THE EFFECT OF FERTILIZATION AND CHEMICAL WEED CONTROL ON THE ESTABLISHMENT AND SURVIVAL OF NK-37 AND MIDLAND BERMUDAGRASS

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INTRODUCTION

The establishment of Bermudagrass (Cynodon dactylon L.) from seed is of particular interest to farmers and ranchers because of reduced costs in this method of establishment as compared to the use of rhizomes.

Hildreth and Prochaska (17)* conducted a survey among 40 East Texas farmers to determine costs of establishing Coastal Bermudagrass. The total cost of sprigs, fertilizer, labor and power amounted to approximately $33 per acre. Using current seed, fertilizer and custom rate costs (35), seeded Bermudagrass can be established for an estimated investment of $14 per acre.

Results from seeded Bermudagrass plantings have been disappointing in many instances due to reduction of stand by winter injury. Yield of most seeded varieties has been lower, in general, than that of improved hybrids and selections that are established from rhizomes.

NK-37, an Arizona Bermudagrass selection established from seed, has created much interest in Oklahoma by reason of its rapid growth and high forage yield in the year of establishment. Winter survival and second year yields have been disappointing throughout the State.

The objective of this study was to determine effects of fertilization and chemical weed control on the establishment of NK-37 and Midland Bermudagrass, a recommended variety for Oklahoma, and to

*Figures in parenthesis refer to literature cited.

study the influence of fertilization on winter survival of NK-37 at Ardmore.

Information on winter survival was secured from 31 counties in Oklahome where NK-37 has been growing from 1 to 4 years to aid in determining the value of this grass as a permanent improved pasture plant for Oklahoma climatic conditions.

REVIEW OF LITERATURE

Bermudagrass is the most important pasture grass in the South. Agriculturists realized the potential of Bermuda as a pasture grass for Oklahoma as early as 1904 when a hardy strain was released from the Oklahoma Agricultural Experiment Station.

Holt, Potts, and Fudge (20) found that percentage of ground covered by Bermuda was increased about equally when fertilized with nitrogen, phosphorus, and potassium as separate treatments. However, the greatest ground cover was produced when the elements were applied in combination.

Elder and Murphy (13) found that one pound of nitrogen produced 1.5 pounds of beef gain when applied to common Bermudagrass on responsive soils at Stillwater, Oklahoma.

Carrying capacities of common Bermudagrass pastures at Batesville, Arkansas were significantly increased by the application of 100 and 200 pounds of nitrogen per acre. Yields were not significantly increased by 50 pound treatments per acre according to Spooner and Clary (40).

Alexander (1) found that Midland and Coastal produced more than twice as much forage as did Greenfield and common Bermuda under similar nitrogen treatments.

Carter (9) found that planting dates affected total yield of NK-37 Bermuda at Homer, Louisiana, whereas planting rates of 5 and 10 pounds

per acre were not reflected as significant differences in yields. Average yield was 8,550 pounds of dry forage per acre.

Holt, Lancaster, and Buckingham (22) state that NK-37 Bermuda was inferior to Coastal Bermuda in tests in northeast Texas. Yields at Mt. Pleasant, Texas in 1960 were: Coastal 13,160 pounds, Midland 12,800 pounds, common 9,710 pounds, and NK-37 5,600. The NK-37 yield was taken in the year of establishment. The yield of the other grasses was from two year old stands. The NK-37 was planted April 25, 1960, and produced 2,600 pounds of forage by July 1, 1960.

Holt and Fisher (21) concluded that heavy rates of nitrogen increased the root growth of Coastal Bermuda only slightly, while topgrowth was increased several fold. Without nitrogen fertilization, 75% of the total plant weight was in the root. With 800 pounds of nitrogen per acre, root weight made up only 30% of the total plant weight. Topgrowth totaled more than 9.5 tons on a root system that weighed less than 4 tons per acre.

Wells and McGill (42) found that NK-37 was the most susceptible to Helminthosporium stenospilum of 15 Bermudagrass varieties and unnamed selections at the Georgia Plain Experiment Station.

At the Sandy Land Research Station at Mangum Oklahoma, NK-37 produced 423 pounds more oven-dry forage than Midland in the year of establishment. Midland exceeded NK-37 yield the second year after establishment by 3,873 pounds per acre (29).

Nielsen (27) concluded that Bermuda seed should be covered no deeper than $\frac{1}{2}$ inch. He also found that seeding should not be made until a daily mean temperature of 65° Fahrenheit is attained. Heavy rains retarded seedling emergence regardless of prevailing temperature. Lack of moisture

retarded stolon development. Weed competition was a limiting factor in developing and maintaining a good turf of Bermudagrass from seed.

Winter injury was not a limiting factor provided a dense turf had developed. Isolated plants were highly susceptible to frost injury, particularly through heaving.

Nilsson-Leissner (28) states that two main factors play an important part in determining the association between resistance to cold and other physiologic conditions in the plant cell. These are: 1. The possibility of undercooling, or the mechanically coagulating influence of the loss of cell water on the plasmic colloids due to freezing. 2. The water retaining power of the cell content and the resistance to ice formation. Tissues with small cells will be more readily undercooled, whereas tissues with large cells will freeze on shaking at or below the freezing point.

Maximov (25) stressed the idea that soluble carbohydrates may increase frost resistance to plants by decreasing the precipitation of proteins.

Wilhelm (43) investigated the nutrient effect on hardiness by growing various plants such as wheat, oats, barley, rye, tomatoes, and beans in sand cultures with high, normal, low, and minus amounts of nitrogen, phosphorus, and potassium supplied in nutrient solutions. In general, high amounts of potassium gave greatest survival of freezing temperature. Plants receiving none of the elements were usually lowest in survival.

Wang, Attoe, and Truog (41) working with alfalfa found that larger amounts of starch and non-reducing sugars appeared to promote resistance to winter killing.

Adams and Twersky (3) observed that winter injury to Coastal Bermudagrass decreased with increasing levels of applied potash. Injury increased with increasing levels of applied nitrogen at a specific level of potash.

From work with 15 species of grass, 6 of which were turf grasses, Carrol (8) found that species from high nitrogen test areas were most susceptible to winter damage.

Hill (19) stated that the effectiveness of a herbicide used for preemergence or soil sterilization is dependent on movement, activity, and residual period in the soil. A high concentration of herbicide in the upper 1/8 to 1/2 inch of the surface is essential to good weed control. The absorption of monuron and diuron increases as the soil content of organic matter or clay increases.

Laboratory studies conducted by the DuPont Corporation to evaluate the effect of temperature differential and sterility differential on the residual activity of "Karmex" DL diuron revealed that diuron disappeared more rapidly in soil samples stored at 80° Fahrenheit than in samples stored at 41° Fahrenheit. Treated soil samples stored for six weeks under sterile conditions retained the initial toxic effect while treated samples stored under non-sterile conditions showed a marked reduction in toxicity (2).

Hill, et al. (18) found that no phytotoxic concentration remained from soil treatment with diuron at 1 to 2 pounds per acre followed by retreatment 12 months later. Phytotoxic concentration disappeared after 4 to 8 months. Four pound per acre treatment was not toxic after 12 to 16 months. Twenty to 60 pound treatments caused toxicity for 24 to 36 months.

Elder (12) stated that diuron treatment of Bermuda plantings controlled weeds, thereby encouraging rapid grass cover making some pasture

utilization possible in the year of establishment. Only a small amount of Bermuda growth was observed in the untreated areas. Yield from plots treated with 2 pounds of diuron per acre was higher than plots treated with simizan, atrazine, and no treatment.

Huffine, et al. (23) concluded from studying the effect of various rates of herbicides applied from mid-September to mid-April on the control of crabgrass (Digitaria sanguinalis) in U-3 Bermudagrass, that 2 pounds of diuron per acre gave fair to good control when applied from November 12 thru April 15.

Chaffin (10) suggests that 2,4-D application should be made on weeds when they are making rapid growth.

Hamner and Tukey (16) found that a treatment of 1000 ppm of 2,4-D was more effective when applied to susceptible weed species at temperatures not excessively high.

Harris (15) found that treatments of 2/3 to 1 pound per acre of an amine form of 2,4-D in April and again in July was highly effective in controlling most broadleaf weeds in Mississippi pastures consisting principally of Bermudagrass.

Miller, et al. (26) reported that the crude fiber content of Coastal Bermudagrass was not affected by level of nitrogen, phosphorus or potassium fertilization. Increasing nitrogen fertilization reduced the crude fiber content of common Bermudagrass.

Alexander (1) found that increasing rates of nitrogen fertilizer increased the percent of nitrogen and potassium in Midland, Coastal, Greenfield, and common Bermudagrass. The phosphorus content was not affected appreciably.

DESCRIPTION OF THE SOIL USED IN THE FIELD STUDY

Kirkland Loam

The Kirkland series (30) comprises slightly acid, moderately to highly fertile Reddish Prairie soils characterized by A horizons less than 14 inches thick, abrupt to clear boundaries between the A and B horizons, and brownish claypans not overlain by a distinct "grey layer." Topography ranges from nearly level to very gently undulating erosional upland with gradients mostly less than 2 percent. Drainage is slow to moderate from the surface and very slowly internally. Native vegetation consists of tall prairie grasses, which have largely been replaced by short grasses in pastured areas. General distribution of this series is in the Reddish Prairie region of north-central Texas, central Oklahoma, and southern Kansas.

The field study was located in the NW$\frac{1}{4}$ of Section 27, Township 4S, Range 2E, which is a portion of the Samuel Roberts Noble Foundation Farm at Ardmore, Oklahoma.

Results of the physical and chemical properties of the soil used in the study are shown in Table I.

TABLE I

SOME PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE SOIL USED IN THE FIELD STUDY

	Kirkland Loam
Mechanical analysis	
Sand	42.5%
Silt	43.5%
Clay	14.0%
pH	6.9
Cation Exchange Capacity	5.36 meq./100 grams
Organic matter	1.00%
Total nitrogen	.046%
Available phosphorus	28 lbs./acre
Exchangeable potassium	262 lbs./acre

DESCRIPTION OF THE GRASSES USED IN THE FIELD STUDY

Midland Bermudagrass

Midland is a productive, first generation hybrid Bermudagrass that is widely accepted as a tame pasture grass for much of Oklahoma. The hybrid is a product of crosses made between Coastal and a hardy Indiana variety at Tifton, Georgia in 1942. An outstanding variety for Oklahoma conditions was selected from several of these hybrids in tests at Oklahoma State University in 1949 and was released as Midland.

Midland has good resistance to foliar diseases, produces tall, leafy forage, and is winter hardy and drought resistant. Its open sod characteristic due to long, straight rhizomes make it more desirable for inter-seeding legumes than common varieties.

NK-37 Bermudagrass

Dr. Dale Grissom (14), agronomist with Northrup, King and Company furnished the following information about NK-37 which is a release from Northrup, King and Company.

"NK-37 was developed from what was presumed to be a single plant which had spread over a rather wide area on a river island near Yuma, Arizona. When we started checking individual plants from stolons, it was obvious that it was not a single plant but several plants which probably resulted from a heterozygous plant in the area. Selections were made from the plants established by the stolon collection. The selections were increased by means of stolons and seed was harvested from the polycross block involving these stolons. The foundation seed field was planted from seed harvested from the polycross block."

Grissom also related that NK-37 rhizomes are usually much deeper in the soil than other Bermudas and the variety does not form turf under hay conditions but forms some sod under close mowing or pasture. Some variability is to be expected since NK-37 is a synthetic from non-inbred clones.

The NK-37 seed are 50 to 100% larger than common Bermuda seed.

DESCRIPTION OF THE WEED CONTROL CHEMICALS USED IN THE FIELD STUDY

2,4-D (2,4-Dichlorophenoxyacetic Acid)

The organic compound is nontoxic to humans and animals in ordinary usage and at normal rates does not seriously reduce soil microorganism population. It is nonexplosive and fire resistant except where mixed with combustible oils. It is translocated in the plant, thus permitting use of low volume sprays.

The chemical is widely used as a post-emergence weed control chemical for the elimination of many broad leaved weed species. 2,4-D was first mentioned in literature in 1941 (34). Zimmerman and Hitchcock (44) described the use of 2,4-D as a growth regulator in 1942. Marth and

Mitchell (24) of the United States Department of Agriculture reported on the effects of 2,4-D on various weedy plants in a bluegrass lawn in 1944. Farm tests in 1946 and 1947 further proved the merits of the chemical for weed control.

The most commonly used forms of 2,4-D are the amine salt and the ester formulations. The ester formulation is generally considered the most toxic to susceptible plants. The low volatile ester formulation was used as a post-emergence weed control chemical on Midland and NK-37 plots in this study at the rate of .5 pound of active ingredient per acre.

"Karmex" DL diuron (3-(3,4-dichlorophenyl)-1, 1-dimethylurea)

Diuron is a nonvolatile, noncorrosive, nonflammable organic compound having extremely high toxicity to plants when absorbed from the soil by plant roots. As with all soil-borne herbicides, diuron requires soil moisture to be effective.

Weed and grass seedlings are controlled for a period of 3 to 8 weeks according to soil type and rainfall. Weeds may emerge before being killed since diuron does not prevent seed germination. Diuron is not effective against established Johnsongrass, nutgrass, Bermudagrass and other deep rooted perennials.

"Karmex" DL is the registered tradename of the suspension form of 3-(3,4-dichlorophenyl)-1, 1-dimethylurea, a product of the E. I. DuPont de Nemours Company, Inc.

The diuron was used as a pre-emergence weed control chemical on the Midland plots in this study at the rate of 1.5 pounds of active ingredient per acre.

EXPERIMENTAL PROCEDURES

Field Study

Midland and NK-37 Bermudagrass were planted in 10 by 12 foot plots in a randomized block design experiment containing four replications of each treatment on each grass. The 50 by 96 foot area occupied by the plots was located on a Kirkland loam soil on the Noble Foundation Farm near Ardmore.

The effect of fertilization, pre-emergence and post-emergence chemical weed control treatments on establishment, weed control, percent of ground cover, and chemical content of forage were determined on the Midland Bermudagrass.

