333	0.2019
Mgmt. X Aer.	(3)	0.2500	0.1515
Fung. X Mgmt. X Aer.	(3)	0.6111	0.3703
Check vs. Others X Aer.	(1)	0.0093	0.0056
Error	32	1.6505	
C.V. (%) Treatments		25.9	

*Exceeds 5% Level of Significance

TABLE IV

ANALYSIS OF VARIANCE FOR THE EFFECT OF NABAM AND SODIUM AZIDE APPLIED IN FOUR DIFFERENT TREATMENT COMBINATIONS IN AREA ONE, RECOVERY THREE

Source	Degrees of Freedom	Mean Square	F
Replication	2	2.0741	
Aerification	1	0.1667	
Rep. X Aer.	2	0.0000	
Treatment	8	3.2269	3.0503*
Fungicide	(1)	0.7500	0.7090
Management	(3)	2.2778	2.1531
Fung. X Mgmt.	(3)	4.5833	4.3325*
Check vs. Others	(1)	4.4815	4.2360*
Treatment X Aerification	8	0.1250	0.1182
Fung. X Aer.	(1)	0.0000	
Mgmt. X Aer.	(3)	0.2500	0.2363
Fung. X Mgmt. X Aer.	(3)	0.0556	0.0526
Check vs. Others X Aer.	(1)	0.0833	0.0787
Error	32	1.0579	
C.V. (%) Treatments		17.2	

*Exceeds 5% Level of Significance

TABLE V

ANALYSIS OF VARIANCE FOR THE EFFECT OF NABAM AND SODIUM AZIDE APPLIED IN FOUR DIFFERENT TREATMENT COMBINATIONS IN AREA TWO, RECOVERY ONE

Source	Degrees of Freedom	Mean Square	F
Replication	2	1.0556	
Aerification	1	0.1667	
Rep. X Aer.	2	0.1667	
Treatment	8	1.6667	1.6552
Fungicide	(1)	2.5208	2.5035
Management	(3)	3.1319	3.1104*
Fung. X Mgmt.	(3)	3.3194	3.2966*
Check vs. Others	(1)	0.5209	0.5173
Treatment X Aerification	8	0.0833	0.0828
Fung. X Aer.	(1)	0.0208	
Mgmt. X Aer.	(3)	0.0764	
Fung. X Mgmt. X Aer.	(3)	0.1319	
Check vs. Others X Aer.	(1)	0.0209	
Error	32	1.0069	
C.V. (%) Treatments		34.1	

*Exceeds 5% Level of Significance

TABLE VI

ANALYSIS OF VARIANCE FOR THE EFFECT OF NABAM AND SODIUM AZIDE APPLIED IN FOUR DIFFERENT TREATMENT COMBINATIONS IN AREA TWO RECOVERY TWO

Source	Degrees of Freedom	Mean Square	F
Replication	2	2.4630	
Aerification	1	0.6667	1.3333
Rep. X Aer.	2	0.5000	
Treatment	8	9.0602	9.2311**
Fungicide	(1)	33.3333	33.9616**
Management	(3)	2.0556	2.0946
Fung. X Mgmt.	(3)	10.3889	10.5847**
Check vs. Others	(1)	1.8148	1.8490
Treatment X Aerification	8	0.2917	
Fung. X Aer.	(1)	0.3333	
Mgmt. X Aer.	(3)	0.0556	
Fung. X Mgmt. X Aer.	(3)	0.1667	
Check vs. Others X Aer.	(1)	1.3333	
Error	32	0.9815	
C.V. (%) Treatments		25.7	

**Exceeds 1% Level of Significance

TABLE VII

ANALYSIS OF VARIANCE FOR THE EFFECT OF NABAM AND SODIUM AZIDE APPLIED IN FOUR DIFFERENT TREATMENT COMBINATIONS IN AREA TWO, RECOVERY THREE

Source	Degrees of Freedom	Mean Square	F
Replication	2	2.8889	
Aerification	1	0.0741	
Rep. X Aer.	2	0.0741	
Treatment	8	2.1250	
Fungicide	(1)	5.3333	3.6514+
Management	(3)	0.1389	
Fung. X Mgmt.	(3)	3.0556	2.0920
Check vs. Others	(1)	2.0833	
Treatment X Aerification	8	0.1991	
Fung. X Aer.	(1)	0.0000	
Mgmt. X Aer.	(3)	0.2500	
Fung. X Mgmt. X Aer.	(3)	0.2778	
Check vs. Others X Aer.	(1)	0.0093	
Error	32	1.4606	
C.V. (%) Treatments		28.6	

