

The sprays were applied as blanket treatments between the maize rows and as direct basal sprays in the rows to prevent excessive drift onto the maize plants. A spray volume of 50 gallons per acre was adequate to ensure thorough wetting. The weather was sunny and hot. No rain fell during the 24 hour period following spraying.

Trial (b) was sprayed on 22/1/65. The maize plants were approximately 18" high and the weeds were almost of similar height. The sprays were applied in the same manner as above, using a higher volume rate of water, namely, 100 gallons per acre to ensure adequate wetting. Directed basal spraying of the maize was difficult to achieve. The weather during spraying was very hot and sunny. Heavy rains fell over the site approximately 4 hours after spraying.

Results:

No assessment of the treatment effects on the maize was made. The maize stand in both trials was irregular. It was observed, however, that the maize plants which had been contacted by the spray were killed. The appearance and growth of the surviving maize, however, was markedly superior to the unsprayed plants.

Weed control ratings.

Weed control, which includes kill of nutgrass, annual grasses and broadleaf weeds, was assessed by rating the sprayed plots twice after spraying. Results for both trials are given in Appendix Table 53, and the mean values in Table 101.

TABLE 101: WEED CONTROL RATINGS.

TABLE 101. F. WEED CONTROL TRIALS			Trial (b)		
TREATMENTS	Period after spraying		TREATMENTS	Period after spraying	
	2 weeks 2 months			2 weeks 2 months	
	2 weeks	2 months		2 weeks	2 months
1. Linuron 1 lb + 0.5% Agrel	9.0	5.0	1. Linuron 1 lb + 0.5% Agrel	8	6.8
2. Linuron 2 lb + 0.5% Agrel	9.3	7.7	2. Linuron 1.25 lb + 0.5% Agrel	8.7	7.8
3. Control	0	0	3. Linuron 1.5 lb + 0.5% Agrel	8.3	7.7
			4. Linuron 2.0 lb + 2.0% Agrel	8.7	7.8
			5. Control	0	0

Weed Counts

Two weed counts were made on Trial (a), the first on 28/1/65 (15 days after spraying) and the second 10/2/65 (29 days after spraying). For the first count, the total weeds per 2 square foot frame were counted, taking two frames per plot. Results are given in Appendix Table 54 and the means in Table 102. The second weed count consisted of counting the number of weeds per quadrat frame and recording respective weights immediately after cutting. The quadrat frame measuring 2 square feet was placed at random four times along the central line of each plot. The results are tabulated in Appendix Table 55 and the means are given in Table 102. An analysis of variance in respect of nutgrass counts was made on the Log. transformation. The results are given in Table 103.

TABLE 102: 1ST WEED COUNT (15 DAYS AFTER SPRAYING)
MEAN NUMBER OF WEED PER 2 SQUARE FEET (QUADRAT)

TREATMENT	WEED SPECIES	NUMBER
1. 1 lb Linuron + 0.5% Agral	Cyperus	44
	Cyperus	6
	Bromus	0.5
	TOTAL	50.5
2. 2 lb Linuron + 0.5% Agral	Cyperus	17
	Cyperus	4
	Bromus	0.5
	TOTAL	21.5
3. Control	Cyperus	231
	Cyperus	47
	Bromus	130
	TOTAL	408

* Annuals.

The weed species in order of abundance were:-

1. Cyperus seculentus L.
2. Ischaemum minus L.
3. Echinochloa indica Gaertn.
4. Cynodon dactylon Pers.
5. Amaranthus retrofractus L.
6. Eragrostis spp.
7. Portulaca oleracea L.
8. Chenopodium album L.
9. Commelina africana L.

An inspection of the trial 7/2/65, i.e. 3 weeks after spraying, revealed a reinfestation of nutgrass. This reinfestation originated from freshly sprouted tubers and was not associated with regeneration of previously affected plants. The degree of resprouting was more pronounced on the 1 lb linuron than on the 2 lb linuron plots. Observations in Trial (b) showed an excellent kill of Xanthium purpureus and Setaria spp. L. with all levels of linuron.

TABLE 103 : 2ND WEED COUNT (29 DAYS AFTER SPRAYING
DEATH, NUMBER AND WEIGHT (GMS OF WEEDS
PER 2 SQ. FEET

TREATMENT	NUTGRASS		GRASSES		BROADLEAF	
	NUMBER	WEIGHT	NUMBER	WEIGHT	NUMBER	WEIGHT
1, 1 lb Linuron + 0.5% Agc.	32.4	11.8	3.5	3.7	4.6	6.1
2, 2 lb Linuron + 0.5% Agc.	10.5	2.0	3.1	1.7	0.2	0.07
3, Control	53.0	74.5	15.3	30.3	30.9	136.1

LOG NUMBER OF NUTGRASS PER 2 SQUARE FEET, DURORAY

1, 1 lb Linuron + 0.5% Agc	2.076
2, 2 lb Linuron + 0.5% Agc	1.624
3, Control	2.292
L.S.D $p = 0.05$	0.354

Based on the data in respect of nutgrass numbers in Table 103 it is evident that 2 lbs of linuron was significantly better than the control and 1 lb with no difference between the latter two.

Post-emergence applications of 1 and 2 lbs linuron per acre, when applied in conjunction with a surfactant (Agrel), at a concentration of 0.5% gave a high percentage kill of nutgrass as well as excellent control of a number of common annual weeds. The herbicidal activity of lb. linuron appeared to be of a systemic nature. This treatment did not exercise a residual effect against newly emerging nutgrass shoots sprouting from dormant tubers. Regrowth of affected nutgrass plants was not observed. Where a height differential between the maize crop and nutgrass prevailed directed basal row treatment permitted selective weed control.

6. Nutgrass Control in Turf

a) 2,4-D and MCPA

Selective control of nutgrass in turf is a problem of primary importance. Several trials were conducted to evaluate a number of promising herbicides. The experiments were conducted at the Ft. Meade Turf Research Station.

2,4-D (Amine salt) and MCPA were applied in increasing concentrations from 2 lbs to 10 lbs acid equivalent per acre to 4 turf varieties severely infested with nutgrass. The rates were 2,4,6, 8 and 10 lbs acid equivalent per acre. Treatments were applied at the end of summer to 1/100th acre plots arranged in 3 randomised blocks across 4 turf varieties, namely, Digitaria australandensis, ^{S.E.} Bredley, Florida, and Hell's Selection. Foliar chlorosis followed by a systemic necrosis of the nutgrass shoot ^{was} observed two weeks after spraying. After die-back of the stem, a separation of shoots from the stem base was possible. At the severed surface there was evidence of a dark concentric ring. All concentrations of both 2,4-D and MCPA were phytotoxic to the nutgrass but proved non-injurious to the 4 turf varieties. The herbicidal effects were somewhat masked by the low prevailing temperatures subsequent to spraying.

b) Screening trial - 1962

Four herbicides, each at two concentrations, were applied to a newly established Skepplaas turf heavily infested with a uniform stand of nutgrass. The trial was designed to evaluate the selective herbicidal behaviour of three compounds and compare their performance with a phenoxy-acetic hormone herbicide recommended for the control of nutgrass in established turf. The compounds in this trial were selected because of their particularly high degree of contact activity and low order of residual toxicity to perennial grasses. The treatments given in Table 104 were applied on 2/1/62 to 1/220th acre plots arranged in randomised blocks with 3 replications. The site was mown 14 days after spraying. Urea (200 lbs per acre) was applied 18 days after spraying.

The weather at spraying was warm and humid and the soil surface moist, the site having been well irrigated and subsequently mown prior to herbicidal application.

Control of nutgrass and phytotoxicity to the turf was determined by visual assessment of percentage turf cover and nutgrass infestation. The residual effect of the herbicide was evaluated by recording the number of surviving nutgrass plants in 3, 20" x 20" quadrats. Counts were made 55 days (26/2/62) and 90 days (2/4/62) after spraying. Results of ratings and nutgrass counts are given in Appendix Tables 56 and 57. The mean values are recorded in Table 104 and Table 105 respectively.

TABLE 104 : INFLUENCE OF HERBICIDES ON NUTGRASS IN TURF
MEAN RATING PER 3 REPLICATIONS

TREATMENTS	TURF			NUTGRASS		
	PHYTOTOXICITY		% COVER	CONTROL		% COVER
	8 Days 10/1/62	22 Days 24/2/62		8 Days 10/1/62	22 Days 24/2/62	
1. Dinoseb 2.76 lbs	6.7	1.3	3.7	7.3	3.0	6.3
2. Dinoseb 5.52 "	9.0	1.3	2.7	8.3	5.3	6.7
3. MCPA - 4 lbs a.e.	1.3	1.3	6.7	3.0	7.3	3.3
4. MCPA - 8 " "	1.3	4.0	7.3	4.3	9.0	2.7
5. Linuron - 2 lbs	6.0	3.0	4.3	5.3	2.7	5.7
6. Linuron - 4 "	6.7	8.3	4.0	4.3	5.3	6.0
7. Monolinuron - 2 lbs	2.7	0.3	4.7	6.0	2.7	5.3
8. Monolinuron - 4 lbs	7.0	0.3	3.7	6.0	5.3	6.3
9. Control	0	0	6.7	0	0	6.0

TABLE 105 : INFLUENCE OF HERBICIDES ON THE SURVIVAL OF NUTGRASS.
MEAN NUMBER OF SURVIVING NUTGRASS PLANTS PER FRAME

HERBICIDES	DATE OF COUNT	
	26/2/62	2/4/62
1. Dinoseb 2.76 lbs	50.9	56.7
2. Dinoseb 5.52 "	47.8	52.0
3. MCPA - 4 lbs a.e.	45.1	52.6
4. MCPA - 8 lbs a.e.	35.3	41.7
5. Linuron - 2 lbs	44.0	49.9
6. Linuron - 4 lbs	52.2	54.7
7. Monolinuron 2 lbs	42.0	49.1
8. Monolinuron 4 lbs	50.0	52.3
9. Control	42.0	46.9

Results.