The effect of fertilization and post-emergence chemical weed control treatments on establishment, weed control, percent of ground cover, winter survival, and chemical content of forage were determined on the NK-37 Bermudagrass.

Freshly dug Midland sprigs were planted on 1 foot centers in rows 3 feet apart in a well prepared seedbed. A drain spade was used to open the soil for the sprig. The soil was packed around the sprigs by pressing with the foot after planting. A portion of the sprig was not covered.

The NK-37 seed were planted in rows 1 foot apart at the rate of 2 pounds of seed per acre with a Planet, Jr. planter.

The fertilized plots of each grass had fertilizer banded approximately 2 inches below the sprigs and seed previous to planting. A belt

distributor was used to place the fertilizer in the soil.

The planting date was April 16, 1960.

Diuron was applied to the Midland pre-emergence weed control plots immediately after planting with a knapsack sprayer equipped with a fan-type nozzle. This chemical was not used with NK-37 because of toxic effects on germinating seed.

Fertility and weed control treatments used in the study are listed in Table II.

All plots were mowed May 28, 1960 with a rotary-type lawn mower and the residue was discarded. The height of the fertilized NK-37 plots was approximately 6 inches on this date. The height of the unfertilized NK-37 plots was approximately 2 inches. A second mowing of the fertilized NK-37 plots was made on June 20, 1960. This residue was weighed as was that harvested on August 8, and September 12, 1960

The area of the study had previously been infested with Johnsongrass (Sorghum halepense) and crabgrass (Digitaria sanguinalis) which became a problem early in the study. A record of forage yield for each grass was attempted but was discontinued after the first year because the forage that was harvested did not reflect the actual yield of the Bermudagrass.

Nitrogen topdressings were applied to the fertilized plots of each grass on June 6, 1960, May 1, 1961 and May 11, 1962.

2,4-D was applied to the post-emergence weed control plots of each grass with a knapsack sprayer on June 9, 1960.

A trace of rainfall occurred on April 24, 1960. All plots were sprinkler irrigated with approximately 1 inch of water from a nearby

pond on April 27, 1960. The irrigation was delayed until this date in order to evaluate the study under non irrigated farm conditions.

The survival percentage of the Midland sprigs 48 days after sprigging is given in Table XXXII.

The apparatus shown in Figure 6 was devised to record ground cover and weed infestation by means of photographs taken with a 35 mm camera suspended 15 feet above the center of each plot. The camera was equipped with a wide-angle lens. The shutter was activated from the ground by compression of a rubber bulb.

TABLE II

FERTILITY AND WEED CONTROL TREATMENTS USED IN THE FIELD STUDY KIRKLAND LOAM, ARDMORE, 1960-62.

Midland Bermudagrass

No Fertilizer	Fertilizer
Check (no weed control)	Check (no weed control)
1.5 lbs. "Karmex" DL diuron/acre	1.5 lbs. "Karmex"DL diuron/acre
.5 lb. 2,4-D/acre	.5 lb. 2,4-D/acre

NK-37 Bermudagrass

No Fertilizer	Fertilizer
Check (no weed control)	Check (no weed control)
.5 lb. 2,4-D/acre	.5 lb. 2,4-D/acre

Fertilization consisted of 40 lbs. N, 40 lbs. P_2O_5, and 40 lbs., K_2O per acre banded when sprigged and planted, plus an annual topdress application of 40 lbs. of N per acre as NH_4NO_3 (33.5%N)

Aerial photographs of Midland Bermudagrass that are representative of each treatment at an early date in the study and at the close of the study are shown in Figure 1. Aerial views which are representative of NK-37 treatments on several dates throughout the observation period are shown in Figure 2.

Weed population ratings were made to determine the effect of fertilization and chemical weed control treatments on the weed population of each grass. These data are recorded in Tables XXXIV and XXXV for Midland Bermudagrass and Tables XXXVI and XXXVII for NK-37 Bermudagrass.

Weed infestation of Midland diuron treatment plots was no different from that of the untreated plots on May 2, 1960. Observations made May 4, 1960 indicated that the weeds were dying in the diuron treated plots. NK-37 seedlings were appearing in the unfertilized and fertilized plots on this date.

The percent of ground cover made by the Midland Bermudagrass during 1960 and 1961 is given in Tables XXXVIII and XXXIX.

The percent of ground cover made by the NK-37 Bermudagrass in 1960 is shown in Table XL. The percent of ground cover of NK-37 at the close of the second growing season is given in Table XLI.

Chemical analyses of forage were determined on pure grass samples of Midland and NK-37 to determine the percent nitrogen, phosphorus, and potassium in the forage on July 24, 1961, October 19, 1961, and June 7, 1962. The results of the analyses on Midland forage are given in Tables XLII, XLIII, XLVI, XLVII, L, and LI. The results of analyses of forage harvested from the NK-37 plots are given in Tables XLIV, XLV, XLVIII, XLIX, LII, and LIII. The chemical analyses of the forage harvested from NK-37 and Midland plots in 1962 are given in Table XXV.

The percent survival of NK-37 Bermudagrass following the 1960-61 winter season is given in Table LIV. The percent of survival of NK-37 following the 1961-62 winter season is given in Table LV. The percent of winter kill of NK-37 during the 1961-62 winter season is given in Table LVI.

Temperature of the atmosphere, 2-inch, and 6-inch soil depths was recorded during the 1960-62 winter months by use of a recording thermograph. The daily low readings for December through March during two winter seasons are listed in Table XXIX.

Rainfall for the observation period from April 16 to December 31, 1960 was 23.30 inches. The 50-year average at Ardmore for this period is 30.71 inches. Three inches of water were added by irrigation during this period. Rainfall for 1961 was 33.40 inches. The 50-year average for yearly rainfall at Ardmore is 37.41 inches. Four inches of water were applied by irrigation during 1961. Rainfall from January to the termination of the study in August of 1962 amounted to 18.70 inches.

NK-37 Survival Survey Study

Information was gathered through cooperation of the Soil Conservation Service on winter survival of 102 plantings of NK-37 Bermudagrass located in 31 Oklahoma counties.

No attempt was made to distinguish the soil types where the NK-37 was grown or yield of the grass at the locations.

The general location of the plantings is shown by Figure 5.

The percent of winter survival of the plantings throughout the state of Oklahoma is given in Table XXX.

The plantings were grouped into three regions according to their geographic location in the state. The average percent of survival of the NK-37 plantings in these regions is given in Table XXXI.

Analysis of Soil

The mechanical analysis was determined by the Bouyoucos (7) hydrometer method. The pH determination was made according to the method described by Peech and English (32). Cation exchange capacity was determined by the method described by Russel (36). Soil organic matter was determined by the Schollenberger (37) method. Total nitrogen was determined by the Kjeldahl method suggested by Piper (33). The available phosphorus was determined by the modified procedure of Bray and Kurtz (6) using 1,2,4-aminonaphtholsulfonic acid as the reductant. Exchangeable potassium was determined by the method of Peech, et al. (31) and readings were made on a Perkin-Elmer flame photometer.

Analysis of Forage

Oven-dried forage samples of Midland and NK-37 Bermudagrass were analyzed to determine nitrogen, phosphorus, and potassium content on three clipping dates.

Composite samples for each fertilizer treatment on each grass were analysed for a comparison of their feeding value.

A modified semimicro analysis of the method described by Russel (36) was used to determine total nitrogen. Phosphorus was determined by the Shelton and Harper method (38). Potassium was read on a Perkin-Elmer flame photometer after forage digestion according to Shelton and Harper.

Crude protein, crude fiber, and fat were determined by methods outlined by A. O. A. C. (4). Estimated digestible protein, total digestible nutrients, metabolizable energy, and estimated net energy were calculated according to the method described by Baylor, Adams, and Bratzler (5).

Statistical Analysis

The effect of fertilization and chemical weed control on stand establishment, weed population, percent of ground cover, winter survival, and chemical content of the forage of the respective grasses were analyzed statistically.

Analysis of variance for significant differences and coefficients of variation were determined by methods outlined by Snedecor (39). A multiple range test proposed by Duncan (11) was used as an aid in interpreting the data when significant values were obtained.

RESULTS AND DISCUSSION

Field Study

Midland Bermudagrass is a recommended variety for Oklahoma. NK-37 Bermudagrass has been grown in several locations throughout the State. Results and reports about this grass have been varied. NK-37 and Midland were studied to determine the effect of fertilization and chemical weed control on establishment, percent of ground cover, weed control, and chemical content of the forage. Winter survival was also recorded on the NK-37 Bermudagrass.

Yield data is not included in this study. An attempt was made to harvest forage of each grass for yield information but weedy grasses became such a problem that yields were unrealistic and misleading.

The fertilized NK-37 plots were the only plots of either grass that were of sufficient height to clip for forage yield throughout the harvest period of 1960. The plots recovered quickly after the removal of forage. Lack of fertility and weed competition were the apparent cause for poor growth of the unfertilized plots of NK-37. Low fertility and weed competition retarded the growth of the unfertilized Midland plots. Weed competition was so severe in the fertilized Midland plots which did not receive diuron treatment that most of the vegetative growth was upright.

Clipping was done with a rotary mower set at a cutting height of 2 inches. Dates of clipping were May 28, 1960, June 20, 1960, August 8, 1960, and September 12, 1960. Regrowth following the September clipping was left on the plots throughout the winter and was removed by mowing on March 24, 1961. Some idea of the growth of the unfertilized and fertilized NK-37 plots can be obtained from Figure 2 and Figure 7.

Forage yields were not attempted in 1961 and the plots were mowed frequently to lessen the vigor of the Johnsongrass and crabgrass which infested the area.

Overhead photographs were made of all plots on May 23, 1960, November 25, 1960, June 9, 1961, July 26, 1961, October 26, 1961, and June 7, 1962. The photographs, such as appear in Figure 1 and 2, were used to substantiate ground cover, and winter survival.

Viable Midland sprigs were counted June 6, 1960. The average percent survival of the various treatments is given in Table III. There was no significant difference in survival percentage of sprigs regardless of weed control or fertility treatment as shown by the analysis of variance data of Table XXXII. The average viable sprig count was 42.8%.

Stand rating for fertilized NK-37 plots was significantly higher than unfertilized plots as shown in Table IV. No attempt was made to determine whether this was a result of the fertilizer alone or a combination of other factors such as fertilizer, moisture, and condition of seedbed. Stand differences of unfertilized and fertilized plots are shown by Figure 2.

Weed population was lowest in Midland plots which received 1.5 lbs. of diuron. There was a significant difference on June 20, 1960

as indicated by the multiple range test of Table V between unfertilized diuron plots and no weed control and 2,4-D plots regardless of fertility treatment. The unfertilized diuron plots had a slightly lower weed population than the fertilized diuron plots. Diuron treated plots had lower weed populations at each fertility level than the other weed control treatment plots. Table VI shows that a similar trend existed on November 25, 1960 although weed population had increased in all plots. The effect of diuron on weed control in Midland plots is clearly shown by Figure 1.

TABLE III

THE EFFECT OF FERTILIZATION AND CHEMICAL WEED CONTROL ON THE SURVIVAL OF MIDLAND BERMUDAGRASS SPRIGS, KIRKLAND LOAM, ARDMORE, JUNE 6, 1960.

Treatment (lbs./acre)	Percent Survival	
	No Fertilizer	Fertilizer
Check (no weed control)	38.5%	43.5%
1.5 lbs. Diuron	41.9%	47.5%

Data are the average of 4 replications. Fertilization consisted of 40-40-40 banded when sprigged.

TABLE IV

THE EFFECT OF FERTILIZATION ON STAND OF NK-37 BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, MAY 24, 1960.

Treatment (lbs./acre)	Stand Rating 0=No Stand 10=Excellent
No Fertilizer	3.5
Fertilizer	8.3

Data are the average of 4 replications. Fertilization consisted of 40-40-40 banded when planted. F value for fertilizer highly significant at 1% level.

TABLE V

THE EFFECT OF FERTILIZATION AND CHEMICAL WEED CONTROL ON THE WEED POPULATION OF MIDLAND BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, JUNE 20, 1960.

Treatment (lbs./acre)	Weed Rating 0=No Weeds 10=Dense Population	
	No Fertilizer	Fertilizer
Check (no weed control)	5.75	6.50
1.5 lbs. Diuron	3.25	4.25
.5 lb. 2,4-D	6.50	6.25

Data are the average of 4 replications. Fertilization consisted of 40-40-40 banded when sprigged plus 40 lbs. nitrogen as a topdressing.

Multiple Range Test

Sm=.5192	1% p. level
No Fertilizer, 1.5 lbs. Diuron	3.25
Fertilizer, 1.5 lbs. Diuron	4.25
No Fertilizer, Check (no weed control)	5.75
Fertilizer, .5 lb. 2,4-D	6.25
No Fertilizer, .5 lb. 2,4-D	6.50
Fertilizer, Check (no weed control)	6.50

Any two means not spanned by the same line are significantly different.

TABLE VI

THE EFFECT OF FERTILIZATION AND CHEMICAL WEED CONTROL ON THE WEED POPULATION OF MIDLAND BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, NOVEMBER 25, 1960.

Treatment (lbs./acre)	Weed Rating 0=No weeds 10=Dense Population	
	No Fertilizer	Fertilizer
Check (no weed control)	9.00	9.10
1.5 lbs. Diuron	5.30	8.00
.5 lb. 2,4-D	9.00	9.00

Data are the average of 4 replications. Fertilization consisted of 40-40-40 banded when sprigged plus 40 lbs. nitrogen as a topdressing.

Multiple Range Test

Sm=.6634	1% p. level	
No Fertilizer, 1.5 lbs. Diuron	5.30	|
Fertilizer, 1.5 lbs. Diuron	8.00	| |
No Fertilizer, Check (no weed control)	9.00	|
No Fertilizer, .5 lb. 2,4-D	9.00	|
Fertilizer, .5 lb. 2,4-D	9.00	|
Fertilizer, Check (no weed control)	9.10	|

Any two means not spanned by the same line are significantly different.