+Exceeds 10% Level of Significance

TABLE VIII

ANALYSIS OF VARIANCE FOR THE EFFECT OF NABAM AND SODIUM AZIDE APPLIED IN FOUR DIFFERENT TREATMENT COMBINATIONS IN AREA THREE, RECOVERY ONE

Source	Degrees of Freedom	Mean Square	F
Replication	2	22.7963	
Aerification	1	0.0000	
Rep. X Aer.	2	0.0556	
Treatment	8	6.4907	1.4947
Fungicide	(1)	5.3333	1.2281
Management	(3)	6.8889	1.5864
Fung. X Mgmt.	(3)	2.1111	
Check vs. Others	(1)	19.5926	4.5117+
Treatment X Aerification	8	0.1667	
Fung. X Aer.	(1)	0.3333	
Mgmt. X Aer.	(3)	0.1111	
Fung. X Mgmt. X Aer.	(3)	0.2222	
Check vs. Others X Aer.	(1)	0.0000	
Error	32	4.3426	
C.V. (%) Treatments		70.3	

+Exceeds 10% Level of Significance

TABLE IX

ANALYSIS OF VARIANCE FOR THE EFFECT OF NABAM AND SODIUM AZIDE APPLIED IN FOUR DIFFERENT TREATMENT COMBINATIONS IN AREA THREE, RECOVERY TWO

Source	Degrees of Freedom	Mean Square	F
Replication	2	3.0185	
Aerification	1	2.6667	
Rep. X Aer.	2	0.0556	
Treatment	8	6.6713	2.2747*
Fungicide	(1)	12.0000	4.0915*
Management	(3)	5.5833	1.9037
Fung. X Mgmt.	(3)	8.0556	2.7466+
Check vs. Others	(1)	0.4537	0.1547
Treatment X Aerification	8	0.6250	
Fung. X Aer.	(1)	0.3333	
Mgmt. X Aer.	(3)	0.4722	
Fung. X. Mgmt. X Aer.	(3)	0.3889	
Check vs. Others X Aer.	(1)	2.0833	
Error	32	2.9329	
C.V. (%) Treatments		47.8	

*Exceeds 5% Level of Significance

+Exceeds 10% Level of Significance

TABLE X

ANALYSIS OF VARIANCE FOR THE EFFECT OF NABAM AND SODIUM AZIDE APPLIED IN FOUR DIFFERENT TREATMENT COMBINATIONS IN AREA THREE, RECOVERY THREE

Source	Degrees of Freedom	Mean Square	F
Replication	2	1.500	
Aerification	1	0.9074	
Rep. X Aer.	2	0.3519	
Treatment	8	9.7917	2.7414*
Fungicide	(1)	22.6875	6.3518*
Management	(3)	7.4653	2.0901
Fung. X Mgmt.	(3)	7.4097	2.0745
Check vs. Others	(1)	11.0208	3.0855
Treatment X Aerification	8	0.9491	
Fung. X Aer.	(1)	1.0210	
Mgmt. X Aer.	(3)	1.0764	
Fung. X Mgmt. X Aer.	(3)	1.0764	
Check vs. Others X Aer.	(1)	0.1134	
Error	32	3.5718	
C.V. (%) Treatments		52.3	

*Exceeds 5% Level of Significance

TABLE XI

TABLE OF TREATMENT MEANS FOR NABAM AND SODIUM AZIDE IN AREA ONE, RECOVERY ONE

Treat-ment	Aerifi-cation*	Repli-cations	Fungicide	Means	Combined Means
1	A	3	Nabam	3.67	3.67
1	N-A	3	Nabam	3.67	
2	A	3	Nabam	4.00	4.00
2	N-A	3	Nabam	4.00	
3	A	3	Nabam	3.67	3.67
3	N-A	3	Nabam	3.67	
4	A	3	Nabam	3.67	3.67
4	N-A	3	Nabam	3.67	
5	A	3	Sodium Azide	4.00	4.00
5	N-A	3	Sodium Azide	4.00	
6	A	3	Sodium Azide	3.67	3.67
6	N-A	3	Sodium Azide	3.67	
7	A	3	Sodium Azide	3.67	3.67
7	N-A	3	Sodium Azide	3.67	
8	A	3	Sodium Azide	3.67	3.67
8	N-A	3	Sodium Azide	3.67	
9	A	3	Check	3.67	3.67
9	N-A	3	Check	3.67	
Aerified Mean					3.74
Non-Aerified Mean					3.74
Overall Mean					3.74