Nutgrass Control.

Of the four compounds tested, dinoseb gave the most effective initial control of nutgrass followed closely by monolinuron at the higher rate of application. An assessment made three weeks after spraying revealed that the high dosage MCPA treatment gave excellent control of the weed, despite poor initial performance. Similarly, the low MCPA rate also gave good control. This pattern of control was maintained for a further 18 days when the percentage area infested by nutgrass was estimated. Plots receiving 8 lbs of MCPA showed the greatest reduction in nutgrass infestation. Assessments made one year after spraying revealed that nutgrass had reinvaded all the sprayed plots, with indications of an increase in nutgrass population density, possibly induced by previous herbicidal toxicity to the turf.

Phytotoxicity to turf.

All the treatments with the exception of MCPA and the lower monolinuron application were injurious to the turf. Toxicity of dinoseb was of a transient nature.

Based on the above results, MCPA applied at a rate of 8 lbs acid equivalent per acre proved to be safe for use on a Skeppians turf giving effective nutgrass control for a period of 6 weeks after treatment. To ensure complete eradication, repeated spraying during the active growing period would probably be necessary.

c) TCA trial.

Sodium trichloroacetate (TCA) is a herbicide principally employed for the control of perennial grasses and particularly rhizomatous species such as *Cynodon dactylon*^{var.}. The latter, nevertheless exhibits considerable tolerance to low dosage levels of this herbicide and is unaffected by rates below 40 lbs per acre. At these low dosage rates, however, nutgrass shows considerable susceptibility. A trial was therefore designed to screen low dosage levels of sodium trichloroacetate with regard to its susceptibility and turf tolerance.

Three levels of TCA, 15, 25 and 35 lbs per acre, were applied to a well established and actively growing Royal Cape turf, infested with a uniform stand of nutgrass.

Herbicidal treatments were applied on 25/1/60, arranged in randomized blocks, interspersed with un sprayed check plots and replicated three times. Plot size was 1/300th acre. (See Fig. 59).

Hot, humid conditions prevailed at spraying. The soil was moist, light rain having fallen the day prior to treatment.

Results.

1) Pre- and post-treatment counts of nutgrass plants were carried out 1 day prior to and 15 days after spraying. Total number of living nutgrass per 20" x 20" quadrat was recorded. The nutgrass population per 3 quadrats are given in Appendix Table 58 and the mean values in Table 106.

2)a Post treatment rating of herbicidal efficacy was made 35 days after spraying. Results are given in Appendix Table 59 and the mean values in Table 105.

2)b Phytotoxicity to turf was assessed 35 days after spraying and the subjective ratings are given in Appendix Table 59 and the mean values in Table 107.

3) Control of nutgrass and phytotoxicity to turf. Approximately 12 months after spraying, the plots were examined and rated both in respect of turf survival and nutgrass control. Results are given in Appendix Table 60 and the means in Table 108.

TABLE 105: MEAN PRE- AND POST-TREATMENT NUTGRASS POPULATIONS. NUMBER OF PLANTS PER 20" x 20" QUADRAT.

TABLE 106: MEAN PRE- AND POST-TREATMENT NUTGRASS POPULATIONS. NUMBER OF PLANTS PER 20" x 20" QUADRAT			
15 lbs	63.4	19.8	
25 "	54.2	13.8	
35 "	68.3	12.6	
CONTROL	53.5	45.2	



FIGURE 59 : Sodium trichloroacetate damage to Lin.

TABLE 107 : POST-TREATMENT RATING OF NUTGRASS CONTROL AND TURF PHYTOTOXICITY (35 DAYS AFTER SPRAYING).

TREATMENT	NUTGRASS CONTROL*	TURF PHYTOTOXICITY*
15 LBS	7.3	8.0
25 "	8.3	9.0
35 "	9.0	9.3
CONTROL	0	0

* 10 = Complete kill of nutgrass

* 10 = Complete kill of turf.

TABLE 108 : LATE POST-TREATMENT RATING OF NUTGRASS CONTROL AND PHYTOTOXICITY TO TURF (49 WEEKS AFTER SPRAYING).

TREATMENT	NUTGRASS CONTROL*	TURF PHYTOTOXICITY*
15	8.3	1.3
25	8.3	2.0
35	8.6	4.0
CONTROL	9.4	0

* 10 = Complete regrowth.

* 10 = Complete kill of turf - bare patches.

sodium trichloroacetate damage to turf.

Summary and Conclusions.

Increasing levels of sodium trichloroacetate applied to a Royal Cape turf, heavily infested with nutgrass, caused marked initial reductions in the nutgrass populations. The highest dosage (35 lbs per acre) gave the most effective and persistent control. The herbicidal action was of a transient nature, being confined to the first three months subsequent to treatment. Rapid regrowth of the nutgrass was evident during the following summer season.

The severe degree of damage caused by all the herbicidal concentrations, coupled with short herbicidal persistence, renders sodium trichloroacetate completely unsuitable for selective herbicidal control of nutgrasses in turf. Pre-planting treatments with this herbicide at the lowest levels, followed by an interval of 6 - 8 weeks prior to planting, is a method which warrants further investigation.

d) EPTC trial - 1963.

Four rates of EPTAN 5% Granules were applied to disturbed strips in a nutgrass-infested Skeapless turf after the sods had been excavated. The granules were applied at rates of 0, 0.25, 0.5 and 1 oz per square yard, equivalent to 75, 150 and 300 lbs per acre, at the end of November, 1963.

The granules were raked into the plots measuring 9' x 1' and the treatments were arranged at random with untreated strips serving as controls.

Four months after application, the number of nutgrass plants per 3, 18" x 6" quadrats were recorded. The plants were clipped and the green aerial nutgrass weight per 3 frames determined. Results are given in Appendix Table 60 and the means in Table 109.

4 soil cores, 6" diameter and 5' deep were removed from each plot. The soil was removed by washing and the total turf weight per 4 cores recorded. Results are given in Appendix Table 60 and Table 109, respectively. These weights include roots, rhizomes and stolons.

TABLE 109 : CONTROL OF NUTGRASS IN TURF WITH EPTC
5% GRANULES. MEANS OF 4 REPLICATIONS.

RATE OF APPLI- CATION PER SQ. YD	NUTGRASS PER 3(18"x6" FRAMES)		TURF GREEN WEIGHT
	NUMBER	GREEN WT.	
1. 1/2 oz	10	9.50	13.55
2. 3/4 oz	0	0	6.65
3. 1 oz	1	0.3	8.15
4. Control	48.25	92.60	29.30

EPTC granules were highly effective in controlling nutgrass invading disturbed sites in turf, particularly at the high rate of application. At this level, however, EPTC was extremely toxic to the turf and prevented regrowth of the grass. The lowest rate of application reduced the infestation of nutgrass but grass growth was still markedly retarded. All rates of EPTC gave good control of annual weeds.

a) EPTC trial - 1964.

EPTC 5% Granules were applied to a well prepared seedbed, heavily infested with nutgrass, as pre-planting soil treatments. The granules were applied at two rates, namely, 0.5 oz and 1.5 oz per 25 square feet, equivalent to 75 and 150 lbs per acre, and incorporated into the soil. Two turf varieties, Skaspleas and Royal Cope, were planted at 4. Planting dates after treatment viz. 0, 1, 2 and 4 weeks after planting. Plot size was 8' x 5'. The treatments were arranged in randomized blocks and replicated 3 times. The same weight of grass runners were planted in each plot. Treatments were applied 5/3/64 and the plots received

additional irrigation whenever necessary. Periodic observations of the plots were made.

From the results obtained, it was evident that the high rate of EPIC was injurious to both grass varieties whereas the low application rate was tolerated. The growth rate of Stampless/^{was} ~~more~~ more rapid, ~~growth~~ and ~~was~~ less affected by the herbicide than the slower growing Royal Cape. Delayed planting caused less herbicidal toxicity to the turf grass. Both rates of EPIC gave excellent control of nutgrass during the first season.

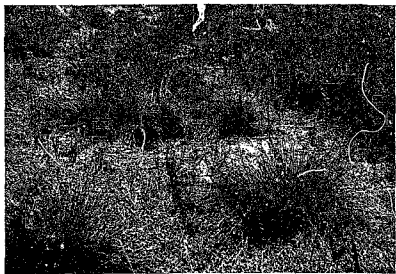


FIGURE 60: Rodent denudation of Eragrostis curvula pasture.

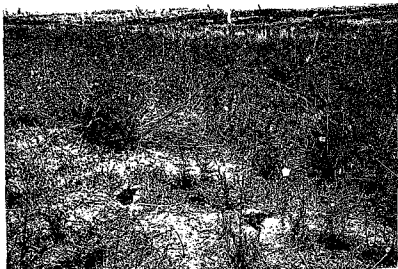


FIGURE 61: Rodent activity in Eragrostis curvula pasture.

CHAPTER XII

ECOLOGICAL STUDIES

A. DISTRIBUTION OF NUTGRASS IN CERTAIN PLANT COMMUNITIES

The stages of succession on the sandy soils of the Transvaal Highveld have been outlined by Davidson (1960b). A number of plant communities at Frankenwald, representative of various stages of succession, were examined with regard to the presence of nutgrass. These communities included the following:

1. Natural Veld

- a) Undisturbed Purple Veld.
- b) Lightly grazed Purple Veld.
- c) Heavily grazed Purple Veld.
- d) Hyparrhenia grass stage.
- e) Eragrostis - Cynodon stage.