The effect of 2,4-D application on weed control on NK-37 plots on June 20, 1960 was not significant according to analysis of variance data of Table XXXVI. Weed ratings for this date are given in Table VII. The multiple range test of Table VIII for November 25, 1960 ratings indicates a significant difference at the 1% probability level between the weed population of unfertilized and fertilized NK-37 plots. The fertilized plots had a higher weed population than unfertilized plots.

It should be noted that many of the weeds present at each rating date were weedy grasses. Pigweed (Amaranthus sp.), lambsquarter (Chenopodium album), evening primrose (Oenothera biennis), and western ragweed (Ambrosia psilostachya) were the principal broadleaf species present in the plots. These were effectively controlled by the application of 2,4-D. Mowing for yield produced some bias because the weed population of the no weed control plots was reduced somewhat.

The percent of ground cover made by Midland in 1960 is given in Table IX and shown according to treatment in Figure 1. The fertilized plots had a higher percentage of ground cover than the unfertilized plots with the exception of the unfertilized diuron plots. The unfertilized diuron plots had a slightly higher ground cover percentage than the fertilized diuron plots. The unfertilized diuron plots were significantly different from the unfertilized no weed control and 2,4-D plots. The 2,4-D plots of each fertility treatment had a higher percent cover than the plots receiving no weed control practices. A similar trend is indicated in Table X, which gives October 23, 1961 ground cover ratings. Weeds were present in the diuron plots in 1961 and cover rate was slower than in 1960.

The presence of heavy Johnsongrass and crabgrass infestation prevented stolon development in all plots of Midland not treated with diuron. The area covered by many Midland sprigs was no greater at the end of the first year's growth than 6 weeks after sprigging.

TABLE VII

THE EFFECT OF FERTILIZATION AND CHEMICAL WEED CONTROL ON THE WEED POPULATION OF NK-37 BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, JUNE 20, 1960.

Treatment (lbs./acre)	Weed Rating 0=No Weeds 10=Dense Population	
	No Fertilizer	Fertilizer
Check (no weed control)	6.50	6.25
.5 lb. 2,4-D	4.50	6.50

Data are the average of 4 replications. Fertilization consisted of 40-40-40 banded when planted plus 40 lbs. nitrogen as a topdressing.

TABLE VIII

THE EFFECT OF FERTILIZATION AND CHEMICAL WEED CONTROL ON THE WEED POPULATION OF NK-37 BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, NOVEMBER 25, 1960.

Treatment (lbs./acre)	Weed Rating 0=No Weeds 10=Dense Population	
	No Fertilizer	Fertilizer
Check (no weed control)	8.80	3.50
.5 lb. 2,4-D	8.00	4.50

Data are the average of 4 replications. Fertilization consisted of 40-40-40 banded when planted plus 40 lbs. nitrogen as a topdressing.

Multiple Range Test

Sm=.5719	1% p. level
Fertilizer, Check (no weed control)	3.50
Fertilizer, .5 lb. 2,4-D	4.50
No Fertilizer, .5 lb. 2,4-D	8.00
No Fertilizer, Check (no weed control)	8.80

Any two means not spanned by the same line are significantly different.

TABLE IX

THE EFFECT OF FERTILIZATION AND CHEMICAL WEED CONTROL ON THE PERCENT OF GROUND COVER OF MIDLAND BERMUDAGRASS IN THE YEAR OF ESTABLISHMENT, KIRKLAND LOAM, ARDMORE, NOVEMBER 25, 1960.

Treatment (lbs./acre)	Percent of Ground Cover	
	No Fertilizer	Fertilizer
Check (no weed control)	5.0%	12.0%
1.5 lbs. Diuron	37.8%	31.3%
.5 lb. 2,4-D	5.8%	21.3%

Data are the average of 4 replications. Fertilization consisted of 40-40-40 banded when sprigged plus 40 lbs. nitrogen as a topdressing.

Multiple Range Test

Sm=8.246	5% p. level
No Fertilizer, Check (no weed control)	5.0%
No Fertilizer, 15 lb. 2,4-D	5.8%
Fertilizer, Check (no weed control)	12.0%
Fertilizer, .5 lb. 2,4-D	21.3%
Fertilizer, 1.5 lbs. Diuron	31.3%
No Fertilizer, 1.5 lbs. Diuron	37.8%

Any two means not spanned by the same line are significantly different.

TABLE X

THE EFFECT OF FERTILIZATION AND CHEMICAL WEED CONTROL ON THE PERCENT OF GROUND COVER OF MIDLAND BERMUDAGRASS THE SECOND YEAR FOLLOWING ESTABLISHMENT, KIRKLAND LOAM, ARDMORE, OCTOBER 23, 1961.

Treatment (lbs./acre)	Percent of Ground Cover	
	No Fertilizer	Fertilizer
Check (no weed control)	12.5%	20.8%
1.5 lbs. Diuron	55.0%	34.3%
.5 lb. 2,4-D	13.8%	25.3%

Data are the average of 4 replications. Fertilization consisted of 40-40-40 banded when sprigged plus annual application of 40 lbs. nitrogen as a topdressing.

Multiple Range Test

Sm=4.939	5% p. level	
No Fertilizer, Check (no weed control)	12.5%	|
No Fertilizer, .5 lb. 2,4-D	13.8%	|
Fertilizer, Check (no weed control)	20.8%	|
Fertilizer, .5 lb. 2,4-D	25.3%	|
Fertilizer, 1.5 lbs. Diuron	34.3%	| |
No Fertilizer, 1.5 lbs. Diuron	55.0%	|

Any two means not spanned by the same line are significantly different.

Fertilized NK-37 plots had a significantly higher percent of ground cover than unfertilized plots as indicated by Table XI and Table XII for 1960 and 1961. Most of the difference in cover was apparently due to a better stand of grass on the plots receiving fertilizer. Very few stolons were present in any of the NK-37 plots in 1960, 1961 or 1962. Plots having thin stands produced a few short stolons the first year, whereas thick stands produced no stolons until the stand was thinned by winter damage. The fertilized NK-37 plots with good stands were more competitive with the weedy grasses than were the unfertilized plots.

Analysis of the forage harvested in 1960 from the fertilized NK-37 plots is not included because of the presence of foreign grasses in the sample. Only pure Bermuda forage was harvested for analysis in 1961.

Midland Bermudagrass broke dormancy about a week earlier than NK-37 in the spring of 1961 and 1962. The NK-37 plants that survived the winters were less vigorous than those of the 1960 season. Response to nitrogen application seemed to be greatly reduced in 1961. This may have been due to a lack of phosphorus and potash.

The nitrogen content of Midland forage from the plots receiving fertilization was significantly different from the unfertilized plots. Forage from fertilized plots had a higher nitrogen content than that from the unfertilized plots. The fertilized plots receiving weed control treatments had significantly higher nitrogen contents on July 24, 1961 than the fertilized plots without weed control treatments as indicated by Table XIII. Midland forage clipped October 19, 1961 had a lower nitrogen content than the July clipping as indicated by Table XIV. A multiple range test indicated no significant difference between nitrogen content of forage from fertilized and unfertilized plots

receiving 2,4-D and those receiving no weed control treatment. Forage from diuron treated plots was slightly lower in nitrogen content than other treatment plots.

TABLE XI

THE EFFECT OF FERTILIZATION AND CHEMICAL WEED CONTROL ON THE PERCENT OF GROUND COVER OF NK-37 BERMUDAGRASS IN THE YEAR OF ESTABLISHMENT, KIRKLAND LOAM, ARDMORE, NOVEMBER 25, 1960.

Treatment (lbs./acre)	Percent of Ground Cover	
	No Fertilizer	Fertilizer
Check (no weed control)	22.7%	73.8%
.5 lb. 2,4-D	28.3%	70.0%

Data are the average of 4 replications. Fertilization consisted of 40-40-40 banded when planted plus 40 lbs. nitrogen as a topdressing.

Multiple Range Test

Sm=7.343	1% p. level
No Fertilizer, Check (no weed control)	22.7%
No Fertilizer, .5 lb. 2,4-D	28.3%
Fertilizer, .5 lb. 2,4-D	70.0%
Fertilizer, Check (no weed control)	73.8%

Any two means not spanned by the same line are significantly different.

TABLE XII

THE EFFECT OF FERTILIZATION AND CHEMICAL WEED CONTROL ON THE PERCENT OF GROUND COVER OF NK-37 BERMUDAGRASS THE SECOND YEAR FOLLOWING ESTABLISHMENT, KIRKLAND LOAM, ARDMORE, OCTOBER 23, 1961.

Treatment (lbs./acre)	Percent of Ground Cover	
	No Fertilizer	Fertilizer
Check (no weed control)	16.4%	70.0%
.5 lb. 2,4-D	7.3%	61.3%

Data are the average of 4 replications. Fertilization consisted of 40-40-40 banded when planted plus annual application of 40 lbs. nitrogen as a topdressing.

Multiple Range Test

Sm=8.7325	1% p. level
No Fertilizer, .5 lb. 2,4-D	7.3%
No Fertilizer, Check (no weed control)	16.4%
Fertilizer, .5 lb. 2,4-D	61.3%
Fertilizer, Check (no weed control)	70.0%

Any two means not spanned by the same line are significantly different.

TABLE XIII

THE EFFECT OF FERTILIZATION AND CHEMICAL WEED CONTROL ON THE NITROGEN CONTENT OF MIDLAND BERMUDAGRASS, KIRKLAND LOAM, ARIMORE, JULY 24, 1961.

Treatment (lbs./acre)	Percent Nitrogen	
	No Fertilizer	Fertilizer
Check (no weed control)	1.19%	1.48%
1.5 lbs. Diuron	1.16%	1.73%
.5 lb. 2,4-D	1.14%	1.64%

Data are the average of 4 replications. Fertilization consisted of 40-40-40 banded when sprigged plus annual application of 40 lbs. nitrogen as a topdressing.

Multiple Range Test

Sm=.0459	1% p. level
No Fertilizer, .5 lb. 2,4-D	1.14%
No Fertilizer, 1.5 lbs. Diuron	1.16%
No Fertilizer, Check (no weed control)	1.19%
Fertilizer, Check (no weed control)	1.48%
Fertilizer, .5 lb. 2,4-D	1.64%
Fertilizer, 1.5 lbs. Diuron	1.73%

Any two means not spanned by the same line are significantly different.

TABLE XIV

THE EFFECT OF FERTILIZATION AND CHEMICAL WEED CONTROL ON THE NITROGEN CONTENT OF MIDLAND BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, OCTOBER 19, 1961.

Treatment (lbs./acre)	Percent Nitrogen	
	No Fertilizer	Fertilizer
Check (no weed control)	1.05%	1.08%
1.5 lbs. Diuron	.90%	.86%
.5 lb. 2,4-D	1.04%	1.11%

Data are the average of 4 replications. Fertilization consisted of 40-40-40 banded when sprigged plus annual application of 40 lbs. nitrogen as a topdressing.

Multiple Range Test

Sm=.0589	1% p. level
Fertilizer, 1.5 lbs. Diuron	.86%
No Fertilizer, 1.5 lbs. Diuron	.90%
No Fertilizer, .5 lb. 2,4-D	1.04%
No Fertilizer, Check (no weed control)	1.05%
Fertilizer, Check (no weed control)	1.08%
Fertilizer, .5 lb. 2,4-D	1.11%

Any two means not spanned by the same line are significantly different.

The multiple range test of Table XV indicates a significant nitrogen difference between unfertilized and fertilized NK-37 plots on July 24, 1961. Forage from fertilized plots was higher in nitrogen content than forage from the unfertilized plots. Analysis of variance data of Table XLIII for nitrogen content on October 19, 1961 indicated no significant difference for fertility treatments. Weed control treatments were not significant at either clipping date. Nitrogen content of the October 19, 1961 harvest is given in Table XVI.

The phosphorus content of Midland forage was not affected appreciably by fertility or weed control treatments at either clipping date as indicated by the analysis of variance data of Table XLVI and Table XLVII. Phosphorus levels on July 24, 1961 and October 19, 1961 are given in Table XVII and Table XVIII.

Analysis of variance data of Tables XLVIII and XLIX indicates no significant differences of phosphorus content of NK-37 forage due to fertility or weed control treatments. A significant difference in replications was shown for the July 24, 1961 clipping date. This difference was probably due to phosphorus application to the replication area in previous years. Percent phosphorus on July 24, 1961 and October 19, 1961 is given in Tables XIX and XX.

The multiple range test of Table XXI for potassium content of Midland forage on July 24, 1961 indicates significant differences between unfertilized and fertilized plots. The potassium content of the fertilized plots was higher than that of the unfertilized plots. The diuron plots of each fertility treatment had the highest potassium content on October 19, 1961 as indicated by Table XXII.

TABLE XV

THE EFFECT OF FERTILIZATION AND CHEMICAL WEED CONTROL ON THE NITROGEN CONTENT OF NK-37 BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, JULY 24, 1961.

Treatment (lbs./acre)	Percent Nitrogen	
	No Fertilizer	Fertilizer
Check, (no weed control)	1.17%	1.45%
.5 lb. 2,4-D	1.21%	1.45%

Data are the average of 4 replications. Fertilization consisted of 40-40-40 banded when planted plus annual application of 40 lbs. nitrogen as a topdressing.

Multiple Range Test

Sm=.0458	1% p. level
No Fertilizer, Check (no weed control)	1.17%
No Fertilizer, 5. lb. 2,4-D	1.21%
Fertilizer, Check (no weed control)	1.45%
Fertilizer, .5 lb. 2,4-D	1.45%

Any two means not spanned by the same line are significantly different.

TABLE XVI

THE EFFECT OF FERTILIZATION AND CHEMICAL WEED CONTROL ON THE NITROGEN CONTENT OF NK-37 BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, OCTOBER 19, 1961.

Treatment (lbs./acre)	Percent Nitrogen	
	No Fertilizer	Fertilizer
Check (no weed control)	1.03%	.93%
.5 lb. 2,4-D	.92%	.97%

Data are the average of 4 replications. Fertilization consisted of 40-40-40 banded when planted plus annual application of 40 lbs. nitrogen as a topdressing.