*A = Aerified; N-A = Non-Aerified

$LSD_{.05}$ 0.729

TABLE XII

TABLE OF TREATMENT MEANS FOR NABAM AND SODIUM AZIDE IN AREA TWO, RECOVERY ONE

Treat-ment	Aerifi-cation*	Repli-cations	Fungicide	Means	Combined Means
1	A	3	Nabam	3.33	3.33
1	N-A	3	Nabam	3.33	
2	A	3	Nabam	4.00	3.83
2	N-A	3	Nabam	3.67	
3	A	3	Nabam	3.00	3.00
3	N-A	3	Nabam	3.00	
4	A	3	Nabam	2.67	2.67
4	N-A	3	Nabam	2.67	
5	A	3	Sodium Azide	2.67	2.67
5	N-A	3	Sodium Azide	2.67	
6	A	3	Sodium Azide	3.33	3.33
6	N-A	3	Sodium Azide	3.33	
7	A	3	Sodium Azide	3.33	3.00
7	N-A	3	Sodium Azide	2.67	
8	A	3	Sodium Azide	2.00	2.00
8	N-A	3	Sodium Azide	2.00	
9	A	3	Check	2.67	2.67
9	N-A	3	Check	2.67	
Aerified Mean					3.00
Non-Aerified Mean					2.89
Overall Mean					2.94

*A = Aerified; N-A = Non-Aerified

$LSD_{.05}$ 1.181

TABLE XIII

TABLE OF TREATMENT MEANS FOR NABAM AND SODIUM AZIDE IN AREA THREE, RECOVERY ONE

Treat-ment	Aerifi-cation*	Repli-cations	Fungicide	Means	Combined Means
1	A	3	Nabam	3.00	2.83
1	N-A	3	Nabam	2.67	
2	A	3	Nabam	2.00	1.83
2	N-A	3	Nabam	1.67	
3	A	3	Nabam	4.67	4.67
3	N-A	3	Nabam	4.67	
4	A	3	Nabam	3.00	3.00
4	N-A	3	Nabam	3.00	
5	A	3	Sodium Azide	2.00	2.33
5	N-A	3	Sodium Azide	2.67	
6	A	3	Sodium Azide	2.00	2.00
6	N-A	3	Sodium Azide	2.00	
7	A	3	Sodium Azide	2.67	2.83
7	N-A	3	Sodium Azide	3.00	
8	A	3	Sodium Azide	2.67	2.50
8	N-A	3	Sodium Azide	2.33	
9	A	3	Check	4.67	4.67
9	N-A	3	Check	4.67	
Aerified Mean					2.96
Non-Aerified Mean					2.96
Overall Mean					2.96

*A = Aerified; N-A = Non-Aerified

$LSD_{.05}$ 2.452

TABLE XIV

TABLE OF TREATMENT MEANS FOR NABAM AND SODIUM AZIDE IN AREA ONE, RECOVERY TWO

Treat- ment	Aerifi- cation*	Repli- cations	Fungicide	Means	Combined Means
1	A	3	Nabam	6.00	5.83
1	N-A	3	Nabam	5.67	
2	A	3	Nabam	4.67	4.50
2	N-A	3	Nabam	4.33	
3	A	3	Nabam	4.33	4.83
3	N-A	3	Nabam	5.33	
4	A	3	Nabam	6.00	6.00
4	N-A	3	Nabam	6.00	
5	A	3	Sodium Azide	4.00	3.83
5	N-A	3	Sodium Azide	3.67	
6	A	3	Sodium Azide	4.00	3.83
6	N-A	3	Sodium Azide	3.67	
7	A	3	Sodium Azide	5.67	5.33
7	N-A	3	Sodium Azide	5.00	
8	A	3	Sodium Azide	5.67	5.83
8	N-A	3	Sodium Azide	6.00	
9	A	3	Check	4.67	4.67
9	N-A	3	Check	4.67	
Aerified Mean					5.00
Non-Aerified Mean					4.92
Overall Mean					4.96