2. Stoebe vulgaris

3. Cultivated areas - Eragrostis curvula Nees

Natural Veld

No nutgrass was found in the Purple Veld or grazed Purple Veld. However, nutgrass was found in both the Hyparrhenia as well as in the Eragrostis-Cynodon stages, but only where disturbance had occurred. In the case of Hyparrhenia communities, it was found near rodent (presumably gerbilles) workings and in the Eragrostis-Cynodon communities only at old kraaling sites, where build up of dung had occurred, or near watering or feeding points. In the Hyparrhenia camp, there were patches of continuous grass denudation, the grass tussocks revealing a progressive die-back, becoming completely necrotic. The denuded areas were covered with a thick grass litter and colonized by nutgrass growing vigorously from tubers. These nutgrass infestations appear to have originated from tubers, probably introduced by the rodents as a fodder reserve.

Stoebe vulgaris Leys.

No evidence of nutgrass could be found in these communities.

of Eragrostis curvula

in Eragrostis.

Cultivated areas - *Eragrostis curvula* Nees,

In the *Eragrostis curvula* ^{Nees} camps which had been established for a number of years and subjected to heavy grazing pressure, the soil was compacted and no evidence of nutgrass could be found. Where disturbance had occurred and heavy dung deposits were evident, e.g. near feeding racks, dense colonies of nutgrass were found. In one particular camp where rodent activity was very pronounced, nutgrass had invaded and occupied the denuded areas. As a result of rodent activity an unbroken belt of denudation was evident. This belt consisted of a system of interconnecting subterranean tunnels and nests, the soil subsiding readily when subjected to slight pressure. (Figures 60 and 61).

In one camp (Spacement Studies - A Camp), a large number of *Cyperus rotundus* colonies were located. The colonies were within close proximity of each other, occupying the inter spaces between the *Eragrostis* tussocks. It is pertinent to mention that this would appear to be the first time that *Cyperus rotundus* has been recorded at Frankenswald. Glover (1937) in his survey of the flora at Frankenswald, refers solely to *C. rotundus*. It is possible that the seed of the *Eragrostis* ^{Nees} *curvula*, used in the Spacement Trial, may have been contaminated with *C. rotundus*.

From the observations made at Frankenswald, it would therefore appear that nutgrass is confined solely to the early stages of succession and in disturbed areas within plant communities higher in the succession.

9. RELATIONSHIP BETWEEN NUTGRASS AND DUNG.

The presence of nutgrass adjacent to or within decomposed dung patches poses the question as to whether the seed had been introduced by means of an animal agent or whether it was more tolerant to high nitrogen levels than the competing grasses.

Evidence in support of the second theory is unfortunately lacking, as no data is available regarding the susceptibility of the young nutgrass seedling to N concentrations. On filter paper treated with 0.2% KNO_3 , Bohn et al. (1962) have shown a 66 percent germination of nutgrass seed, while Jong and Roux (1955) have suggested that the degree of tolerance of different grass seedlings to ammonium sulphate diminishes as their place in the succession advances.

This evidence would seem to favour the supposition that most ruderals tolerate high nitrogen concentrations. This indeed has been confirmed where industrial water effluents, containing high concentrations of N, have been applied to cultivated land. In one project undertaken by Messrs. African Explosives & Chemical Industries, Ltd., the equivalent of 2000 lbs N per acre was applied to a plantation of trees which, after the effluent treatment, was prepared and seeded to maize. The principal weed problem on this site was nutgrass (Mokenzie 1965).

In an attempt to establish the reason for the absence of nutgrass in most of the plant communities at Frankenswald, a number of pot experiments were carried out. In the experiments, nutgrass tubers or seed were respectively planted or sown in soils sampled from a number of representative plant communities.

C. GROWTH AND DEVELOPMENT OF NUTGRASS IN SOILS FROM DIFFERENT PLANT COMMUNITIES.

A series of pot experiments were conducted in the glasshouse to compare the growth and development of sprouted and unsprouted nutgrass tubers planted in soils removed from different grassland communities at Frankenswald. The standard comparison in all these tests consisted of an arable soil sample which had been removed from a continuously cultivated site. Each soil sample consisted of 9, 6" cores taken at random in each community. The samples were bulked, passed through a 2 mm screen and sub-sampled. The pots or trays were then filled with an equal volume of soil. All the experiments were conducted in the glasshouses.

Test 1.

12 clay pots were filled with soils from 4 communities (3 replications per community), namely,

1. Trachypogon - Other Species.
2. *Themeda triandra* ^{Forest} (Sampled at Bothal)
3. Arable.
4. Eragrostis lay.

15 grams of unsprouted nutgrass tubers ($\pm$ 75 - 100 tubers) were planted in each pot 18/1/62. Nutgrass emergence was recorded over a period of 13 days and the stems clipped 11 weeks after planting. The number of nutgrass plants, the number of inflorescences and the fresh aerial weights of nutgrass are given in Appendix Table 61. Green aerial weights have been subjected to an analysis of variance. Mean values are given in Table 110.

TABLE 110: MEAN NUMBER AND WEIGHTS OF NUTGRASS STEMS

I PLANT NUMBER PER POT		PLANT COMMUNITY			
DATE		Trachypogon	Themeda	Arable	Eragrostis
1.	25/1/62	0.7	0.7	1.7	0
2.	26/1/62	1.7	3.0	4.3	2
3.	28/1/62	7.7	9.3	16.3	5.7
4.	31/1/62	24.0	21.0	30	20
II NUMBER OF INFLORESCENCES PER POT					
12/3/62		5	7.7	7	1
III GREEN AERIAL WEIGHTS IN GRAMS PER POT					
7/4/62		6.1	5.8	4.1	9.6

The green weights of nutgrass stems, grown in soils sampled from 4 different communities, did not differ significantly from each other.

Test 2.

18 white polythene pots were filled with soil from the following 3 sites.

1. Arable
2. Trachypogon
3. Eragrostis

5 sprouted and 35 unspouted tubers were planted in each soil type and replicated three times.

a) Sprouted tubers test.

All pots received a fertilizer dressing of 2 grams of Complanal per pot to cancel out nutrient variations between the 3 soil samples. The stems were clipped 8 weeks after planting and air-dried. Weight of stems, roots, tuber weights and tuber numbers are given in Appendix Table 62 and the means in Table 111.

TABLE 111 : AIR DRY WEIGHTS OF NUTGRASS

TREATMENTS	STEM WEIGHT	TUBER		ROOT + TUBER WEIGHT
		WEIGHT	NUMBER	
Arable	2.36	3.41	35	7.0
Eragrostis	2.74	2.55	29	9.4
Trachypogon	2.91	3.65	40	7.1

b) Unspouted tuber test.

The final number of shoots, inflorescences and foreign species invading the pots are given in Appendix Table 63 and the means in Table 112.

TABLE 112 : AIR-DRY WEIGHTS OF NUTGRASS

TREATMENT	STEM		ROOT WEIGHT	TUBER		FOREIGN SP.	
	NUMBER	WEIGHT		NUMBER	WEIGHT	GRASSES	BROADL.
Arable	3	1.51	1.05	4.7	0.61	6.7	0
Eragrostis	7	1.75	1.41	8.7	0.83	14.7	8.7
Trachypogon	5.7	0.59	0.53	8	0.48	0	0

In the unspouted tuber test, the air-dry stem weight of nutgrass grown on Trachypogon soil was significantly lower. Because of the experimental variation and the small number of degrees of freedom for error, yield differences are not reliable.

Test 3

White polythene pots were filled with soils from the following 3 sites:-

1. Areble
2. Eragrostis
3. Trachypogon.

Half the pots were planted to 10 sprouted and the remainder to 20 unsprouted nutgrass tubers. Treatments were replicated 3 times. The pots were harvested 8 weeks later and the green serial weights of nutgrass recorded. Results are given in Appendix Table 64 and the means in Table 113.

TABLE 113. MEAN GREEN STEM WEIGHTS OF NUTGRASS.

TREATMENT	SPROUTED WEIGHT STEMS	UNSPROUTED		
		WEIGHT STEMS	NURSER STEMS	NO. FOREIGN WEEDS.
1. Areble	6.5	4.0	3	2.7
2. Eragrostis	5.5	0.3	1.3	24.0
3. Trachypogon	9.2	3.9	2.7	-

There were no significant differences among the different treatments. Where unsprouted tubers were planted in the Eragrostis soil, annual grasses emerged in considerable numbers. These annual weeds consisted primarily of *Setaria verticillata* ^{P. Beauv.} and *Echinochloa indica* ^{C. Gaertn.}. Sprouted nutgrass tubers appeared to grow more vigorously on the Trachypogon soil.

Test 4.

The soils and method of sampling were similar to those described for the preceding experiment, Test 3. Galvanised sheet metal trays were filled with equal volumes of soil and sown to *Bidens pilosa* ^{L.} and nutgrass seed. The trays were subdivided into two sections and the seeds sown uniformly over each section.

The seeds were sown and covered with 1/2" of soil and placed on laboratory tables adjacent to a window. Bidens germinated within 2 days. Nutgrass was considerably slower to emerge. Due to the rapid growth of the Bidens, the seedlings were counted 5 days after sowing. Three germination counts of emerged nutgrass seedlings are presented in Table 114.

TABLE 114 : NUMBER OF *BIDENS PILOSA* AND NUTGRASS SEEDLINGS PER SECTION.