TABLE XVII

THE EFFECT OF FERTILIZATION AND CHEMICAL WEED CONTROL ON THE PHOSPHORUS CONTENT OF MIDLAND BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, JULY 24, 1961.

Treatment (lbs./acre)	Percent Phosphorus	
	No Fertilizer	Fertilizer
Check (no weed control)	.17%	.19%
1.5 lbs. Diuron	.19%	.18%
.5 lb. 2,4-D	.19%	.18%

Data are the average of 4 replications. Fertilization consisted of 40-40-40 banded when sprigged plus annual application of 40 lbs. nitrogen as a topdressing.

TABLE XVIII

THE EFFECT OF FERTILIZATION AND CHEMICAL WEED CONTROL ON THE PHOSPHORUS CONTENT OF MIDLAND BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, OCTOBER 19, 1961.

Treatment (lbs./acre)	Percent Phosphorus	
	No Fertilizer	Fertilizer
Check (no weed control)	.15%	.14%
1.5 lbs. Diuron	.14%	.14%
.5 lb. 2,4-D	.11%	.13%

Data are the average of 4 replications. Fertilization consisted of 40-40-40 banded when sprigged plus annual application of 40 lbs. nitrogen as a topdressing.

TABLE XIX

THE EFFECT OF FERTILIZATION AND CHEMICAL WEED CONTROL ON THE PHOSPHORUS CONTENT OF NK-37 BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, JULY 24, 1961.

Treatment (lbs./acre)	Percent Phosphorus	
	No Fertilizer	Fertilizer
Check (no weed control)	.11%	.17%
.5 lb. 2,4-D	.15%	.18%

Data are the average of 4 replications. Fertilization consisted of 40-40-40 banded when planted plus annual application of 40 lbs. nitrogen as a topdressing.

TABLE XX

THE EFFECT OF FERTILIZATION AND CHEMICAL WEED CONTROL ON THE PHOSPHORUS CONTENT OF NK-37 BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, OCTOBER 19, 1961.

Treatment (lbs./acre)	Percent Phosphorus	
	No Fertilizer	Fertilizer
Check (no weed control)	.16%	.16%
.5 lb. 2,4-D	.15%	.15%

Data are the average of 4 replications. Fertilization consisted of 40-40-40 banded when planted plus annual application of 40 lbs. nitrogen as a topdressing.

TABLE XXI

THE EFFECT OF FERTILIZATION AND CHEMICAL WEED CONTROL ON THE POTASSIUM CONTENT OF MIDLAND BERMUDAGRASS, KIRKLAND LOAM, ARMORE, JULY 24, 1961.

Treatment (lbs./acre)	Percent Potassium	
	No Fertilizer	Fertilizer
Check (no weed control)	.94%	1.48%
1.5 lbs. Diuron	.98%	1.50%
.5 lb. 2,4-D	.97%	1.26%

Data are the average of 4 replications. Fertilization consisted of 40-40-40 banded when sprigged plus annual application of 40 lbs. nitrogen as a topdressing.

Multiple Range Test

Sm=.1125	1% p. level
No Fertilizer, Check (no weed control)	.94%
No Fertilizer, .5 lb. 2,4-D	.97%
No Fertilizer, 1.5 lbs. Diuron	.98%
Fertilizer, .5 lb. 2,4-D	1.26%
Fertilizer, Check (no weed control)	1.48%
Fertilizer, 1.5 lbs. Diuron	1.50%

Any two means not spanned by the same line are significantly different.

TABLE XXII

THE EFFECT OF FERTILIZATION AND CHEMICAL WEED CONTROL ON THE POTASSIUM CONTENT OF MIDLAND BERMUDAGRASS, KIRKLAND LOAM, ARMORE, OCTOBER 19, 1961.

Treatment (lbs./acre)	Percent Potassium	
	No Fertilizer	Fertilizer
Check (no weed control)	.82%	.78%
1.5 lbs. Diuron	.71%	.76%
.5 lb. 2,4-D	.84%	.83%

Data are the average of 4 replications. Fertilization consisted of 40-40-40 banded when sprigged plus annual application of 40 lbs. nitrogen as a topdressing.

Multiple Range Test

Sm=.0332		5% p. level
No Fertilizer, 1.5 lbs. Diuron	.71%	|
Fertilizer, 1.5 lbs. Diuron	.76%	| |
Fertilizer, Check (no weed control)	.78%	| |
No Fertilizer, Check (no weed control)	.82%	|
Fertilizer, .5 lb. 2,4-D	.83%	|
No Fertilizer, .5 lb. 2,4-D	.84%	|

Any two means not spanned by the same line are significantly different.

There was no significant difference in the potassium content of unfertilized and fertilized NK-37 plots on July 24, 1961 and October 19, 1961 as indicated by analysis of variance data given in Table LII and LIII. Forage from 2,4-D treated plots was slightly higher in potassium on July 24, 1961 than forage from plots not treated as shown in Table XXIII. Forage from unfertilized plots was higher in potassium than forage from fertilized plots on October 19, 1961 as given in Table XXIV.

Final forage clipping was made June 7, 1962 and the results of the laboratory analyses for nitrogen, phosphorus, and potassium content of composite samples of each treatment replication for each grass is given in Table XXV. A comparison of the nitrogen, phosphorus, and potassium content of both grasses on each clipping date is given by Figure 3.

The effect of fertilization on the rhizome growth of Midland and NK-37 can be observed in Figure 4. The fertilized plants of each grass were more vigorous and had a better developed root system than plants from the unfertilized plots.

A comparison of the feeding value of Midland and NK-37 forage is given in Table XXVI. The quality of each grass was improved by fertilization as indicated by the increase in digestible protein, total digestible nutrients, and net energy. The feeding value of Midland appeared to be slightly superior to that of NK-37.

TABLE XXIII

THE EFFECT OF FERTILIZATION AND CHEMICAL WEED CONTROL ON THE POTASSIUM CONTENT OF NK-37 BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, JULY 24, 1961.

Treatment (lbs./acre)	Percent Potassium	
	No Fertilizer	Fertilizer
Check (no weed control)	.89%	.98%
.5 lb. 2,4-D	1.00%	1.02%

Data are the result of 4 replications. Fertilization consisted of 40-40-40 banded when planted plus annual application of 40 lbs. nitrogen as a topdressing.

TABLE XXIV

THE EFFECT OF FERTILIZATION AND CHEMICAL WEED CONTROL ON THE POTASSIUM CONTENT OF NK-37 BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, OCTOBER 19, 1961.

Treatment (lbs./acre)	Percent Potassium	
	No Fertilizer	Fertilizer
Check (no weed control)	.93%	.88%
.5 lb. 2,4-D	.91%	.83%

Data are the result of 4 replications. Fertilization consisted of 40-40-40 banded when planted plus annual application of 40 lbs. nitrogen as a topdressing.

TABLE XXV

THE EFFECT OF FERTILIZATION AND CHEMICAL WEED CONTROL ON THE NITROGEN, PHOSPHORUS, AND POTASSIUM CONTENT OF MIDLAND AND NK-37 BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, JUNE 7, 1962.

Grass	Treatment	No Fertilizer %N	%P	%K	Fertilizer %N	%P	%K
Midland	Check	1.62	.24	1.20	2.78	.27	1.80
	1.5 lbs. Diuron	1.50	.22	1.30	3.17	.28	1.85
	.5 lb. 2,4-D	1.65	.25	1.50	2.69	.27	1.70
NK-37	Check	1.68	.24	1.50	2.70	.28	1.70
	.5 lb. 2,4-D	1.82	.22	1.10	2.72	.28	1.70

Data are the results of analysis of composite samples from 4 replications. Fertilization consisted of 40-40-40 banded when sprigged and planted plus annual application of 40 lbs. nitrogen as a topdressing.

TABLE XXVI

LABORATORY ANALYSIS OF MIDLAND AND NK-37 BERMUDAGRASS FOR THEIR COMPARATIVE VALUES AS A LIVESTOCK FEED, KIRKLAND LOAM, ARDMORE, JUNE 7, 1962.

	Midland		NK-37	
	No Fertilizer	Fertilizer	No Fertilizer	Fertilizer
Crude Protein	9.93%	18.0%	10.90%	16.90%
Est. Digestible Protein	4.69%	11.34%	5.54%	10.40%
Total Digestible Nutrients	64.88%	70.41%	64.09%	67.36%
Crude Fiber	22.81%	19.83%	24.41%	22.40%
Fat	3.17%	4.71%	3.27%	4.40%
Metabolizable Energy	2,413.92 Therms	2,623.54 Therms	2,388.14 Therms	2,509.76 Therms
Est. Net Energy	55.61 Therms	63.44 Therms	54.64 Therms	59.19 Therms

The data are the result of analysis of composite samples of like fertility treatments. Fertilization consisted of 40-40-40 banded when sprigged and planted plus annual application of 40 lbs. nitrogen as a topdressing.

The survival percentage of NK-37 Bermudagrass on May 5, 1961 and May 28, 1962 is given in Table XXVII. No differences in survival were apparent from weed control treatments. The weed control treatment plots were averaged and analysis of variance data was completed on this information. Multiple range tests indicated significant differences between unfertilized and fertilized plots for each observation date. The fertilized plots had the highest percent of winter survival although these plots received considerable winter kill. There was no significant difference in winter kill between unfertilized and fertilized plots during the 1961-62 winter season as is indicated by analysis of variance data of Table LVI. Winter kill was less in the fertilized plots as shown by Table XVIII. There was no winter damage to Midland plots, regardless of fertilizer treatment.

Soil and atmosphere daily low temperatures for the observation period are given in Table XXIX. The lowest atmosphere temperature recorded during the 1960-61 winter period was 14° F. The lowest recorded atmosphere temperature for the 1961-62 winter period was 4° F.

The lowest temperature at the 2-inch soil depth for the 1960-61 winter period was 29° F. The lowest temperature at this depth in the 1961-62 winter period was 25° F.

The lowest temperature at the 6-inch soil depth in the 1960-61 winter period was 30° F. The lowest temperature reached at this depth in the 1961-62 winter period was 31° F.

TABLE XXVII

THE EFFECT OF FERTILIZATION ON THE SURVIVAL PERCENTAGE OF NK-37 BERMUDAGRASS, 1960-62, KIRKLAND LOAM, ARDMORE.

Treatments (lbs./acre)	Observation Date	
	May 5, 1961	May 28, 1962
	Percent Survival	
No Fertilizer	34.0%	9.0%
Fertilizer	83.0%	66.0%
Treatment F values	16.78*	70.78**
EMS	289.12	80.12

Data are the results of 4 replications. Fertilization consisted of 40-40-40 banded when planted plus annual application of 40 lbs. nitrogen as a topdressing.

* denotes significance at 5% level
** denotes significance of 1% level

TABLE XXVIII

THE EFFECT OF FERTILIZATION ON THE PERCENT WINTER KILL OF NK-37 BERMUDAGRASS DURING THE WINTER SEASON OF 1961-62, KIRKLAND LOAM, ARDMORE

Treatment (lbs./acre)	Percent Winter Kill
No Fertilizer	21.1%
Fertilizer	17.8%

Data are the results of 4 replications. Fertilization consisted of 40-40-40 banded when planted plus annual application of 40 lbs. nitrogen as a topdressing.

TABLE XXIX

Daily Low Temperatures of Soil and Atmosphere, Kirkland Loam, Ardmore, December 1960-61, January - March, 1961-62

Day of Month	Low Temperature in Degrees Fahrenheit																							
	December						January						February						March					
	1960			1961			1961			1962			1961			1962			1961			1962		
	Soil 2"	Soil 6"	Atmos.	Soil 2"	Soil 6"	Atmos.	Soil 2"	Soil 6"	Atmos.	Soil 2"	Soil 6"	Atmos.	Soil 2"	Soil 6"	Atmos.	Soil 2"	Soil 6"	Atmos.	Soil 2"	Soil 6"	Atmos.	Soil 2"	Soil 6"	Atmos.
1				51	53	45	38	37	30	39	40	25	40	39	36	38	41	28	44	40	40	30	36	17
2				55	55	55	38	37	24	36	39	33	39	40	25	38	41	30	52	43	52	31	37	25
3				60	58	57	34	35	25	42	42	46	35	38	26	39	43	43	52	49	56	37	40	30
4				55	57	46	34	36	36	50	46	30	35	38	32	38	45	33	60	54	56	39	42	28
5	50	56		53	54	42	40	38	29	44	46	20	37	38	30	41	46		52	56	40	38	42	22
6	43	51		49	49	39	42	40	34	38	42	31	37	37	28	36	42	22	52	54	44	34	40	23
7	34			47	50	40	40	40	20	40	40	25		35	23	37	41	32	48	51	38	42	43	40
8	40	47		47	48	40		38	24	40	40	17	30	30	25	40	42	35	44	48	32	46	46	32
9	39	47		47	47	35	37	37	26	42	43	10	32	34	28	41	44	27	45	46	34	41	44	35
10	39	45		43	46	26	38	36	28		39	4	39	35	32	39	44	31	44	46	45	46	46	41
11	38	44		42	45	15	36	36	28	25	35	11	38	38	42	43	45	47	52	48	56	44		31
12	38	44		40	43	16	38	40	32	26	32	22	44	42	44	46	47	53	45	52	41	42	46	30
13	36			37	40	20	48	39	37	28	33	34	44	44	37	48	49	51	48	52	37	41	45	28
14	36	38	49	38	40	33	38	40	26	30	34	18	44	43	40	50	51	54	47	50	45	41	46	
15		48	24	40	42	33	38	38	28	30	32	20	48	45	44	46	53	36	54	53	50	36	39	25
16	37	38	26	44	42	40	39	36	36	28	33	22	52	48	57	41	47	38	54	55	45	37	42	25
17	36	36	28	48	46	36	42	40	32	30	34	29	46	52	34	46	49	39	48	52	38	41	45	47
18	38	36	28	46	45	28	38	40	30	34	37	13	40	46	29	43	47	26	46	48	34	49	49	52
19	36	38	34	44	41	22	36	40	24	30	35	8	38	44	30	38	44	32	46	47	39	50	50	54
20				38	42	23	34	38	14	28	34	20	42	42	37	45	47	42	42	45	31	50	52	41
21	35	37	24	38	41	20	32	37	28	30	34	14		42	38	47	47	31	42	42	38	46	50	39
22	34	36	24	43	46	31	32	34	26	30	36	12	44	42	43	45	47	21	44	46	34	44	50	35
23	38	36	28	38	44	23	35	35	35	26	32	25	42	43	32	44	47	30	43	47	38	43	46	50
24	34	34	38	40	41	31	36	40	19	26	31	35	38	42	28	42	46	31	46	48	45	48	50	41
25	39	38	34	41	40	41	34	38	20	30	33	36	36	38	40	41	45	28	43	50	47	46	49	36
26	40	42	30	44	43	30	33	35	18	35	37	30	42	41	40	40	46	21	49	40	40	43	46	37
27		40	36	41	44	25	34	36	18	36	40	22	38	42	27	37	43	15	54	48	44	45	49	49
28		42	38	40	42	20	32	34	16	33	37	24	38	40	28	33	39	15	53	52	42	41	53	52
29				38	41	22	29	32	25	34	38	29							49	50	40	51	56	42
30	34	36	34	36	38	28		32	33	35	38	26							48	49	39	42	49	38
31	38	40	30	39	40	25	34	34	39	37	40	28							40	47	30	41	46	41
Average	37.8	41.3	31.6	43.9	45.3	31.8	36.5	37.0	27.1	33.7	37.2	23.2	39.9	40.6	34.1	41.5	45.3	33.0	47.9	48.6	41.6	42.1	45.8	36.2

Survey of NK-37 Survival in Oklahoma

A questionnaire was mailed to Soil Conservation Service personnel asking them to report the estimated survival percentage of NK-37 plantings in their work area. The approximate location of 102 NK-37 plantings in 31 Oklahoma counties on which survival percentage was reported is shown by Figure 5. The plot work at Ardmore is included.