*A = Aerified; N-A = Non-Aerified

$LSD_{.05}$ 1.151

TABLE XV

TABLE OF TREATMENT MEANS FOR NABAM AND SODIUM AZIDE IN AREA TWO, RECOVERY TWO

Treat-ment	Aerifi-cation*	Repli-cations	Fungicide	Means	Combined Means
1	A	3	Nabam	5.33	5.33
1	N-A	3	Nabam	5.33	
2	A	3	Nabam	5.33	5.00
2	N-A	3	Nabam	4.67	
3	A	3	Nabam	5.00	4.67
3	N-A	3	Nabam	4.33	
4	A	3	Nabam	4.33	4.00
4	N-A	3	Nabam	3.67	
5	A	3	Sodium Azide	1.67	1.50
5	N-A	3	Sodium Azide	1.33	
6	A	3	Sodium Azide	2.67	2.50
6	N-A	3	Sodium Azide	2.33	
7	A	3	Sodium Azide	4.00	4.00
7	N-A	3	Sodium Azide	4.00	
8	A	3	Sodium Azide	4.33	4.33
8	N-A	3	Sodium Azide	4.33	
9	A	3	Check	3.00	3.33
9	N-A	3	Check	3.67	
Aerified Mean					3.96
Non-Aerified Mean					3.74
Overall Mean					3.85

*A = Aerified; N-A = Non-Aerified

$LSD_{.05}$ 1.166

TABLE XVI

TABLE OF TREATMENT MEANS FOR NABAM AND SODIUM AZIDE IN AREA THREE, RECOVERY TWO

Treat-ment	Aerifi-cation*	Repli-cations	Fungicide	Means	Combined Means
1	A	3	Nabam	5.33	4.67
1	N-A	3	Nabam	4.00	
2	A	3	Nabam	4.00	3.33
2	N-A	3	Nabam	2.67	
3	A	3	Nabam	3.67	3.67
3	N-A	3	Nabam	3.67	
4	A	3	Nabam	5.00	5.83
4	N-A	3	Nabam	4.67	
5	A	3	Sodium Azide	2.00	1.67
5	N-A	3	Sodium Azide	1.33	
6	A	3	Sodium Azide	2.67	2.50
6	N-A	3	Sodium Azide	2.33	
7	A	3	Sodium Azide	5.00	4.67
7	N-A	3	Sodium Azide	4.33	
8	A	3	Sodium Azide	3.67	3.67
8	N-A	3	Sodium Azide	3.67	
9	A	3	Check	3.00	3.33
9	N-A	3	Check	3.67	
Aerified Mean					3.82
Non-Aerified Mean					3.37
Overall Mean					3.59

*A = Aerified; N-A - Non-Aerified

$LSD_{.05}$ 2.015

TABLE XVII

TABLE OF TREATMENT MEANS FOR NABAM AND SODIUM AZIDE IN AREA ONE RECOVERY THREE

Treat-ment	Aerifi-cation*	Repli-cations	Fungicide	Means	Combined Means
1	A	3	Nabam	6.33	6.33
1	N-A	3	Nabam	6.33	
2	A	3	Nabam	5.67	5.50
2	N-A	3	Nabam	5.33	
3	A	3	Nabam	5.67	5.50
3	N-A	3	Nabam	5.33	
4	A	3	Nabam	6.33	6.50
4	N-A	3	Nabam	6.67	
5	A	3	Sodium Azide	5.33	5.17
5	N-A	3	Sodium Azide	5.00	
6	A	3	Sodium Azide	6.00	5.83
6	N-A	3	Sodium Azide	5.67	
7	A	3	Sodium Azide	7.33	7.33
7	N-A	3	Sodium Azide	7.33	
8	A	3	Sodium Azide	6.33	6.50
8	N-A	3	Sodium Azide	6.67	
9	A	3	Check	5.33	5.17
9	N-A	3	Check	5.00	
Aerified Mean					6.04
Non-Aerified Mean					5.93
Overall Mean					5.98