TREATMENT	NUMBER OF <i>BIDENS PILOSA</i>	NUMBER OF NUTGRASS AFTER		
	5 DAYS	7 DAYS	8 DAYS	44 DAYS
Trachypogon	214	23	36	240
Eragrostis	224	11	25	180
Arable	228	13	25	204

Nutgrass and *Bidens pilosa* germinated in all 3 soils.

The results confirm that seeds of ruderal weeds can, if present, germinate under a wide range of edaphic conditions.

Test 5.

Tussocks of similar diameter of *Eragrostis curvula* and *O. Kuhnii* were removed from their respective communities with adhering soil. Two tussocks of each grass were planted during mid-January in deep asbestos trays. The grasses were trimmed back to a height of 2" and 30 nutgrass tubers planted in 3 rows between the grass tussocks in each tray. Growth and development of the nutgrass was compared with that of nutgrass grown on arable soil. The treatments were replicated three times and the pots arranged at random in the open.

Results.

Emergence of nutgrass shoots was recorded one month after planting. Three months after planting, the nutgrass and grass herbage was clipped, air-dried and weighed. Underground fractions were washed out, dried and weighed. Results of shoot emergence and weights of plant fractions are given in Table 115.

TABLE 115 : MEAN AIR DRY WEIGHTS AND NUMBER OF NUTGRASS AND GRASS STEMS. GRAMS PER TRAY.

COMMUNITY	Shoot emergence after 1 month	WEIGHT OF		
		Grass herbage	Grass + Nutgrass roots	Nutgrass stems.
Trachypogon	31.0	48.1	129.2	1.6
Eragrostis	31.3	92.1	222.5	0.3
Cultivated	35.0	-	-	11.4

The slow growth of nutgrass in the Eragrostis and Trachypogon trays was markedly lower than in the control trays.

Summary of Results. From the results obtained in the preceding pot experiments, it is evident that the growth of nutgrass is not adversely affected when planted or sown in soils sampled from the higher stages of plant succession on the Highveld. The absence of nutgrass in these communities does not appear to be due to a relationship involving allelopathy. It is concluded that edaphic factors, e.g. availability,

which influence the cause and nature of the shears (Davidson 1960 b), may be responsible.

B. NUTGRASS POPULATION DENSITIES IN TWO ADJACENT ARABLE FIELDS.

An inspection during mid-December 1965 of two adjacent fields (Site I and Site II) at Frankenwald, revealed a marked difference in nutgrass infestation levels. The two camps were formerly seeded to Eragrostis curvula ^{Nees}. Site I had been under continuous cultivation since 1958. An Eragrostis nursery established on Site II, was ploughed over for the first time during 1964. Both sites were ploughed and disced during October 1964, fertilised with 150 lbs of superphosphate per morgen and sown to babala (Pennisetum typhoides) ^{Stepf.}. Nutgrass infestations almost entirely absent on Site I, were widely distributed on Site II. Furthermore, it was evident that in the nutgrass infested zones within Site II where the weed had formed unbroken, continuous colonies, the babala and/or annual weed species had been completely suppressed. Where babala or dicotyledonous weed species were present, nutgrass was totally absent. An analysis of plant density, weight and composition was undertaken during mid-January 1965. Site II was sub-divided into two zones, viz. a babala-dominated zone and a non-babala zone. 8, 20" x 20" square quadrats were sampled at random in each site and zone.

A further two zones within Site II were also selected and sampled. These consisted of almost complete stands of Phytolacca angulata and Datura stramonium. The mean total number of all plants, fresh and air dry weights of stems and roots per 8, 20" x 20" frames are given in Table 116.

A chemical analysis of the above samples, derived from composite samples of herbage and roots, was carried out. Results reflecting the composition of the aerial and underground fractions are shown in Table 117. The total weight of each fraction (air dry weight x percentage) per quadrat is given in Table 118.

TABLE 116: . . . ME., NUMBER, FRESH AND AIR-DRY WEIGHTS OF NUTGRASS, BABALA AND OTHER SPECIES . . . (8, 20" x 20" QUADRANTS)

ORIGIN OF SAMPLE	NO.	STEMS		BABALA		ROOTS		NUTGRASS OR ALIEN SPECIES		ROOTS	
		Fr. Wt.	AD Wt.	Fr. Wt.	AD Wt.	Fr. Wt.	AD Wt.	Fr. Wt.	AD Wt.	Fr. Wt.	AD Wt.
		g.	g.	g.	g.	g.	g.	g.	g.	g.	g.
Site I Cult. 7 years	37	26.04	141.6	58.1	29.6	1.7*	2.7	0.5	0.8	0.22	
Site II Cult. 1 year											
a) Babala zone	62	1.97	169.0	58.4	27.0	16	42.6	11.0	7.9	3.6	
b) Non-babala zone Nut.	"	"	"	"	"	205	309.8	82.8	103.5	44.0	
c) " " Physa.	"	"	"	"	"	21	2.218152.2	36.2	13.9		
d) " " Det.	"	"	"	"	"	5	2.68143.0	39.1	11.7		

NO = Number of plants. Fr. Wt = Fresh weight babala stems only in lbs. Other fractions in grams
 AD Wt = Air-dry weight in grams. *Alien weeds weighed in the 100% per 20" x 20" quadrat.

TABLE 117: . . . CHEMICAL COMPOSITION OF . . . NUTGRASS AND ALIEN WEEDS

ORIGIN OF SAMPLE	% PROTEIN	% PHOSPHORUS	% CALCIUM	% ASH
Site I Cult. 7 years				
Nutgrass stems	7.0	0.35	0.44	11.96
Nutgrass roots	3.2	0.19	0.60	26.59
Site II Cult. 1 year				
a) Babala zone				
Nutgrass stems	5.4	0.31	0.26	18.0*
Nutgrass roots	2.6	0.09	0.46	60.04
b) Non-babala zone				
Nutgrass stems	10.2	0.36	0.80	24.50
Nutgrass roots	3.2	0.10	0.18	57.9
Physalis stems	5.2	0.20	0.86	7.56
Physalis roots	4.6	0.17	0.36	18.14
Physalis stems	3.2	0.31	0.95	7.72
Physalis roots	3.4	0.22	0.73	11.48

TABLE 118 : TOTAL UPTAKE OF CERTAIN MACRO ELEMENTS IN NUTGRASS, *PHYSALIS ANGULATA* AND *DATURA STRamonium*, GRAMS PER 20" X 20" QUADRAT X 100.

ORIGIN OF SAMPLE	GRAMS PROTEIN	GRAMS PHOSPHORUS	GRAMS CALCIUM	GRAMS ASH
<u>Site I. Cult. 7 years</u>				
Nutgrass stems	3.60	.175	.220	5.99
Nutgrass roots	.704	.0396	.132	5.848
Total	4.204	.2146	.352	11.838
<u>Site II. Cult. 1 year</u>				
<u>a) Babala zone</u>				
Nutgrass stems	59.4	3.41	2.86	198.99
Nutgrass roots	9.36	.324	.936	216.144
Total	68.76	3.734	3.796	415.134
<u>b) Non-Babala zone</u>				
Nutgrass stems	844.56	29.808	56.24	2028.60
Nutgrass Roots	140.80	8.40	7.92	2547.60
Total	985.36	38.208	64.16	4576.20
Physalis stems	791.44	30.44	130.892	1120.192
Physalis roots	63.94	2.363	5.004	210.448
Total Physalis	855.38	32.803	135.896	1330.636
Datura stems	457.60	44.33	135.65	1103.96
Datura roots	46.58	3.014	10.001	154.262
Total Datura	504.18	47.344	145.651	1258.222

Plant numbers.

It will be noted that the number of nutgrass shoots recorded in Site I (continuous cultivation) was extremely low when compared to the population density on non-babala zone (308 per quadrat frame). Nutgrass drops sharply on the babala zone of Site II indicating that where babala is able to compete, nutgrass invasion has been restricted. Also of interest is the fact that for a given area, the number of nutgrass shoots is much larger than that of both *dicotyledonous* weed species.

Weight.

Fresh air-dry weights of stems of both *dicotyledonous* weeds are higher than those of nutgrass on non-babala zones within Site II. The difference regarding air-dry weights are less pronounced. The reverse situation is evident as far as root weights are concerned. Nutgrass root weight per given area is approximately 3 times as high as that of both *dicotyledonous* species.

Chemical Composition.

Based on the results in Table 17, it is possible to compare the composition of nutgrass when grown under conditions of inter or intra species competition. Generally, the percentage of protein, phosphorus and calcium in the roots remained low, while ash content was very high. There were no marked differences between the three nutgrass root samples. In the case of nutgrass stems, however, the highest protein, calcium and ash contents were located in nutgrass sampled in the non-babala zones. Where nutgrass was growing in competition with babala, i.e. babala zone Site II or Site I, the quality of the nutgrass herbage with the exception of phosphorus, decreased very markedly.

Comparing the composition of three weed species sampled in the non-babala zones, it is quite clear that the percentage of protein, phosphorus and ash is of a much higher order in the stems of nutgrass than in those of *Physalis* or *Datura*. The calcium content of *Datura* is particularly high. With the exception of ash, the roots of *Physalis* and *Datura* are higher in phosphorus, calcium and to a lesser degree in protein.

Total nutrient uptake.

Differences between the three weed species with regard to the total nutrient uptake are again very striking. Of interest is the high concentration of plant foods in the aerial fractions of all three species. The high nutrient uptake by nutgrass plants growing in the absence of competition is clearly demonstrated.