The number of winters having passed since the planting was made was used as the basis for age of the planting. No distinction was made as to the year in which the planting was made. The survival percentage of planting within the reporting counties surviving 1 to 4 winters is given in Table XXX.

Oklahoma was divided into three regions in order to better evaluate the winter kill of NK-37 withing these areas. The average survival percentage for the plantings reported in these regions is shown by Table XXXI. The data listed in this table were complied by averaging the survival percentages of individual plantings within the region. Plantings with low and high survival rates were usually reported in the same general area of the county.

Fertilization was reported to have been used on 93% of the plantings. The usual rate of fertilization listed was 150 to 200 pounds of 10-20-10 per acre. The winter kill data on the plots receiving no fertilization was not conclusive as to whether fertilization was a factor in winter survival.

The percent of winter survival was generally higher in the southern region of the State. The northern region had the lowest percent of survival.

Degree of use was reported on many of the plantings but no correlation with survival percentage seemed to exist.

TABLE XXX

THE SURVIVAL PERCENTAGES OF NK-37 BERMUDAGRASS IN THIRTY-ONE OKLAHOMA COUNTIES, 1958-62.

Region & County	Percent of NK-37 Remaining After: First Winter	1/	Second Winter	1/	Third Winter	1/	Fourth Winter	1/
Northern								
Adair	2.5%	2	2.0%	1				
Blaine	30.0%	3	32.5%	2	0.0%	1		
Cherokee	80.0%	1	60.0%	1	40.0%	1		
Kay	0.0%	2						
Logan	25.0%	1						
Nowata	0.0%	1						
Tulsa	6.0%	4	2.8%	4	3.6%	3	5.0%	1
Central								
Caddo	15.0%	5	0.0%	1				
Canadian	25.0%	1						
Grady	10.0%	1						
Haskell	58.3%	3						
Jackson	75.0%	1						
Kiowa	13.0%	1						
Latimer	50.9%	16	38.7%	8	40.0%	7	43.3%	6
Leflore	78.8%	5						
McClain	90.0%	1						
McIntosh	52.0%	2	60.0%	1	60.0%	1	60.0%	1
Muskogee	25.0%	1						
Pittsburg	65.5%	10						
Pontotoc	55.0%	2						
Pottawatomie	25.0%	1						
Sequoyah	10.0%	2	10.0%	2				
Southern								
Atoka	100.0%	7	50.0%	7	65.0%	4	100.0%	1
Bryan	55.0%	5	50.0%	3	50.0%	1		
Carter	52.3%	3	37.5%	2				
Choctaw	55.8%	6						
Cotton	50.0%	1						
Johnston	25.0%	1						
Love	30.0%	1	15.0%	1	10.0%	1		
Marshall	70.5%	10	62.0%	10	49.5%	10	53.3%	2
McCurtain	20.0%	2	13.0%	2	4.0%	2	2.0%	1

1/ Number of observations included in the average.

TABLE XXXI

THE AVERAGE SURVIVAL PERCENTAGE OF NK-37 BERMUDAGRASS PLANTINGS IN NORTHERN, CENTRAL, AND SOUTHERN OKLAHOMA, 1958-62.

Region of Oklahoma	Percent NK-37 Remaining After: 1 Winter	2 Winters	3 Winters	4 Winters
Northern	20.5%	24.3%	14.5%	5.0%
Central	43.2%	27.1%	50.0%	51.7%
Southern	50.9%	37.9%	35.7%	51.7%

See Figure 5 for the approximate location of plantings within the region. The number of plantings reported in each average are given in Table XXX.

SUMMARY AND CONCLUSIONS

The objectives of this study were to determine the effect of fertilization on winter survival of NK-37 and to determine the influence of fertilization and chemical weed control on establishment of NK-37 and Midland, a recommended Bermudagrass variety for Oklahoma.

A survey of the survival percentage of NK-37 in various counties of Oklahoma was conducted in order to evaluate the feasibility of using NK-37 as a permanent pasture grass in Oklahoma.

The field study was conducted on a Kirkland loam soil at Ardmore. Fertilization consisted of a banded application of 40 lbs. of nitrogen, 40 lbs. of phosphorus (P_2O_5) and 40 lbs. of potassium (K_2O), plus annual topdress application of 40 lbs. of nitrogen as NH_4NO_3.

Diuron and 2,4-D were used for weed control treatments on the Midland and 2,4-D was used on the NK-37. The observation period began April 18, 1960 and was concluded August 31, 1962.

Results and conclusions drawn from observations and statistical analysis of data obtained during the field study may be summarized as follows:

1. Under the conditions of this study, the only forage produced in sufficient quantities to harvest for yield in 1960 was from fertilized NK-37 plots.
2. Fertilization and diuron weed control treatments had no significant effect on the number of Midland sprigs which survived.

3. The weed population was lower in Midland plots which were treated with diuron than in plots receiving no chemical weed control and 2,4-D application.
4. Stand rating of fertilized NK-37 plots was significantly higher than that of unfertilized plots.
5. The weed population of Midland and NK-37 plots receiving 2,4-D were not significantly different from plots receiving no weed control treatment. A major portion of the weeds present were weedy grasses not affected by 2,4-D.
6. The percent of ground cover of Midland was greater in the diuron treated plots. The fertilized plots had slightly less cover than unfertilized plots. The presence of vigorous Johnsongrass and crabgrass growth in the fertilized plots was a factor which prevented cover.
7. The percent of ground cover of NK-37 was higher in the fertilized plots. This was apparently due to stand since very little stolon growth was observed during the observation period.
8. The nitrogen and potassium content of fertilized Midland and NK-37 forage was significantly higher than forage from unfertilized plots.
9. The phosphorus content of Midland and NK-37 was not significantly affected by fertility or chemical weed control treatments.
10. The winter survival of NK-37 was significantly higher in plots which were fertilized. Stand was reduced in all plots of NK-37 regardless of fertility treatment.

NK-37 Survival Survey

Information was secured on the winter survival of 102 NK-37 plantings located in 31 counties in Oklahoma where the grass had survived from 1 to 4 winters.

The following conclusions were drawn from information obtained in the survey of these plantings.

1. The percent of winter kill was more severe in counties located in the northern part of Oklahoma.
2. High and low survival percentages of winter survival were reported on plantings having similar fertility treatments in the same general area of the State.
3. NK-37 has limited value as a dependable perennial pasture plant under Oklahoma climatic conditions.

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APPENDIX

TABLE XXXII

THE SURVIVAL PERCENTAGE OF MIDLAND BERMUDAGRASS SPRIGS, KIRKLAND LOAM, ARDMORE, JUNE 6, 1960.

Treatment (lbs./acre)	Percent of Sprigs Surviving				
Reps.	I	II	III	IV	$\bar{X}$
No Fertilizer, Check	40.3	44.6	36.1	32.8	38.5
No Fertilizer, 1.5 lbs. Diuron	42.5	44.4	47.2	33.3	41.9
Fertilizer, Check	41.3	41.7	43.4	37.5	43.5
Fertilizer, 1.5 lbs. Diuron	75.0	50.0	40.0	25.0	47.5
				$\bar{X}$	42.8

Fertilization consisted of 40-40-40 banded when sprigged.

F values: Replications 2.0850 n.s., Treatments .5208 n.s., Fertilizer 1.050 n.s., Fert. x W. Control .5083 n.s., CV=24.60%, EMS=108.46. n.s. denotes not significant.

TABLE XXXIII

STAND RATING OF NK-37 BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, MAY 24, 1960.

Treatment (lbs./acre)	Stand Rating 0=No Stand 10=Excellent				
Reps.	I	II	III	IV	$\bar{X}$
No Fertilizer	3	3	3	5	3.5
Fertilizer	8	8	10	7	8.3

Fertilization consisted of 40-40-40 banded when planted.

F values: Replications .22 n.s., Fertilizer 21.52,** CV=24.55%, EMS=2.10. **denotes significance at the 1% level, n.s. denotes not significant.

TABLE XXXIV

THE WEED POPULATION OF MIDLAND BERMUDAGRASS, KIRKLAND LOAM, ARMORE, JUNE 20, 1960.

Treatment (lbs./acre)	Weed Rating 0=No Weeds 10=Dense Population				
Reps.	I	II	III	IV	$\bar{X}$
No Fertilizer, Check	7	4	5	7	5.75
No Fertilizer, 1.5 lbs. Diuron	3	3	2	5	3.25
No Fertilizer, .5 lb. 2,4-D	7	5	7	7	6.50
Fertilizer, Check	7	6	6	7	6.50
Fertilizer, 1.5 lbs. Diuron	4	4	3	6	4.25
Fertilizer, .5 lb. 2,4-D	9	4	4	8	6.25

Fertilization consisted of 40-40-40 banded when sprigged plus 40 lbs. nitrogen as a topdressing.

F values: Replications 7.68**, Treatments 6.83**, Fertilizer 1.39 n.s., Weed Control 15.60**, Fert. x W. Control .81 n.s., CV=19.15%, EMS=1.0778. **denotes significance at the 1% level, n.s. denotes not significant.

TABLE XXXV

THE WEED POPULATION OF MIDLAND BERMUDAGRASS, KIRKLAND LOAM, ARMORE, NOVEMBER 25, 1960.

Treatment (lbs./acre)	Weed Rating 0=No Weeds 10=Dense Population				
Reps.	I	II	III	IV	$\bar{X}$
No Fertilizer, Check	9	9	9	9	9.0
No Fertilizer, 1.5 lbs. Diuron	4	4	4	9	5.3
No Fertilizer, .5 lb. 2,4-D	9	10	9	8	9.0
Fertilizer, Check	9	9	9	10	9.1
Fertilizer, 1.5 lbs. Diuron	6	8	9	9	8.0
Fertilizer, .5 lb. 2,4-D	10	9	7	10	9.0

Fertilization consisted of 40-40-40 banded when sprigged plus 40 lbs. nitrogen as a topdressing.

F values: Replications 1.36 n.s., Treatments 5.34**, Fertilizer 3.41 n.s., Weed Control 9.02**, Fert. x W. Control 2.63 n.s., CV=16.11%, EMS=1.76. **denotes significance at the 1% level, n.s. denotes not significant.

TABLE XXXVI

THE WEED POPULATION OF NK-37 BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, JUNE 20, 1960.

Treatment (lbs./acre)	Weed Rating 0=No Weeds 10=Dense Population				
Reps.	I	II	III	IV	$\bar{X}$
No Fertilizer, Check	5	8	6	7	6.50
No Fertilizer, .5 lb. 2,4-D	5	6	3	4	4.50
Fertilizer, Check	4	10	3	8	6.25
Fertilizer, .5 lb. 2,4-D	8	8	3	7	6.50

Fertilization consisted of 40-40-40 banded when planted plus 40 lbs. nitrogen as a topdressing.

F values: Replications 5.31*, Treatments 1.56 n.s., Fertilizer 1.28 n.s., Weed Control 1.28 n.s., Fert. x W. Control 2.11 n.s., CV= 26.06%, EMS=2.3958. **denotes significance at the 5% level, n.s. denotes not significant.

TABLE XXXVII

THE WEED POPULATION OF NK-37 BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, NOVEMBER 25, 1960.

Treatment (lbs./acre)	Weed Rating 0=No Weeds 10=Dense Population				
Reps.	I	II	III	IV	$\bar{X}$
No Fertilizer, Check	10	9	10	6	8.8
No Fertilizer, .5 lb. 2,4-D	10	8	9	7	8.0
Fertilizer, Check	6	3	2	3	3.5
Fertilizer, .5 lb. 2,4-D	8	4	3	3	4.5

Fertilization consisted of 40-40-40 banded when planted plus 40 lbs. nitrogen as a topdressing.

F values: Replications 7.56**, Treatments 22.31**, Fertilizer 65.32**, Weed Control .44 n.s., Fert. x W. Control 1.18 n.s., CV=18.51%, EMS=1.31. **denotes significance at the 1% level, n.s. denotes not significant.

TABLE XXXVIII

THE PERCENT OF GROUND COVER OF MIDLAND BERMUDAGRASS IN THE YEAR OF ESTABLISHMENT, KIRKLAND LOAM, ARDMORE, NOVEMBER 25, 1960.