*A = Aerified; N-A = Non-Aerified

$LSD_{.05}$ 1.210

TABLE XVIII

TABLE OF TREATMENT MEANS FOR NABAM AND SODIUM AZIDE IN AREA TWO, RECOVERY THREE

Treat-ments	Aerifi-cation*	Repli-cations	Fungicide	Means	Combined Means
1	A	3	Nabam	5.00	5.33
1	N-A	3	Nabam	5.67	
2	A	3	Nabam	4.67	4.67
2	N-A	3	Nabam	4.67	
3	A	3	Nabam	4.33	4.50
3	N-A	3	Nabam	4.67	
4	A	3	Nabam	4.33	4.00
4	N-A	3	Nabam	3.67	
5	A	3	Sodium Azide	3.33	3.33
5	N-A	3	Sodium Azide	3.33	
6	A	3	Sodium Azide	3.67	3.83
6	N-A	3	Sodium Azide	4.00	
7	A	3	Sodium Azide	4.33	4.33
7	N-A	3	Sodium Azide	4.33	
8	A	3	Sodium Azide	4.33	4.33
8	N-A	3	Sodium Azide	4.33	
9	A	3	Check	3.67	3.67
9	N-A	3	Check	3.67	
Aerified Mean					4.19
Non-AerifiedMMean					4.26
Overall Mean					4.22

*A = Aerified; N-A = Non-Aerified

$LSD_{.05}$ 1.422

TABLE XIX

TABLE OF TREATMENT MEANS FOR NABAM AND SODIUM AZIDE IN AREA THREE, RECOVERY THREE

Treatment	Aerification*	Replications	Fungicide	Means	Combined Means
1	A	3	Nabam	4.67	4.50
1	N-A	3	Nabam	4.33	
2	A	3	Nabam	3.67	3.83
2	N-A	3	Nabam	4.00	
3	Aer	3	Nabam	3.33	4.50
3	N-A	3	Nabam	5.67	
4	A	3	Nabam	5.00	5.00
4	N-A	3	Nabam	5.00	
5	A	3	Sodium Azide	1.33	1.33
5	N-A	3	Sodium Azide	1.33	
6	A	3	Sodium Azide	3.00	3.00
6	N-A	3	Sodium Azide	3.00	
7	A	3	Sodium Azide	5.00	5.00
7	N-A	3	Sodium Azide	5.00	
8	A	3	Sodium Azide	3.00	3.00
8	N-A	3	Sodium Azide	3.00	
9	A	3	Check	2.33	2.33
9	N-A	3	Check	2.33	
Aerified Mean					3.48
Non-Aerified Mean					3.74
Overall Mean					3.61

*A = Aerified; N-A = Non-Aerified

$LSD_{.05}$ 2.220

TABLE XX

SUMMARY TABLE OF TREATMENT MEANS FOR NABAM AND SODIUM AZIDE AVERAGED OVER ALL AREAS AND ALL RECOVERY OBSERVATIONS

Treat-ment	Aerifi-cation*	Repli-cations	Fungicide	Means
1	A	27	Nabam	4.74
1	N-A	27	Nabam	4.56
2	A	27	Nabam	4.22
2	N-A	27	Nabam	3.89
3	A	27	Nabam	4.19
3	N-A	27	Nabam	4.48
4	A	27	Nabam	4.48
4	N-A	27	Sodium Azide	4.33
5	A	27	Sodium Azide	2.93
5	N-A	27	Sodium Azide	2.81
6	A	27	Sodium Azide	3.44
6	N-A	27	Sodium Azide	3.33
7	A	27	Sodium Azide	4.55
7	N-A	27	Sodium Azide	4.37
8	A	27	Sodium Azide	3.96
8	N-A	27	Sodium Azide	4.00
9	A	27	Check	3.67
9	N-A	27	Check	3.78
Nabam				4.36
Sodium Azide				4.68
Overall Mean Less Check				4.02
Over Mean With Check				3.99

*A = Aerified; N-A = Non-Aerified

TABLE XXI

MEANS OF THREE RECOVERY OBSERVATIONS IN AREA ONE FOR NABAM AND SODIUM AZIDE APPLIED IN FOUR DIFFERENT TREATMENT COMBINATIONS