CHAPTER XIII

DISCUSSION

From an ecological point of view, an essential feature of man's activities in agriculture is the production of open or at least disturbed habitats (Bunting, 1960). The weeds invading these habitats are pioneers of secondary succession. In order to establish, grow and reproduce in such an environment, clearly requires a degree of specialization. An efficient mode of vegetative reproduction may therefore be as valuable as the production of viable seed, since it makes the species less dependent on the chances of germination and greatly assists in invading new habitats. Where adaptability to diverse environmental conditions is combined with efficient dispersal of seed and tubers, the invasion of new habitats is greatly accelerated and the species is capable of assuming pest status shortly after introduction. Such reproductive behaviour displayed by nutgrass, to a large extent accounts for the rapid spread of this species throughout the Highveld Region of South Africa.

In an attempt to define the ecological requirements of nutgrass a number of studies were undertaken to investigate the response of this weed to certain environmental factors and to critically examine those physiological adaptations concerned with survival, reproduction and competition. It is expected that the results from these investigations will ultimately contribute towards an improved approach to and a better understanding of the control measures which are essential to achieve ultimate eradication of the weed.

4. RESPONSE TO ENVIRONMENTAL CONDITIONS.

1. Plant Nutrients.

Nutgrass responded positively to applications of nitrogen, particularly in the presence of phosphate. Fertilizer responses in terms of herbage yields obtained in the field, were confirmed in the glasshouse studies. A significant correlation between the two series of experimental results was established. A significant correlation between air-dry and green aerial weights was also demonstrated. Glasshouse investigations may thus be used for predicting fertilizer responses of nutgrass in the field.

There was evidence of a differential response to nitrogen carrier, and a remarkable ability to tolerate heavy dressings of nitrogen. Growth response to nitrogen measured both in the glasshouse and the field revealed that the herbage yields increased with dressings up to 200 lbs of N per acre.

Altering the edaphic conditions of turf plots which have been established for the past 32 years were responsible for some interesting flare changes which epitomize the response of nutgrasses to certain soil nutrients. Annual applications of nitrogen and phosphate (NP) and applications of nitrogen, phosphate and potash (NPK) not only improved the growth and vigour of the grass, but permitted a population of nutgrass to establish a perfect co-ecesis with the turf. Unfertilized, or plots receiving only phosphates, supported poor turf growth and were free of nutgrasses. Over a long term period it appears that an NPK interaction would be more favourable for the growth and development of nutgrasses.

The results presented above suggest that the response of nutgrasses to fertilizers is similar to that of ruderals such as annual grasses, which constitute the first stages of the subsera. This response would appear to be independent of drastic changes in soil reaction. It seems clear, therefore, that one of the principal edaphic factors influencing the distribution and, especially the growth of nutgrass, is the soil nitrogen status. The dominance of nutgrass in the ruderal stages of disturbed *Eragrostis* leys is explained in part by its ability to respond to relatively high concentrations of available nitrogen. The pattern of adaptation and survival of nutgrass are much the same as those described by Davidson (1960 b) for typical ruderals in the subsera. It would also appear that the position occupied by nutgrass in the subsera is, to some extent, determined by the soil nutrient response described by Jong and Roux (1965) for typical ruderals. The latter have demonstrated that as the succession advances the seedlings of dominant species exhibit a decreasing tolerance to ammonium N in nutrient solutions. The ruderal, *Eleusine indica*, and the dominant *Trachypogon spicatus* showing maximum and minimum tolerance respectively.

Davidson (1966 b) states that the edaphic factors strongly influence the course and nature of the sere and that annual applications of nitrogenous fertilizers influence both the rate of succession and the composition of the seral stages. In fact the early seral species may be used as indicators of available nitrogen. The disappearance of nutgrass from those grassland communities occupying advanced stages in the sere could be related to the high mineralisation of nitrogen in recent fallows and the low rate in the grassland climax.

Another misconception which warrants clarification is the absence of ruderals, including nutgrass, on sites of disturbed grassland climax. From the investigations it was evident that the growth and development of nutgrass is not adversely affected when sown or planted in soils removed from a representative Trachypogon - other species community, or when competing directly with the active growing climax species. Failure of the nutgrass to appear in sub-climax grassland sites is attributed to the absence of a primary source of seed inoculum. Biotic factors such as gerbils (Anon. 1964) may produce drastic changes in the sere by artificial introduction of the nutgrass, particularly if the community is surrounded by a source of infestation.

It is sometimes claimed that a soil supporting a luxuriant weed growth is excellent for cropping purposes and that the prolific weed growth indicates an abundance of mineral nutrients (Crafts and Robins 1962). In the case of nutgrass, this statement would appear to be true. These present experiments have shown positive increases in plant number, herbage yield, rate of spread and a marked improvement in both quality and quantity of herbage where balanced macro element mixtures have been applied to nutgrass.

2. Soil Reaction.

Considerable data is available showing the relation between soil reaction and the nature of seed growth. Crafts and Robins (1962) cite the case of sheep sereal which is generally conceded to serve as an indicator of lime deficient soil. The fact that this weed seems to flourish on soil deficient in lime has led to the conclusion that the plant is best adapted to, or demands an acid soil.

The results in this study seem to favour the supposition that nutgrass is very adaptable in regard to soil pH and consequently should not be used as an indicator of soil reaction. The presence of nutgrass is frequently associated with acid soils but this relationship would seem to be largely circumstantial in the light of sedge affinity for favourable soil moisture relations.

Of interest was the response of nutgrass to lime. Heavy dressings of calcium hydroxide, applied ^{in the} field and to pots illustrated the adaptability of nutgrass to soil pH. Rates as high as 7 tons of calcium hydroxide per acre had no measurable effect on the growth of nutgrass.

The majority of the soils on the Highveld are highly leached and generally acid, but on the littoral sands of the Natal sugar belt where heavy dressings of filter press have induced alkaline conditions, nutgrass is known to constitute a serious threat to cane production on soils suffering from Fe chlorosis. The evidence obtained in this investigation that nutgrass is capable of tolerating exaggerated dressings of lime and ammonium sulphate, confirms that soil reaction has no direct bearing on the growth of this species.

Hall et al. (1948) found that where continuous use of ammonium sulphate had greatly increased the acidity of unlined turf plots at Frankenwald, the grass formed a poor cover and nutgrass species invaded the stand. The present plant population occupying these plots do not correspond with the data of Hall and co-workers. A plant survey of these plots revealed that ~~that~~ despite an extremely low soil pH, both nutgrass and turf growth on the NP and NPX plots improved, and was superior to that of the unfertilised or P fertilised plots. There is no question of nutgrass surviving under acid conditions at the expense of the grassward. In fact a fairly stable association is apparent, the balance of which is not readily disturbed by frequent cutting or increased applications of "acidic" nitrogenous fertilizers.

3. Herbicides.

There is ample evidence available that the weed flora on cultivated sites can be drastically altered as a result of herbicidal treatment. The use of these agents is rapidly becoming a factor in the artificial selection of certain species. A case in point is the emergence of nutgrass as a dominant on arable fields where previously a mixed weed population had prevailed. Two examples are the increase in grass annuials and nutgrass at the expense of broadleaf species as a result of post-emergence 2,4-D applications and the replacement of annual grasses by nutgrass with continuous applications of triazines on heavy soils. The role which selective hormone type herbicides have played in elevating nutgrass to its present position dominating position cannot be overlooked. The devastating side effects this particular practice can create in an otherwise stable weed population is not always apparent.

4. Agronomic Practice.

From an agronomic point of view, the response of nutgrass to soil nutrients is of great importance when considering fertilizer applications for field crops. It is obvious that in order to restrict nutrient uptake by the nutgrass, certain modifications in regard to time and method of fertilizer placement must be introduced. Deep phosphate placement at planting appears to be important to reduce or retard incipient nutgrass growth, while nitrogen dressings to the crop should not be applied prior to removal of the weed.

5. COMPETITION.

To approach the problem of nutgrass control in a realistic manner, it is necessary that the fundamental factors connected with nutgrass competition be carefully examined. These factors include direct competition i.e. water, plant nutrients and population density and an appraisal of antagonism of undefined origin, "allelopathy".

The water uptake of nutgrass was compared with that of two other species when grown with or without maize. The object was to establish whether nutgrass consumed more water during a given period of time.

According to Bunting (1960), the transpiration per day from a given surface is determined by factors which are not dependent on the number of plants or on their leaf area. It follows that provided the plants are all much the same size and kind and more or less covering the ground, there is no competition for water even in dense stands. Further a crop does not in general suffer more severely from drought simply because it contains an unusually large number of individuals, though the effect of nutrient shortages are often mistaken for those of drought.

The results in the two water uptake studies revealed that when the three weeds were grown in competition with maize, the total uptake of water for a specific period over a given surface remained constant, irrespective of the weed species concerned. The depressing effect of the weed on the maize, however, differed among the three weed species. Cleome indica, for example, was a far more serious competitor than an equal number of nutgrass plants.

Where nutgrass was grown in pure stands, and its water uptake compared with that of Leptotes and Cleome, there was no evidence to suggest that water uptake was greater in the case of nutgrass. In these tests, the comparisons were drawn from identical population densities which are not necessarily truly representative of field conditions. According to Bunting, however, population density would not appear to be of primary importance.

Plant surveys have revealed that nutgrass population densities per area are higher than most other weeds. The results obtained in the increasing plant populations studies showed that the aerial weight, underground weight and number of tubers produced per given area was significantly increased as the population of nutgrass increased.

Three competition studies were conducted, the results of which partially explain nutgrass competition. When sorghum was grown with increasing population densities of nutgrass under low fertility levels, results showed that the weight of nutgrasses increased, but the weight of sorghum decreased with increasing numbers of nutgrass plants.