Treatment (lbs./acre)	Percent of Ground Cover				
Reps.	I	II	III	IV	$\bar{X}$
No Fertilizer, Check	5.0	5.0	4.0	8.0	5.0
No Fertilizer, 1.5 lbs. Diuron	60.0	35.0	50.0	6.0	37.8
No Fertilizer, .5 lb. 2,4-D	5.0	5.0	8.0	5.0	5.8
Fertilizer, Check	10.0	15.0	20.0	3.0	12.0
Fertilizer, 1.5 lbs. Diuron	65.0	45.0	10.0	5.0	31.3
Fertilizer, .5 lb. 2,4-D	5.0	15.0	35.0	30.0	21.3

Fertilization consisted of 40-40-40 banded when sprigged plus 40 lbs. nitrogen as a topdressing.

F values: Replications .97 n.s., Treatments 2.69 n.s., Fertilizer .73 n.s., Weed Control 5.63*, Fert. x W. Control .73 n.s., CV=87.45%, EMS=272.03. **denotes significance at the 5% level, n.s. denotes not significant.

TABLE XXXIX

THE PERCENT OF GROUND COVER OF MIDLAND BERMUDAGRASS THE SECOND YEAR FOLLOWING ESTABLISHMENT, KIRKLAND LOAM, ARDMORE, OCTOBER 23, 1961.

Treatment (lbs./acre)	Percent of Ground Cover				
Reps.	I	II	III	IV	$\bar{X}$
No Fertilizer, Check	5.0	20.0	15.0	10.0	12.5
No Fertilizer, 1.5 lbs. Diuron	65.0	55.0	85.0	15.0	55.0
No Fertilizer, .5 lb. 2,4-D	5.0	20.0	15.0	15.0	13.8
Fertilizer, Check	30.0	25.0	25.0	3.0	20.8
Fertilizer, 1.5 lbs. Diuron	65.0	50.0	15.0	7.0	34.3
Fertilizer, .5 lb. 2,4-D	8.0	20.0	40.0	33.0	25.3

Fertilization consisted of 40-40-40 banded when sprigged plus annual application of 40 lbs. nitrogen as a topdressing.

F values: Replications 1.45 n.s., Treatments 3.16*, Fertilizer .002 n.s., Weed Control 5.94*, Fert. x W. Control 1.97 n.s., CV=66.35%, EMS=319.67. *denotes significance at the 5% level, n.s. denotes not significant.

TABLE XL

THE PERCENT OF GROUND COVER OF NK-37 BERMUDAGRASS IN THE YEAR OF ESTABLISHMENT, KIRKLAND LOAM, ARDMORE, NOVEMBER 25, 1960.

Treatment (lbs./acre)	Percent of Ground Cover				
Reps.	I	II	III	IV	$\bar{X}$
No Fertilizer, Check	1.0	20.0	10.0	60.0	22.7
No Fertilizer, .5 lb. 2,4-D	3.0	40.0	20.0	50.0	28.3
Fertilizer, Check	40.0	80.0	95.0	80.0	73.8
Fertilizer, .5 lb. 2,4-D	25.0	80.0	90.0	85.0	70.0

Fertilization consisted of 40-40-40 banded when planted plus 40 lbs. nitrogen as a topdressing.

F values: Replications 9.00**, Treatments 13.43**, Fertilizer 39.89**, Weed Control .01 n.s., Fert. x W. Control .40 n.s., CV=30.18%, EMS=215.67. **denotes significance at the 1% level, n.s. denotes not significant.

TABLE XLI

THE PERCENT OF GROUND COVER OF NK-37 BERMUDAGRASS THE SECOND YEAR FOLLOWING ESTABLISHMENT, KIRKLAND LOAM, ARDMORE, OCTOBER 23, 1961.

Treatment (lbs./acre)	Percent of Ground Cover				
Reps.	I	II	III	IV	$\bar{X}$
No Fertilizer, Check	.5	10.0	5.0	50.0	16.4
No Fertilizer, .5 lb. 2,4-D	2.0	10.0	7.0	10.0	7.3
Fertilizer, Check	20.0	85.0	90.0	85.0	70.0
Fertilizer, .5 lb. 2,4-D	10.0	80.0	85.0	70.0	61.3

Fertilization consisted of 40-40-40 banded when planted plus annual application of 40 lbs. nitrogen as a topdressing.

F values: Replications 4.49*, Treatments 1.04 n.s., Fertilizer 30.38**, Weed Control .84 n.s., Fert. x W. Control .0003 n.s., CV=50.37%, EMS=381.29. *denotes significance at the 5% level. **denotes significance at the 1% level, n.s. denotes not significant.

TABLE XLII

THE NITROGEN CONTENT OF MIDLAND BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, JULY 24, 1961.

Treatment (lbs./acre)	Percent Nitrogen				
Reps.	I	II	III	IV	$\bar{X}$
No Fertilizer, Check	1.12	1.25	1.08	1.34	1.19
No Fertilizer, 1.5 lbs. Diuron	1.10	1.05	1.13	1.37	1.16
No Fertilizer, .5 lb. 2,4-D	1.08	1.13	1.04	1.29	1.14
Fertilizer, Check	1.45	1.56	1.50	1.42	1.48
Fertilizer, 1.5 lbs. Diuron	1.56	1.66	1.79	1.93	1.73
Fertilizer, .5 lb. 2,4-D	1.61	1.66	1.64	1.64	1.64

Fertilization consisted of 40-40-40 banded when sprigged plus annual application of 40 lbs. nitrogen as a topdressing.

F values: Replications 4.13*, Treatments 32.63**, Fertilizer 14.67**, Weed Control 2.84 n.s., Fert. x W. Control 5.30*, CV=6.59%, EMS=.0084. *denotes significance at the 5% level. **denotes significance at the 1% level, n.s. denotes not significant.

TABLE XLIII

THE NITROGEN CONTENT OF MIDLAND BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, OCTOBER 19, 1961.

Treatment (lbs./acre)	Percent Nitrogen				
Reps.	I	II	III	IV	$\bar{X}$
No Fertilizer, Check	1.00	1.00	.90	1.28	1.05
No Fertilizer, 1.5 lbs. Diuron	.85	.90	.79	1.06	.90
No Fertilizer, .5 lb. 2,4-D	.89	.93	1.00	1.33	1.04
Fertilizer, Check	1.00	1.00	1.18	1.12	1.08
Fertilizer, 1.5 lbs. Diuron	.76	.77	.86	1.06	.86
Fertilizer, .5 lb. 2,4-D	.90	1.36	1.04	1.12	1.11

Fertilization consisted of 40-40-40 banded when sprigged plus annual application of 40 lbs. nitrogen as a topdressing.

F values: Replications 5.42*, Treatments 2.81 n.s., Fertilizer .17 n.s., Weed Control 6.54**, Fert. x W. Control .41 n.s., CV=11.66%, EMS=.0139. *denotes significance at the 5% level. **denotes significance at the 1% level, n.s. denotes not significant.

TABLE XLIV

THE NITROGEN CONTENT OF NK-37 BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, JULY 24, 1961.

Treatment (lbs./acre)	Percent Nitrogen				
Reps.	I	II	III	IV	$\bar{X}$
No Fertilizer, Check	1.18	1.02	1.34	1.15	1.17
No Fertilizer, .5 lb. 2,4-D	1.15	1.20	1.42	1.08	1.21
Fertilizer, Check	1.46	1.40	1.42	1.52	1.45
Fertilizer, .5 lb. 2,4-D	1.48	1.37	1.48	1.47	1.45

Fertilization consisted of 40-40-40 banded when planted plus annual application of 40 lbs. nitrogen as a topdressing.

F values: Replications 2.31 n.s., Treatments 10.65**, Fertilizer 31.58**, Weed Control .19 n.s., Fert. x W. Control .19 n.s., CV=6.94%, EMS=.0084. **denotes significance at the 1% level, n.s. denotes not significant.

TABLE XLV

THE NITROGEN CONTENT OF NK-37 BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, OCTOBER 19, 1961.

Treatment (lbs./acre)	Percent Nitrogen				
Reps.	I	II	III	IV	$\bar{X}$
No Fertilizer, Check	1.03	.99	1.21	.88	1.03
No Fertilizer, .5 lb. 2,4-D	.94	.93	.86	.94	.92
Fertilizer, Check	.81	1.02	.78	1.12	.93
Fertilizer, .5 lb. 2,4-D	.97	.99	.86	1.05	.97

Fertilization consisted of 40-40-40 banded when planted plus annual application of 40 lbs. nitrogen as a topdressing.

F values: Replications .28 n.s., Treatments .59 n.s., Fertilizer .13 n.s., Weed Control .35 n.s., Fert. x W. Control 1.28 n.s., CV=13.28%, EMS=.0163. n.s. denotes not significant.

TABLE XLVI

THE PHOSPHORUS CONTENT OF MIDLAND BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, JULY 24, 1961.

Treatment (lbs./acre)	Percent Phosphorus				
Reps.	I	II	III	IV	$\bar{X}$
No Fertilizer, Check	.20	.18	.12	.17	.17
No Fertilizer, 1.5 lbs. Diuron	.20	.19	.21	.17	.19
No Fertilizer, .5 lb. 2,4-D	.22	.17	.20	.15	.19
Fertilizer, Check	.17	.19	.22	.18	.19
Fertilizer, 1.5 lbs. Diuron	.21	.16	.19	.14	.18
Fertilizer, .5 lb. 2,4-D	.18	.16	.16	.20	.18

Fertilization consisted of 40-40-40 banded when sprigged plus annual application of 40 lbs. nitrogen as a topdressing.

F values: Replications 1.36 n.s., Treatments .61 n.s., Fertilizer .30 n.s., Weed Control .08 n.s., Fert. x W. Control 1.20 n.s., CV=13.56%, EMS=.0006. n.s. denotes not significant.

TABLE XLVII

THE PHOSPHORUS CONTENT OF MIDLAND BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, OCTOBER 19, 1961.

Treatment (lbs./acre)	Percent Phosphorus				
Reps.	I	II	III	IV	$\bar{X}$
No Fertilizer, Check	.18	.11	.14	.15	.15
No Fertilizer, 1.5 lbs. Diuron	.18	.11	.14	.11	.14
No Fertilizer, .5 lb. 2,4-D	.20	.11	.14	.11	.11
Fertilizer, Check	.13	.14	.12	.15	.14
Fertilizer, 1.5 lbs. Diuron	.14	.10	.16	.15	.14
Fertilizer, .5 lb. 2,4-D	.15	.10	.15	.11	.13

Fertilization consisted of 40-40-40 banded when sprigged plus annual application of 40 lbs. nitrogen as a topdressing.

F values: Replications .56 n.s., Treatments .20 n.s., Fertilizer .40 n.s., Weed Control .10 n.s., Fert. x W. Control .40 n.s., CV=16.00%, EMS=.0005. n.s. denotes not significant.

TABLE XLVIII

THE PHOSPHORUS CONTENT OF NK-37 BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, JULY 24, 1961.

Treatment (lbs./acre)	Percent Phosphorus				
Reps.	I	II	III	IV	$\bar{X}$
No Fertilizer, Check	.15	.24	.12	.14	.11
No Fertilizer, 2,4-D	.13	.19	.12	.14	.15
Fertilizer, Check	.13	.24	.11	.18	.17
Fertilizer, 2,4-D	.18	.24	.11	.18	.18

Fertilization consisted of 40-40-40 banded when planted plus annual application of 40 lbs. nitrogen as a topdressing.

F values: Replications 29.66**, Treatments .23 n.s., Fertilizer .40 n.s., Fert. x W. Control .33 n.s., CV=11.53%, EMS=.0003. **denotes significance at the 1% level. n.s. denotes not significant.

TABLE XLIX

THE PHOSPHORUS CONTENT OF NK-37 BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, OCTOBER 19, 1961.

Treatment (lbs./acre)	Percent Phosphorus				
Reps.	I	II	III	IV	$\bar{X}$
No Fertilizer, Check	.16	.19	.19	.09	.16
No Fertilizer, .5 lb. 2,4-D	.14	.24	.11	.11	.15
Fertilizer, Check	.20	.16	.08	.18	.16
Fertilizer, .5 lb. 2,4-D	.13	.16	.10	.22	.15

Fertilization consisted of 40-40-40 banded when planted plus annual application of 40 lbs. nitrogen as a topdressing.

F values: Replications 1.10 n.s., Treatments .03 n.s., Weed Control .04 n.s., Fert. x W. Control .04 n.s., CV=34.12%, EMS=.0028. n.s. denotes not significant.

TABLE L

THE POTASSIUM CONTENT OF MIDLAND BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, JULY 24, 1961.

Treatment (lbs./acre)	Percent Potassium				
Reps.	I	II	III	IV	$\bar{X}$
No Fertilizer, Check	.96	.97	.84	1.00	.94
No Fertilizer, 1.5 lbs. Diuron	.93	.97	.91	1.10	.98
No Fertilizer, .5 lb. 2,4-D	.95	.95	.97	1.00	.97
Fertilizer, Check	1.20	1.50	1.80	1.40	1.48
Fertilizer, 1.5 lbs. Diuron	1.70	1.20	1.60	1.50	1.50
Fertilizer, .5 lb. 2,4-D	1.10	.93	1.10	1.90	1.26

Fertilization consisted of 40-40-40 banded when sprigged plus annual application of 40 lbs. nitrogen as a topdressing.

F values: Replications 1.16 n.s., Treatments 5.34**, Fertilizer 23.83**, Weed Control .69 n.s., Fert. x W. Control .74 n.s., CV=18.90%, EMS=.0506. **denotes significance at the 1% level. n.s. denotes not significant.

TABLE LI

THE POTASSIUM CONTENT OF MIDLAND BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, OCTOBER 19, 1961.