Fungicide	Application	Repli-cations	Recovery 1	Recovery 2	Recovery 3
Nabam	Oct., Mar.	6	3.67	6.00	6.50
Nabam	Oct.-Mar.	6	3.67	5.83	6.33
Nabam	Oct., Nov., Dec.	6	4.00	4.50	5.50
Nabam	Feb., Mar.	6	3.67	4.83	5.50
Sodium Azide	Oct., Mar.	6	3.67	4.83	6.50
Sodium Azide	Oct.-Mar.	6	4.00	3.83	5.17
Sodium Azide	Oct., Nov., Dec.	6	3.67	3.83	5.83
Sodium Azide	Feb., Mar.	6	3.67	5.33	7.33
Nabam Overall Mean					5.00
Sodium Azide Overall Mean					4.89

TABLE XXII

MEANS OF THREE RECOVERY OBSERVATIONS IN AREA TWO FOR NABAM AND SODIUM AZIDE APPLIED IN FOUR DIFFERENT TREATMENT COMBINATIONS

Fungicide	Application	Repli-cations	Recovery 1	2	3
Nabam	Oct., Mar.	6	2.67	4.00	4.00
Nabam	Oct.-Mar.	6	3.33	5.33	5.33
Nabam	Oct., Nov., Dec.	6	3.83	5.00	4.67
Nabam	Feb., Mar.	6	3.00	4.67	4.50
Sodium Azide	Oct., Mar.	6	2.00	4.33	4.33
Sodium Azide	Oct.-Mar.	6	2.67	1.50	3.33
Sodium Azide	Oct., Nov., Dec.	6	3.33	2.50	3.83
Sodium Azide	Feb., Mar.	6	3.00	4.00	4.33
Nabam Overall Mean					4.19
Sodium Azide Overall Mean					3.26

TABLE XXIII

MEANS OF THREE RECOVERY OBSERVATIONS IN AREA THREE FOR NABAM AND SODIUM AZIDE APPLIED IN FOUR DIFFERENT TREATMENT COMBINATIONS

Fungicide	Application	Replications	Recovery 1	2	3
Nabam	Oct., Mar.	6	3.00	4.83	5.00
Nabam	Oct.-Mar.	6	2.83	4.67	4.50
Nabam	Oct., Nov., Dec.	6	1.83	3.33	3.83
Nabam	Feb., Mar.	6	4.67	3.67	4.50
Sodium Azide	Oct., Mar.	6	2.50	3.67	3.00
Sodium Azide	Oct.-Mar.	6	2.33	1.67	1.33
Sodium Azide	Oct., Nov., Dec.	6	2.00	2.50	3.00
Sodium Azide	Feb., Mar.	6	2.83	4.67	5.00
Nabam Overall Mean					3.89
Sodium Azide Overall Mean					2.88

TABLE XXIV

SUMMARY OF MEANS OF THREE RECOVERY OBSERVATIONS IN THREE AREAS FOR NABAM AND SODIUM AZIDE APPLIED IN FOUR DIFFERENT TREATMENT COMBINATIONS

Fungicide	Application	Repli-cations	Recovery 1	2	3
Nabam	Oct., Mar.	18	3.11	4.94	5.17
Nabam	Oct.-Mar.	18	3.28	5.28	5.39
Nabam	Oct., Nov., Dec.	18	3.22	4.28	4.67
Nabam	Feb., Mar.	18	3.78	4.39	4.83
Sodium Azide	Oct., Mar.	18	2.72	4.61	4.61
Sodium Azide	Oct.-Mar.	18	3.00	1.83	3.28
Sodium Azide	Oct., Nov., Dec.	18	3.00	2.94	4.22
Sodium Azide	Feb., Mar.	18	3.17	4.67	5.56
Nabam Overall Mean					4.36
Sodium Azide Overall Mean					3.68

TABLE XXV

MURPHY'S STUDENTIZED MAXIMUM GAP TEST FOR THE MEANS OF THE RECOVERY OBSERVATIONS FOR NABAM AND SODIUM AZIDE IN FOUR DIFFERENT TREATMENT COMBINATIONS IN AREA ONE, RECOVERY TWO

Management	Fungi-cide	Means**	Management	Fungi-cide	Means
Oct., Mar.	Nabam	5.9167	Oct., Mar.	Sodium	5.9167
		*0.8334		Azide	*0.8334
Feb., Mar.		5.0833	Feb., Mar.		5.0833
		0.2500			0.2500
Oct.-Mar.		4.833	Oct.-Mar.		4.8333
		0.6666			0.6666
Oct.-Dec.		4.1667	Oct.-Dec.		4.1667

*Significant at the 5% Level
**Mean Differences are Shown Between the Means.