When nutgrass was planted with cucumbers in a sand culture and supplied with adequate quantities of nutrient, there was no depression in the yield of cucumbers.

In a third competition study, the competition for nutrients between maize and nutgrass was once again clearly demonstrated. In this study, the total weight of green material produced per tray remained constant, irrespective of whether the nutgrass was planted together with, or separated from, the maize. The competition effect was much more severe in the fertilized trays than in the unfertilized trays. The competing action of nutgrass would therefore appear to be closely linked with its response to nitrogen.

In turf plots, there was evidence that high nitrogen dressings had stabilised the turf-nutgrass population balance. Both species were co-existing as a mixed population, unaffected by each other's presence and showing no visual signs of competition. This suggests that, wherever two species may be competing simultaneously for one and the same nutrient, the ultimate suppression of one competitor will, ultimately, depend on its ability to compete for essential nutrients.

A striking morphological feature of nutgrass is the tremendous concentration of roots and rhizomes in the soil. The root weight produced from a given area of nutgrass was approximately three times that of the root material produced by Datura stramonium and Physalis angulata. This high concentration of root and rhizome in the soil, combined with the liberal uptake of nitrogen, are undoubtedly the two principal factors showing clearly the competitive behaviour of nutgrass.

The manner in which plants compete with one another has been the subject of extensive study throughout the world.

The possible role of toxic substances produced by weeds in reducing crop growth has been widely investigated (Sonner 1950; Hörner 1960). Whereas highly concentrated aqueous extracts of dead nutgrass underground fractions were responsible for marked growth inhibition of test seedlings, the results were not always reproducible when reducing the concentration of the plant material or changing the method of preparation. Similarly, leachates, percolates and exudates obtained from living nutgrass plants, or residue of nutgrass, failed to produce any retardation or reduction in the growth of test crops. In fact, there is repeated evidence of a stimulation of seedling growth when treated with several of the extracts and leachates.

Since Osvald's (1942) publication on Agropyron repens, which suggested that toxic root substances by the grass were responsible for the deleterious effects of quackgrass, a large number of publications have appeared which deal with the ecological role of quackgrass in crops. Most of the evidence which has accumulated has been circumstantial (Ohman and Kommedahl 1964), and no-one has isolated and identified chemically any substance that can reproduce the effect of quackgrass. The findings of Ohman and Kommedahl may be applicable in the case of nutgrass, namely, that a greater ability to withdraw available nutrients, especially nitrogen, and to a lesser extent phosphorus and potassium from a nutrient solution, is the deciding factor which explains the highly competitive role of nutgrass in the field.

The recent evidence published by Boshoff (1965) attributes reduced growth of maize and cowpeas which were cultured with C. rotundus in the same water or sand medium to a toxic substance or substances produced by the weed. Boshoff, however, reports that in 3 water culture tests, he obtained an increase in the percentage of N and reduction of percentage P in the maize when the latter was cultured with C. rotundus. In sand cultures the N and P contents of the maize decreased and increased respectively when grown in competition with C. rotundus. Boshoff's technique allowed for the removal of the C. rotundus plants regularly in order to obtain a continuous fresh source of root exudates.

Analysis of C. rotundus in the water medium supporting the two competitors were not reported by Boshoff. Though a postulation at this stage may seem presumptuous, there is some reason to believe that a similar pattern of differential nutrient uptake from the Hoagland solution by the C. rotundus (as already described for quackgrass) is the primary factor responsible for the reduced maize growth.

The response of nutgrass tubers to washing indicates that there is a mechanism responsible for tuber dormancy and confirms the findings of Yumblason (1960). The effect of sowing test crops at staggered intervals after planting of nutgrass tubers shows that there is an initial transitory stimulation which later disappears. Whether this stimulation is in any way associated with the growth inhibitor present in the tuber warrants further investigation.

C. LIFE HISTORY OF NUTGRASS IN RELATION TO ITS CONTROL

If nutgrass is to be effectively controlled or eradicated it is essential to study the two mechanisms of reproduction. The explosive nature of colonisation by means of tubers, rhizomes and daughter plants all serve to emphasise the importance of effective control measures during the primary stages of invasion. Physiological and morphological modifications of the tuber, such as dormancy, multiple bud development, ability to sprout under a wide temperature range, organic reserves, resistance to inoculation and herbicides all contribute towards the survival of nutgrass under adverse conditions. These factors, in conjunction with the resistance of the mature plant to repeated clipping and most herbicides, creates numerous difficulties in the control programme.

In arable fields, nutgrass enjoys a distinct advantage over the seeded field crop. Results have shown that if the nutgrass tuber is exposed to moist conditions it swells and absorbs water readily during the first 48 hours. The vertical rhizome therefore emerges above the soil 5 - 7 days after the first spring rains. Allowing for a lapse of 2 - 3 days, which is necessary to ensure suitable soil preparation, it is clear that the germinating nutgrass will always enjoy a distinct

advantage over the field crop. Soil temperatures during this time are favourable for the sprouting of the tuber. The emergence of nutgrass shoots after the first spring rains is a typical feature of infested arable fields on the Highveld. Where infestations are known to be present, growers should therefore attempt early soil preparation (autumn or winter ploughing) so that seeding may commence as soon as possible after the first rains. Furthermore the sowing of infested sites should be given priority over non-infested sites.

With regard to the control of the underground organs, there appears to be limited susceptible periods in the life history of the plant. The two important considerations are obviously the restriction of daughter tuber formation and the exposure of the plant to insolation. The distribution of tubers is primarily confined to the top 6 inch soil layer, which to some extent simplifies the tillage programme, but the success of the programme will be dependent on judicious timing.

In contrast to the versatile tubers, the climatic requirements of nutgrass seedlings are exacting and their initial survival dependent upon optimal soil moisture conditions. Despite the high seed production, seedlings are not frequently found in infested fields. Their absence may be attributed to several factors, namely, severe intraspecific competition, absence of critical light conditions or possibly a germination inhibitor which may originate from the tuber. On uninfested sites, seedlings will emerge readily and cause initial foci of infestation. Production of 2 - 3 tubers from one seedling within the first year of introduction is sufficient to proliferate an entire arable field within a period of 2 years. The importance of preventing the production of seed and the movement of seed from one site to another irrespective of the mechanism concerned are two factors which deserve attention in the implementation of a control programme.

The dispersal of nutgrass by means of seed appears to have been generally disregarded in most agronomic circles. This attitude appears to have gained considerable support largely due to the germination studies. The results obtained in this investigation confirm the findings of Justice and Whitehead (1946), namely, that the seeds of yellow nutgrass are viable. Alternating temperatures in the presence of light, appear to be a *sine qua non* for germination.

In this respect the results differ from those obtained by Rehn et al. (1962). Depending on the advent of the first spring rains on the Highveld, seeds may be viable by mid summer, i.e. January. Furthermore, the laboratory studies have shown that nutgrass seed tolerates exposure to chilling temperatures over protracted periods and retains its viability for numerous seasons (Ballus 1946). Once introduced the seed is capable of initiating foci of infestation over a period of at least 20 years irrespective of the severity of the winter conditions.

V. CONTROL OF NUTGRASS

1. Tillage

a) Discing

The results of three discing experiments conducted on heavily infested sites, have been reported. In the three trials, repetitive disturbance of the nutgrass stand, ranging from 3 - 5 treatments, gave excellent control of the weed. The benefits accruing from these treatments were particularly noticeable in the season following treatment. Nutgrass populations were reduced to such an extent that crop production could once again be considered. The site and the season obviously play a dominant role in determining the final result.

At Bethal 1 and 2 discings applied to a poorly drained site gave a measure of control which involved no residual benefits. Despite slight reductions in stand following discing, the treatment effect was not persistent and had / disappeared by the following spring. The significant factors for continual discing was, firstly, the temporary disappearance of nutgrass and invasion by annual grasses during the season of treatment and, secondly, the failure of the nutgrass to emerge during the successive spring.

The results at Bapsfontein also illustrated the advantages of early and repetitive treatment. Early disc ploughing followed by summer discings, which were concentrated into the first half of the summer season, restricted new daughter tuber formation, the result of which was an apparent eradication of the weed from the cultivated site.

The discing treatments which were introduced at Frankenwald late in the season, illustrate the importance of commencing the first disturbance prior to the formation of daughter tubers. In this trial, the first discing took place on 6/1/65 when the plants had already reached the 8 - 10 leaf stage.

The final analysis of tuber population at the end of the season showed that in spite of a marked reduction in nutgrass root weight with one discing, tuber populations were not significantly reduced by this treatment. All three discing treatments, however, reduced the nutgrass plant populations in the following spring. In other words, even one discing at Frankenwald had a pronounced influence on the survival of the weed. There appears to be an interaction between frequency of discing and site. Whereas at Frankenwald one or two discings gave extremely good control, the same number of treatments made little impression on the weed population at Bethel. The reasons for this differential response may be associated with three important factors. Firstly, the nutgrass tuber population density per unit area at Bethel was far greater than that of Frankenwald. Secondly, the Bethel site was poorly drained, the soil remaining moist almost throughout the summer season and unsuitable for cultivation after heavy rainfall. Cultivation at any stage was thus not as effective as when applied to a well drained site at Frankenwald. Finally, the first two discings at Bethel were applied to nutgrass plants in a more advanced growth stage.