Treatment (lbs./acre)	Percent Potassium				
Reps.	I	II	III	IV	$\bar{X}$
No Fertilizer, Check	.78	.77	.74	.97	.82
No Fertilizer, 1.5 lbs. Diuron	.66	.70	.69	.79	.71
No Fertilizer, .5 lb. 2,4-D	.88	.80	.80	.88	.84
Fertilizer, Check	.79	.71	.73	.90	.78
Fertilizer, 1.5 lbs. Diuron	.67	.66	.75	.95	.76
Fertilizer, .5 lb. 2,4-D	.77	.91	.82	.80	.83

Fertilization consisted of 40-40-40 banded when sprigged plus annual application of 40 lbs. nitrogen as a topdressing.

F values: Replications 5.27*, Treatments 2.13 n.s., Weed Control 4.59*, Fert. x W. Control .82 n.s., CV=8.39%, EMS=.0044. *denotes significance at the 5% level. n.s. denotes not significant.

TABLE LII

THE POTASSIUM CONTENT OF NK-37 BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, JULY 24, 1961.

Treatment (lbs./acre)	Percent Potassium				
Reps.	I	II	III	IV	$\bar{X}$
No Fertilizer, Check	.89	.89	.92	.87	.89
No Fertilizer, .5 lb. 2,4-D	.86	1.60	.70	.83	1.00
Fertilizer, Check	.92	1.00	.78	1.20	.98
Fertilizer, .5 lb. 2,4-D	.96	1.30	.84	.96	1.02

Fertilization consisted of 40-40-40 banded when planted plus annual application of 40 lbs. nitrogen as a topdressing.

F values: Replications 2.29 n.s., Treatments .25 n.s., Fertilizer .21 n.s., Weed Control .44 n.s., Fert. x W. Control .09 n.s., CV=22.44%, EMS=.0474. n.s. denotes not significant.

TABLE LIII

THE POTASSIUM CONTENT OF NK-37 BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, OCTOBER 19, 1961.

Treatment (lbs./acre)	Percent Potassium				
Reps.	I	II	III	IV	$\bar{X}$
No Fertilizer, Check	.93	.94	.99	.85	.93
No Fertilizer, .5 lb. 2,4-D	.91	1.00	.89	.85	.91
Fertilizer, Check	.94	.89	.69	1.00	.88
Fertilizer, .5 lb. 2,4-D	.79	.78	.74	.99	.83

Fertilization consisted of 40-40-40 banded when planted plus annual application of 40 lbs. nitrogen as a topdressing.

F values: Replications .48 n.s., Treatments .59 n.s., Fertilizer 1.30 n.s., Weed Control .35 n.s., Fert. x W. Control .11 n.s., CV=13.33%, EMS=.0141. n.s. denotes not significant.

TABLE LIV

THE SURVIVAL PERCENTAGE OF NK-37 BERMUDAGRASS FOLLOWING THE WINTER SEASON OF 1960-61, KIRKLAND LOAM, ARDMORE, MAY 5, 1961.

Treatment (lbs./acre)	Percent Survival				
Reps.	I	II	III	IV	$\bar{X}$
No Fertilizer	13.0	55.0	8.0	60.0	34.0
Fertilizer	65.0	90.0	90.0	88.0	83.0

Data are the average of weed control treatments within fertility treatments. Fertilization consisted of 40-40-40 banded when planted plus 40 lbs. nitrogen as a topdressing.

F values: Replications 2.09 n.s., Fertilizer 16.78*, CV=29.47%, EMS=289.12. *denotes significance at the 5% level. n.s. denotes not significant.

TABLE LV

THE SURVIVAL PERCENTAGE OF NK-37 BERMUDAGRASS FOLLOWING THE WINTER SEASON OF 1961-62, KIRKLAND LOAM, ARDMORE MAY 28, 1962.

Treatments (lbs./acre)	Percent Survival				
Reps.	I	II	III	IV	$\bar{X}$
No Fertilizer	2.0	10.0	4.0	35.0	9.0
Fertilizer	45.0	68.0	73.0	78.0	66.0

Data are the average of weed control treatments within fertility treatments. Fertilization consisted of 40-40-40 banded when planted plus annual application of 40 lbs. nitrogen as a topdressing.

F values: Replications 4.54 n.s., Fertilizer 70.78**, CV=23.89%, EMS=80.12. **denotes significance at the 1% level. n.s. denotes not significant.

TABLE LVI

THE PERCENT OF WINTER KILL OF UNFERTILIZED AND FERTILIZED NK-37 BERMUDAGRASS DURING THE WINTER SEASON OF 1961-62, KIRKLAND LOAM, ARDMORE

Treatment (lbs./acre)	Percent Winter Kill				
Reps.	I	II	III	IV	$\bar{x}$
No Fertilizer	10.5	45.0	4.0	25.0	21.1
Fertilizer	20.0	23.0	18.0	10.0	17.8

Data are the average of weed control treatments within fertility treatments. Fertilization consisted of 40-40-40 banded when planted plus annual application of 40 lbs. nitrogen as a topdressing.

F values: Replications 1.28 n.s., Fertilizer 1.44 n.s., CV=64.67%, EMS=158.28. n.s. denotes not significant.

FIGURE 1

AERIAL VIEW SHOWING THE EFFECT OF FERTILIZATION AND CHEMICAL WEED CONTROL ON MIDLAND BERMUDAGRASS, KIRKLAND LOAM, ARDMORE

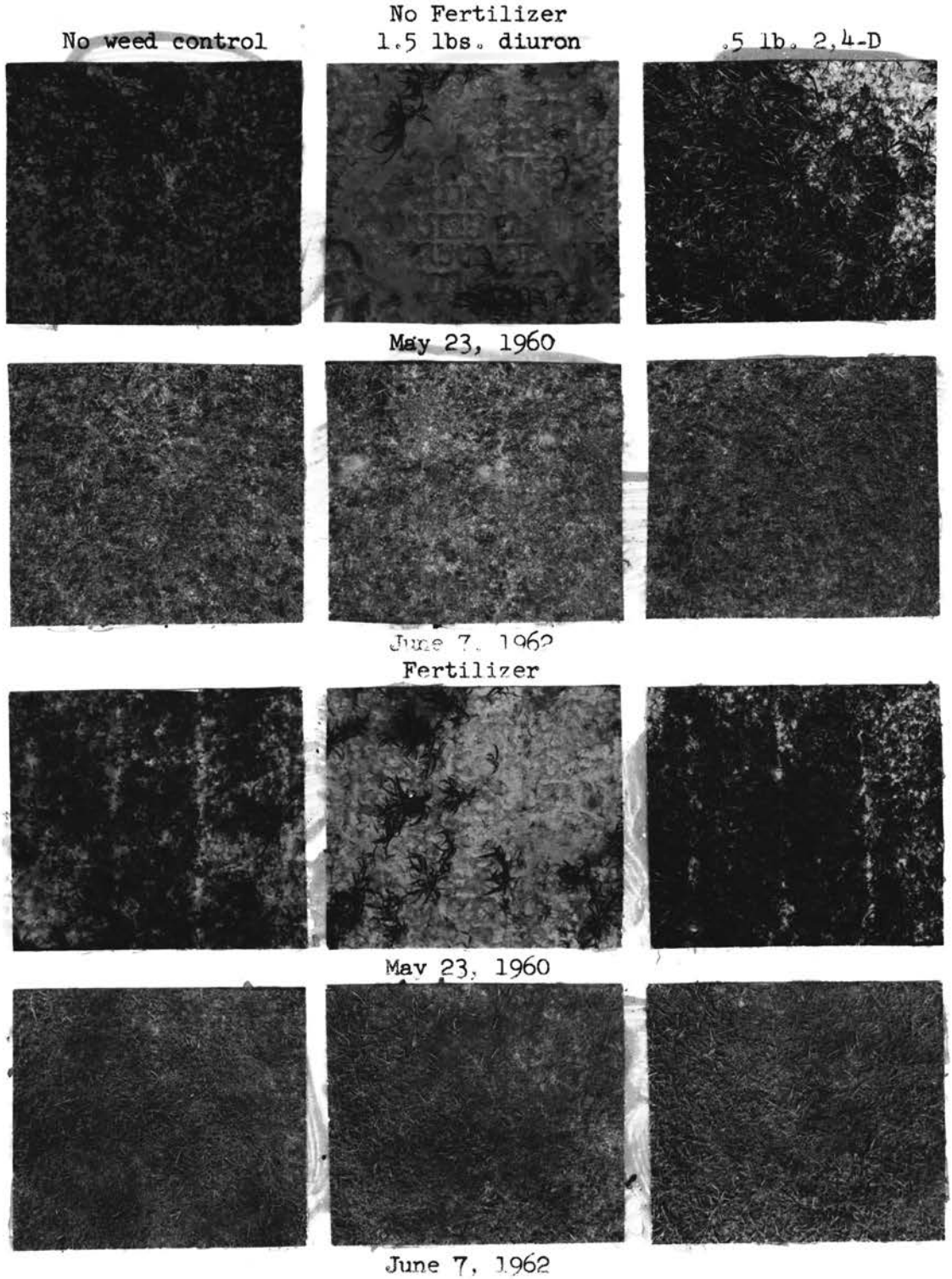


FIGURE 2

AERIAL VIEW SHOWING THE EFFECT OF FERTILIZATION AND CHEMICAL WEED CONTROL ON NK-37 BERMUDAGRASS, KIRKLAND LOAM, ARDMORE

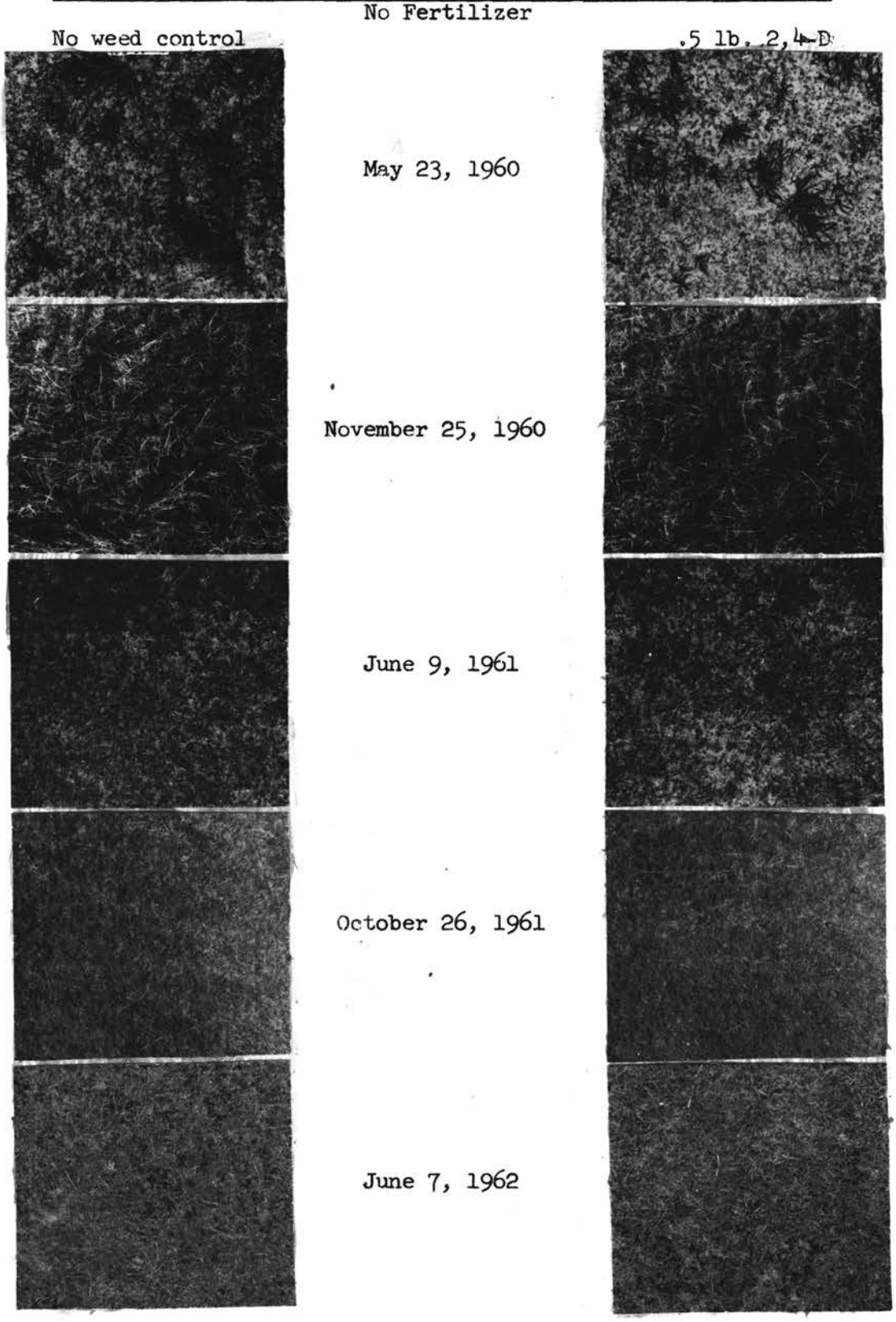


FIGURE 2 (CONTINUED)