TABLE XXVI

MURPHY'S STUDENTIZED MAXIMUM GAP TEST FOR THE MEANS OF THE RECOVERY OBSERVATIONS FOR NABAM AND SODIUM AZIDE IN FOUR DIFFERENT TREATMENT COMBINATIONS IN AREA ONE, RECOVERY THREE

Management	Fungi-cide	Means	Management	Fungi-cide	Means
Oct.-Mar.	Nabam	6.7917	Feb., Mar.	Sodium	6.8750
		0.5000		Azide	0.7500
Feb., Mar.		6.2917	Oct.-Dec.		6.1250
		0.0834			0.1667
Oct., Mar.		6.2083	Oct., Mar.		5.9583
		0.1666			0.5833
Oct.-Dec.		6.0417	Oct.-Mar.		5.3750

TABLE XXVII

MURPHY'S STUDENTIZED MAXIMUM GAP TEST FOR THE MEANS OF THE RECOVERY OBSERVATIONS FOR NABAM AND SODIUM AZIDE IN FOUR DIFFERENT TREATMENT COMBINATIONS IN AREA TWO, RECOVERY ONE

Management	Fungi-cide	Means	Management	Fungi-cide	Means
Oct.-Dec.	Nabam	3.5833	Oct.-Dec.	Sodium	3.5833
		0.5833		Azide	0.5833
Oct.-Mar.		3.0000	Oct.-Mar.		3.0000
		0			0
Feb., Mar.		3.0000	Feb., Mar.		3.0000
		*0.6667			*0.6667
Oct., Mar.		2.3333	Oct., Mar.		2.3333

*Significant at the 5% Level

TABLE XXVIII

MURPHY'S STUDENTIZED MAXIMUM GAP TEST FOR THE MEANS OF THE RECOVERY OBSERVATIONS FOR NABAM AND SODIUM AZIDE IN FOUR DIFFERENT TREATMENT COMBINATIONS IN AREA TWO, RECOVERY TWO

Management	Fungi-cide	Means	Management	Fungi-cide	Means
Oct.-Mar.	Nabam	5.8333	Oct., Mar.	Sodium	4.0833
		1.0000		Azide	0.0833
Oct.-Dec.		4.8333	Oct.-Dec.		4.0000
		0.7500			0.0833
Feb., Mar.		4.0833	Feb., Mar.		3.9167
		0.3333			0.0834
Oct., Mar.		3.7500	Oct.-Mar.		3.8333

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VITA

John Jerry Collins

Candidate for the Degree of

Doctor of Philosophy

Thesis: INFLUENCE OF TWO FUNGICIDES AND FOUR DATE OF TREATMENT COMBINATIONS ON CONTROL OF A DISEASE OF BERMUDAGRASS (<u>CYNODON</u> L. C. RICH SPECIES), SPRING DEAD SPOT

Major Field: Crop Science

Biographical:

Personal Data: Born at Altus, Oklahoma, October 14, 1942, the son of John H. and Lelia Beattrice Collins.

Education: Attended grade school in Headrick, Oklahoma; graduated from Altus High School in May, 1960; received a Bachelor of Science degree from Oklahoma State University in 1964; received a Master of Science degree from Oklahoma State University in 1969.

Experience: Born and reared on a farm; employed during summers of 1962 through 1965 as a field inspector for Texoma Agriculture Supply and Spencer Chemical Company, Altus, Oklahoma; commissioned as a Second Lieutenant in the U.S. Army Reserve in 1964 and served in Virginia and West Germany from June, 1966 until June, 1968; worked as a peanut research technician for the Oklahoma State Department of Agronomy from September, 1968, until September, 1973; Graduate Assistant of the Oklahoma State University Department of Agronomy, 1964-1966, and 1973 until the present time.

Organizations: American Society of Agronomy and the Crop Science Society of America.