The point which should be clearly explained is that one and the same programme will not necessarily yield the same results when applied at two different locations or on two fields within the same locality. In order to achieve effective control, careful consideration must be given to edaphic conditions as well as to the physiological stage of development of the plant. Since eradication is intimately associated with the growth stage of the plant, a growth rhythm for a nutgrass plant theoretically growing in the field on the Highveld has been compiled. The chronological sequence and intervals are based on the advent of the first summer rain by the 15th October, followed by a normal pattern of rainfall distribution.

GROWTH AND DEVELOPMENT	INTERVAL IN DAYS	DATE
1. Sprouting	1	16th Oct.
2. Emergence	7	22nd Oct.
3. 4 leaf stage	10	25th Oct.
4. 5 leaf stage	14	29th Oct.
5. 8 leaf stage	17	1st Nov.
7. 10 leaf stage	21	5th Nov.
8. 12 leaf stage	27	11th Nov.
9. 15 leaf stage	38	12th Nov.
10. Inflorescence emerging	42	26th Nov.
11. Inflorescence emerged	46	29th Nov.
12. Flowering	53	7th Dec.
13. Seeding	68	22nd Dec.
Initiation of daughter plants after	21	
Initiation of tubers	30 - 90	

The first tillage operation should preferably commence at the 10 leaf stage (29th October) and should not be delayed until later than the 10 leaf stage (5th November).

The dangers attendant to the late summer or autumn cultivations should be brought to the attention of growers who are often under a false impression that this particular treatment is advantageous from a weed control and soil preparation point of view. Indeed, a disturbance of the nutgrass population, which visually appears to have reached a dormant stage late in the summer, may produce an explosive distribution and fresh emergence of nutgrass shoots during the late autumn, if favourable soil moisture and temperature conditions prevail. In view of the fact that tubers produced during the late summer are dormant (Tumbleason 1960), it is postulated that cultivation at the end of the season disturbs the tubers breaks the dormancy, and results in extensive sprouting. The hazards of this approach were verified in the season subsequent to discing. The severest nutgrass population density was evident on the late summer cultivated plots.

To summarize therefore it is better to leave a nutgrass infestation undisturbed than to attempt a haphazard late summer treatment.

b) Cultural Practices.

The problem of eradicating nutgrass under arable conditions is not a simple one. The most logical approach would be to investigate the life history of the plant in order to establish critical periods at which it is most vulnerable. Accordingly, the eradication studies by means of tillage practices must be governed by the following facts.

- 1) The initiation and production of daughter tubers 3 - 4 weeks after appearance of the vertical rhizome above ground.
- 2) The resistance of tubers to insolation, low temperature and repeated clipping.
- 3) Dormancy and delayed sprouting of newly produced tubers.
- 4) Longevity of the tuber.
- 5) Viability of undersized tubers (2 mm diameter).
- 6) Food reserves and multiple buds in the tuber.
- 7) Extensive production of nutgrass tubers.
- 8) Distribution in the soil.
- 9) The susceptibility of the nutgrass plant to insolation.

From the above it is obvious that any tillage programme which is to be advocated for the eradication of nutgrass, must be based on maximum exposure of the young nutgrass plant and minimum production of daughter tubers. To achieve this, it is recommended that the infested field be disturbed immediately after emergence of the aerial shoots above the ground. Severing of the vertical rhizome below the base of the plant is probably one of the most efficient methods of control. The severed aerial parts of the plant are thus exposed to desiccation and are unable to survive. At this stage, new daughter tubers will not have been formed. Reshooting must commence from the disrupted tuber which, in turn contributes towards the depletion of tuber reserves. Late summer disturbance as already indicated, is fraught with numerous difficulties. Disturbance of the plant at this stage permits shooting from the old tubers, new tubers and from the basal bulb.

Irrespective of the method adopted, one fact emerges from the life history studies, namely, that the initiation and development of new daughter tubers must be avoided at all costs.

Because of its characteristic behaviour and resistance to most external influences, the principal object in any control or eradication programme should be aimed at the reduction and exhaustion of tuber populations. In practice, this means early, shallow and relatively frequent cultivation, preferably every 2 weeks, and when the soil is dry.

The choice of implement also warrants consideration. Tractor-mounted or tractor-drawn cultivators, fitted with sweeps and not vertical tines, may be used effectively for inter-row treatment. Hand hoeing between, or in the row, though not the most efficient, is also an effective method of control. To support this statement it is pertinent to refer to Jirch's findings (1964). The latter reports that shallow hand hoeings were adequate to give good control of yellow nutgrass and other weeds. He found that once the maize had completed its vegetative growth, the shading effect of maize appeared to adversely affect the development of nutgrass. Furthermore, the hand hoeing treatments reduced the nutsedge potential of the soil to such an extent that only isolated nutsedge plants developed rapidly on such areas in the following spring, prior to planting.

The approach of Sellschop and Hattings (1956) is to obtain maximum exposure of the tuber and not maximum disruption of the vertical rhizome. They emphasise that shallow hoeing leaves the root portions undisturbed, thus aggravating the infestation. They advocate that the soil be loosened to a depth of 3 inches, for which hoe with 2½ inch wide tines are the most suitable.

Notwithstanding the recommendation of the above, it is still felt that the severing approach by means of broad sweeps or hand hoeing will, in the long run, be the most efficient method of control. The disadvantages of having to resort to additional draught power to operate sweep instead of tine cultivators, can be overcome by using a disc for the first mechanical operation. Where wide crop spacing is practised, repeated discing will, as has already been discussed, also give excellent control. This method has certain disadvantages. Numerous plants are covered by the operation and new shoots may emerge from the buried basal bulb. In severely infested fields, tuber movement and distribution may

provoke fresh outbreaks. It should be pointed out that all three methods of cultivation will simultaneously control seedlings and obviate seed formation.

The question is often raised as to whether rotavation, which has proved successful for destroying rhizomatous weed species (Fall 1963), could not be employed for eradicating nutgrass. Rotavators furnish segments of $\frac{1}{2}$ inch to 6 inches in length. Such a treatment would fail to exert an influence on the tuber, while the cutting affects on the rhizomes and roots could be as easily achieved with standard farming equipment without embodying the ancillary disadvantages to soil structure.

It is perhaps appropriate to clarify the control programmes suggested by several workers. The recommendations made by Du Praez (1944) and Sellschop and Hettling (1956) - vide Page 22 - do not appear to be satisfactory solutions to the problem. Rheinhold (1942 a) reported that winter ploughing at month intervals increased the infestation level and, furthermore, growth studies have revealed that tubers are already produced when the plant commences flowering.

There is no doubt that both mid-summer discing and winter ploughing contribute to a marked reduction in population density. Whether these two programmes can be regarded as efficient methods of control is somewhat doubtful.

The conclusions of Rheinhold (1942 a) that nutgrass tubers are destroyed by direct sunlight after 5 days or after eight hours exposure to 50°C are somewhat disputable. Dormancy characteristics are peculiar to the tubers of nutgrass. Failure to sprout or a reduction in sprouting is often erroneously regarded as the destruction of the organ. Indeed, had nutgrass tubers been vulnerable to short-term desiccation and insolation, eradication would have been a simple task and the weed would not have reached and maintained its present pest status.

The recommendations of Nes (1951) and Birch (1964) are regarded as being sound, emphasising a judiciously timed control programme which is based on the life history of the plant.

Based on the available information, an attempt has been made to formulate a cultural programme when establishing annual field crops. The recommendations are as follows:-

1. In heavily infested fields it is recommended that planting be delayed until at least two tillage operations at intervals of 2 weeks have been completed. This results in a reduction in plant population density, prevents new tuber formation and permits the sowing of a short-cycle crop, preferably a fodder crop, which would not be subject to severe nutgrass competition during mid-summer.

2. In light or moderately infested fields, wide row crop spacing should be used, e.g. 6' or 7' depending on available equipment. In the case of wide inter row spacing, great care should be given to the plant populations in the row. Nutgrass will generally not grow where it is well shaded. A dense, shade-producing row crop should therefore be sown. The central 3' or 3'6" strip should receive repeated sweep cultivation or disking at the recommended stages and intervals. A late summer cover crop or winter cereal may be introduced on these strips later in the season. The important consideration, however, is that the wide spacing practice be continued during the successive summer seasons ensuring that the crop rows are annually positioned on the previously inter-row cultivated strips.

There is little doubt that nutgrass can be greatly reduced, if not entirely eradicated, by implementing a rigidly controlled cultivation programme which extends over two successive growing seasons. During the first season, the first treatment should commence as soon as possible after emergence of the vertical rhizomes followed by a second or third cultivation at 2-weekly intervals. There is ample evidence to suggest that late summer, autumn, or winter ploughing are potentially dangerous, and are consequently not recommended. Indiscriminate movement of implements from infested fields should also be carefully controlled. The ploughing over of Eragrostis curvula lays invariably precipitates a serious nutgrass problem. A cautious approach is therefore advocated when converting grass leys to arable sites.

2. Grass Leys.

The severe nutgrass infestations which follow the disturbance of an Eragrostis curvula grass ley pose certain questions. The questions are prompted by the fact that on infested sites, nutgrass is visually absent during the period of grass ley occupation.

This is by no means an isolated case and the problem is one that has been repeatedly observed throughout the Highveld where *Eragrostis* lays are established and finally brought back to annual cropping. The most striking feature of such disturbed grass lays is the serious infestation level reached shortly after the advent of the first spring rains. The situation is further complicated by the fact that the vertical rhizomes, when infested, originate from young tubers. The short interval between the onset of the first spring rains and the widespread emergence of the nutgrass shoots rules out any possibility of tubers having originated from current, early season seedlings. From the seedling studies it is apparent that tubers are not produced during the first ten weeks after emergence.