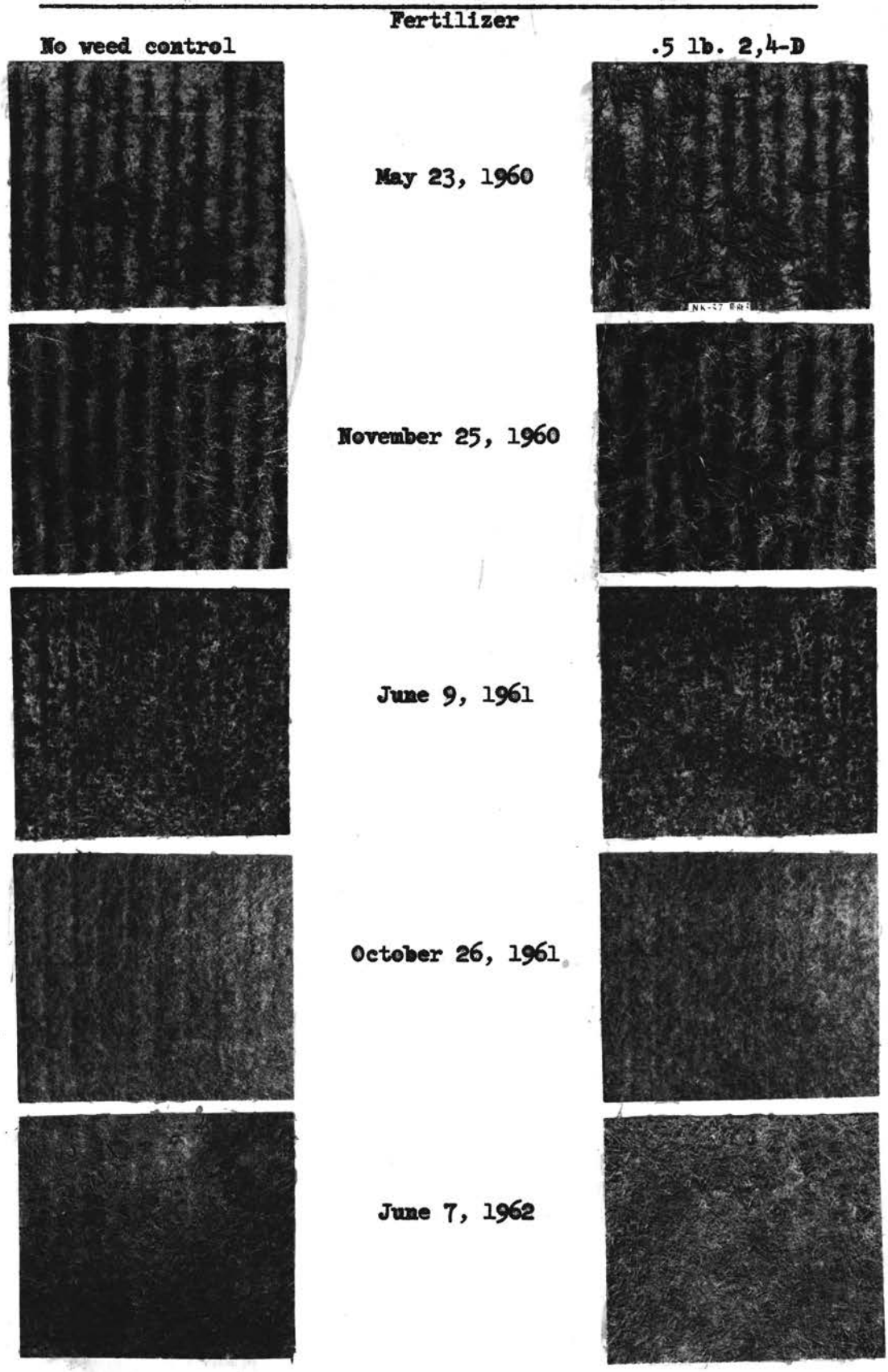
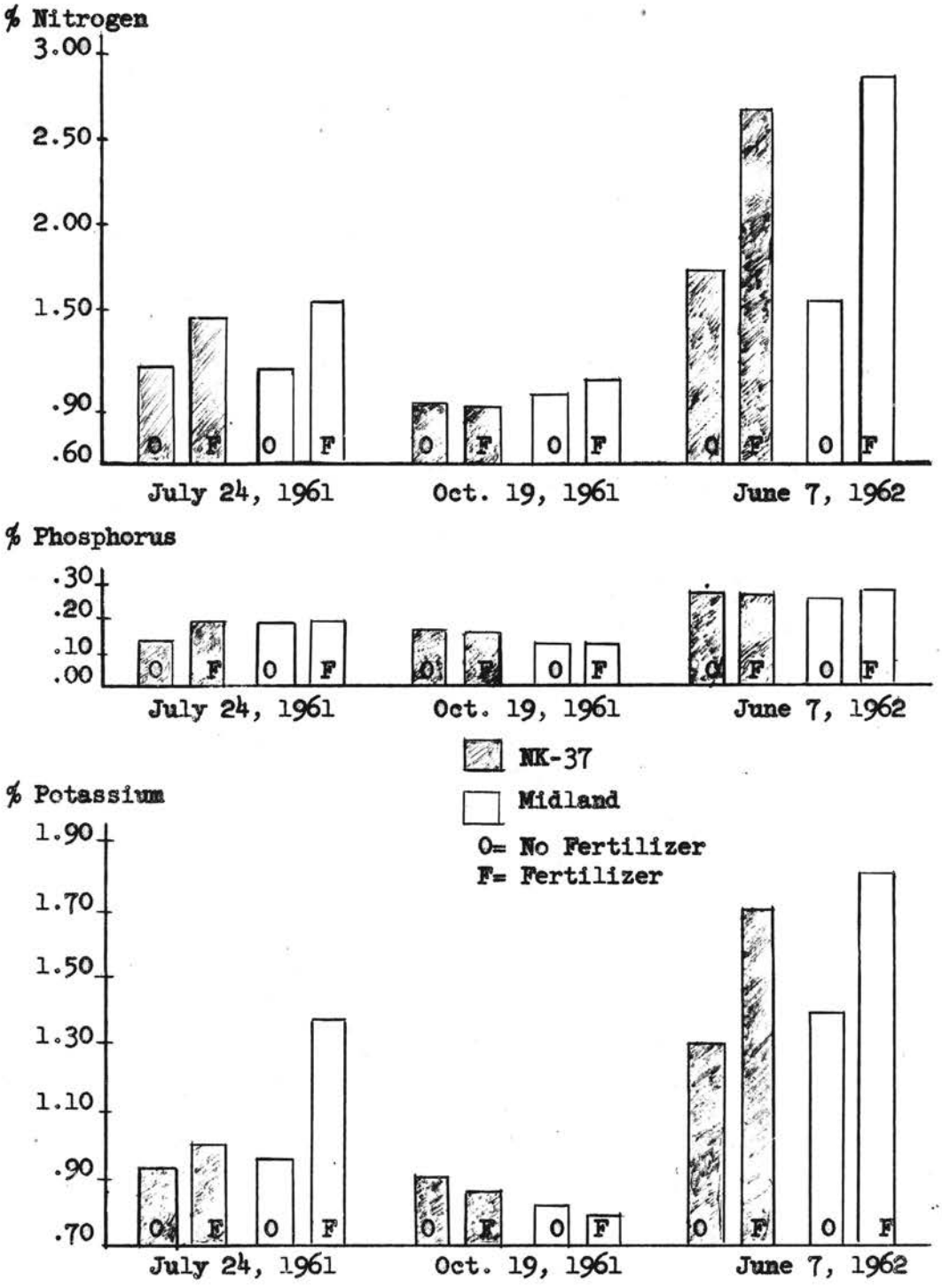


FIGURE 3

THE EFFECT OF FERTILIZATION AND CHEMICAL WEED CONTROL ON THE PERCENT OF NITROGEN, PHOSPHORUS, AND POTASSIUM IN NK-37 AND MIDLAND BERMUDAGRASS FORAGE ON THREE CLIPPING DATES, KIRKLAND LOAM, ARDMORE, 1961-62.



See Table II for fertility and weed control treatments.

FIGURE 4

THE EFFECT OF FERTILIZATION ON THE RHIZOME DEVELOPMENT OF MIDLAND AND NK-37 BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, 1960-62.

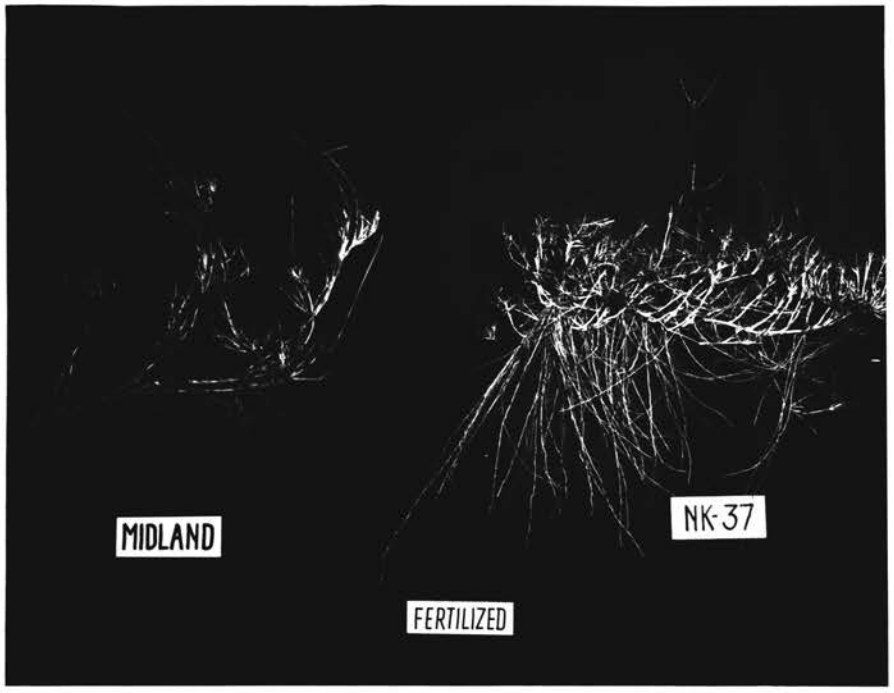


FIGURE 5
THE APPROXIMATE LOCATION AND SURVIVAL PERCENTAGE OF 102 NK-37 BERMUDAGRASS PLANTINGS IN THIRTY-ONE OKLAHOMA COUNTIES, 1958-62

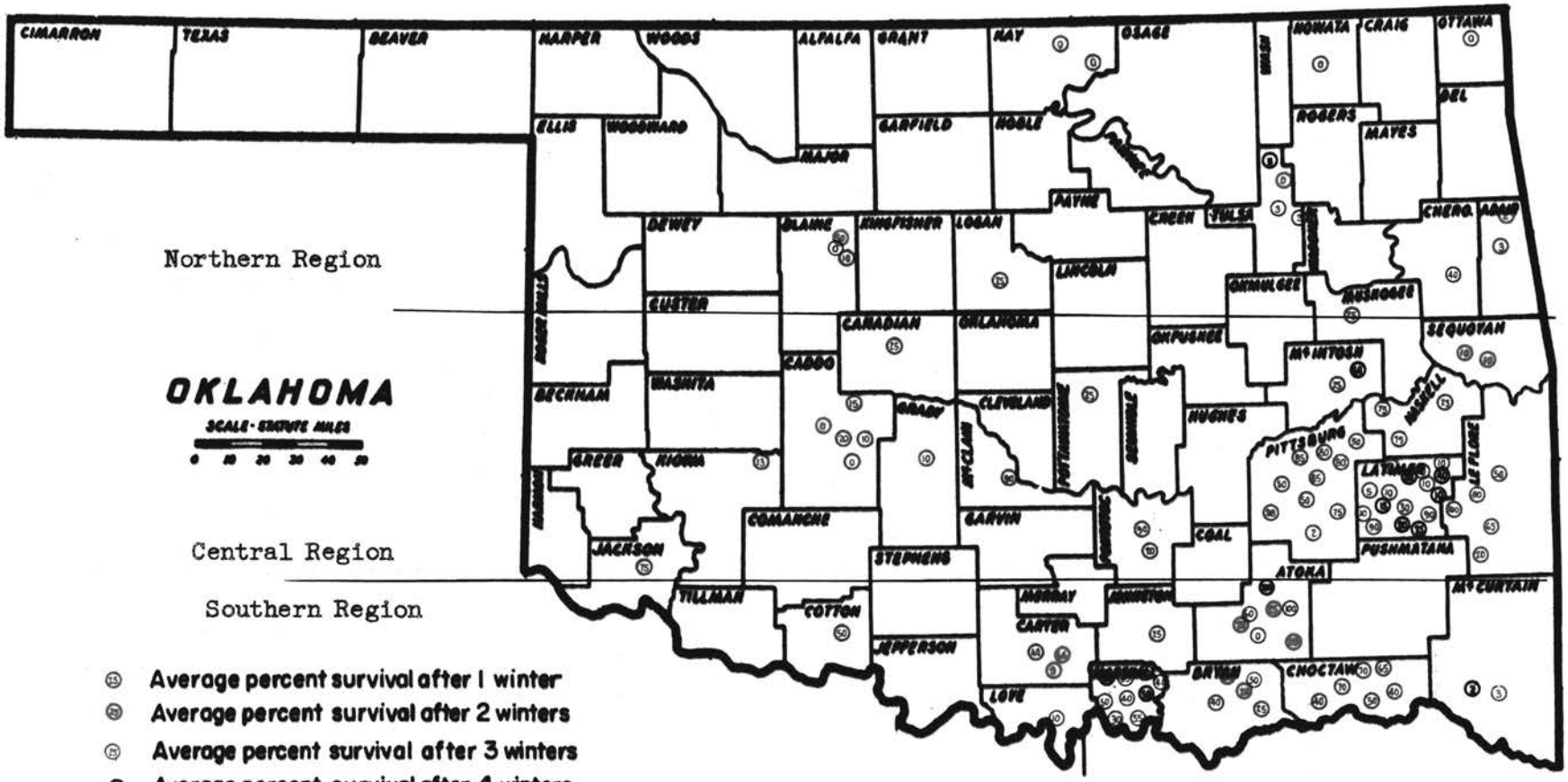


FIGURE 6

CAMERA AND TRIPOD APPARATUS USED TO OBTAIN AERIAL PHOTOGRAPHS OF NK-37 AND MIDLAND BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, 1960-62

FIGURE 7

THE EFFECT OF FERTILIZATION ON STAND AND GROWTH OF NK-37 BERMUDAGRASS, KIRKLAND LOAM, ARDMORE, OKLAHOMA, JUNE 12, 1960.

Foreground

No Fertilizer Fertilizer

VITA

Gary D. Simmons

Candidate for the Degree of

Master of Science

Thesis: THE EFFECT OF FERTILIZATION AND CHEMICAL WEED CONTROL ON THE ESTABLISHMENT AND SURVIVAL OF NK-37 AND MIDLAND BERMUDAGRASS

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Date of Final Examination: May, 1963.