According to Rahn et al (1962) tubers completely lose their viability when buried for periods exceeding 13 - 22 months in Delaware, U.S.A., but at Cornell and Rhode Island observations suggest that some tubers remained viable in the soil for more than two years. Sprouting tests with tubers stored for 4 years in the laboratory at Frankenwald confirmed that tubers did not lose their viability during this period, giving a sprouting percentage of 44%. Laboratory results in this respect are not necessarily applicable to field conditions. Under field conditions, microbial and fungal pressure, exposure to low, fluctuating temperatures could accelerate tuber decomposition, thus influencing longevity. The source of the tuber infestation in newly disturbed *Eragrostis curvula* lays is thus not explicable and warrants further investigation. It appears that the source of rehabilitation originates from a quiescent tuber population. Growers in the Highveld constantly report that when heavily fertilized *Eragrostis* lays are ploughed over, the site is overrun by nutgrass which, within one season, once again reaches epidemic proportions. Apart from the rehabilitative advantages of a grass lay, the additional benefits, namely, the suppression of noxious weed problems is, in fact, lost and in many cases the weed situation is aggravated. The smothering action which the grass lay exerts over nutgrass in the summer following establishment is thus nullified when the grass lay is ploughed over. The above situation is further complicated by the fact that with the disturbance of a grass lay and the attendant soil mineralisation, active growth of the nutgrass is promoted.

This indeed was borne out by the vigorous growth and development of nutgrass plants and tubers on a former *Eragrostis* nursery site at Frankenwald during the first season after cultivation.

Current thought on the rehabilitation of low producing arable fields, centres around *Eragrostis curvula*. The advantages of this practice are unquestionable. It is, however, only appropriate to emphasise some of the definite hazards which the grower must ultimately face when the ley is ploughed over. Although it may not be possible at this stage to offer a suitable explanation in respect of the process of reinvasion, it would appear that the disturbance of *Eragrostis curvula* leys does bring about in its wake certain disadvantages which could readily outweigh the benefits of grass ley.

It is also pertinent to draw attention to the case histories of the two adjacent camps ^(see also) ~~(page 200)~~ which were used to illustrate the problem of

^(page 200).
spreading of nutgrass populations. In recent months, the camps have undergone considerable change. Both camps have been linked by common contour lines. Cultivation is carried out simultaneously across both camps in one direction. The cultivated site which, after 7 years of cultivation - had been free of nutgrass, is once again severely infested. It was obvious that tubers had been transported from the infested camp by means of mechanical cultivation.

3. Smother Crops.

The use of smother crops such as tefl has been widely recommended as an effective method of controlling nutgrass. This belief stems mainly from the fact that tefl sown in nutgrass infested sites, will ultimately suppress the nutgrass and give a false smothering impression. The concensus of opinion among growers is that tefl is the most suitable crop for this purpose. Thurston (1960) states that most weedy species germinate at a definite time of the year and Bunting (1960) reports that in regions of seasonal growth, many weed species are able to establish, grow and even reproduce in the early spring. The seasonal aspects and growth rhythm of nutgrass have already been described in detail.

At the beginning of the season, nutgrass emerges very rapidly excluding and smothering the teff. Gradually, the teff makes its appearance, overhadowing the nutgrass, the latter fading into obscurity by the time the teff is ready for harvesting. Teff height is a function of the prevailing seasonal soil moisture conditions. In a favourable season, the teff will overhadow the nutgrass. In a poor season, however, height differences are not pronounced, which results in the simultaneous harvesting of nutgrass and teff seed. The biggest disadvantage of broadcasting another crops in nutgrass infested sites is the fact that production of fresh daughter tubers can take place before the another crop is capable of exercising a suppressive influence on the nutgrass. In a normal season, the rate of emergence and growth of nutgrass is so rapid that the another crop can only exercise a delayed influence. Growers would ~~then~~ be better advised to apply mechanical cultivation to infested sites than to resort to broadcasting inefficient another crops.

4. Biological Control.

The evidence obtained from local collections and those of overseas workers suggest that some advantages could be derived from certain insects and fungi which are known to attack nutgrass. The latter appears to attack the plant only in the post flowering stage and would thus have limited application in an integrated biological control programme. Furthermore, its specificity has not been determined.

The introduction of certain entomophagous pests, specific to nutgrass (Poiner 1964) certainly merits further investigation. A more detailed examination of local material is indeed warranted. According to Doethuizen (1964) the main objective of biological control is that it is not aimed at complete eradication, but the reduction of an undesirable species to such an insignificant level that its presence is no longer of any moment. This presupposes that a programme of control and not of eradication should be aimed at, which in the case of nutgrass would not be desirable.

5. Chemical Control.

Compared with most annual weeds appearing in arable fields throughout South Africa, nutgrass appears to be remarkably resistant to most chemicals, the degree of resistance being especially noticeable

towards the standard rates, or rates considered to be economic, for obtaining satisfactory control. Whilst in numerous cases, the initial control achieved with herbicides was very promising, residual herbicide action was particularly lacking when treating dense stands invading low lying or poorly drained sites.

Of the few promising treatments, the chemical or the rate in question was such as to necessitate automatic preclusion from a selective spray programme on the Highveld. A case in point is bromacil which, of all the compounds tested, was the only chemical to give a degree of control which could be regarded as satisfactory. Because of its persistent qualities and high level of toxicity to most annual crops, bromacil cannot be considered for the Highveld.

From the experimental evidence obtained in this study, it is clear that a distinction should be made between light, moderate or severe nutgrass infestation levels. Secondly, it is necessary to differentiate between retardation (i.e. foliage or initial top kill), control and eradication. When assessing the value of a particular treatment with a particular herbicide, final judgment should not depend entirely on effectiveness of the top kill even though this may be striking, or on observations concerning toxicity to the crop even though they may be absent. In the case of nutgrass the true picture can only be fully understood after a thorough examination of the attached and unattached underground fractions of the treated plants has been completed. The ultimate success of the compound will depend on its effect on... the dormant tuber population.

An obvious inference from the results obtained in the various investigations is that the different compounds or compound mixtures influence the nutgrass plants in varying degrees. Not only does the mode of action and phytotoxic symptomatology differ markedly, but there is a remarkable divergence in the duration of herbicidal effects. Whilst many herbicidal combinations may give excellent control of the top growth which may or may not lead to systemic die back of the affected plant, these chemicals or mixtures will not necessarily keep the treated site free from nutgrass.

a) Non-selective control.

Based on the present findings, it is possible to classify the herbicides or herbicidal mixtures into various categories. This classification reflects initial and residual toxicity to nutgrass when applied as post-emergence treatments on heavily infested sites. The herbicidal treatments have been inserted into their specific categories when showing rating values of 8 or more for the prescribed periods. Rates are all expressed as active material per acre.

1) Initial kill.

Only the aerial parts of the plants are affected. Depending on the chemical, re-shooting may occur within a short interval after treatment.

- | | |
|------------------|------------------------|
| 1. Paraquat | 1.5 lbs |
| 2. Alachlor | 5.52 lbs and 11.4 lbs. |
| 3. PCP 5% in oil | 5 gallons |

2) Initial + moderate residual plant kill. Residual effect on the treated plants.
persisting for at least 21 days.

1. Paraquat, 1 lb and 1.5 lbs + surfactant
2. Amitrole 4.8 lbs + dalapon 15 lbs.
3. Paraquat 1.5 lbs + diuron 4 lbs + surfactant.
4. Paraquat 1.5 lbs + monolinuron 2.5 lbs + surfactant.
5. Paraquat 1.5 lbs + linuron 2.5 lbs + surfactant.
6. Amitrole 9.6 lbs + atrazine 4 lbs.
7. Amitrole 9.6 lbs + monolinuron 2.5 lbs.
8. Amitrole 9.6 lbs + linuron 2.5 lbs.
9. Amitrole 9.6 lbs.

3. Initial + residual kill + moderate soil persistence.

Residual effect on the treated plant and persistence in the soil for at least 10 weeks.

- | | |
|--------------|---------|
| 1. TCN | 100 lbs |
| 2. Dalapon | 40 lbs |
| 3. "Triuron" | 100 lbs |

4. Residual plant kill + excellent soil persistence

Residual effect on the treated plants and the persistence in the soil for at least 4 weeks.

1. Bromacil 6.4 lbs
2. Bromacil 6.4 lbs + Amitrole 4.8 lbs
3. Double sprays of (a) Bromacil 3.2 lbs
(b) Dalapon 40 lbs.

(c) Paraquat 1.5 lbs + diuron 4 lbs + surfactant.

a) Non-selective control.

Based on the present findings, it is possible to classify the herbicides or herbicidal mixtures into various categories. This classification reflects initial and residual toxicity to outgrass when applied as post-emergence treatments on heavily infested sites. The herbicidal treatments have been inserted into their specific categories when showing rating values of 8 or more for the prescribed periods. Rates are all expressed as active material per acre.

1) Initial kill.

Only the aerial parts of the plants are affected. Depending on the chemical, re-shooting may occur within a short interval after treatment.

1. Paraquat 1.5 lbs
2. Linoseb 5.52 lbs and 11.4 lbs.
3. PCP 5% in oil 5 gallons

2) Initial + moderate residual plant kill. Residual effect on the treated plant.

persisting for at least 21 days.

1. Paraquat, 1 lb and 1.5 lbs + surfactant
2. Amitrole 4.6 lbs + dalapon 15 lbs.
3. Paraquat 1.5 lbs + diuron 4 lbs + surfactant.
4. Paraquat 1.5 lbs + monolinuron 2.5 lbs + surfactant.
5. Paraquat 1.5 lbs + linuron 2.5 lbs + surfactant.
6. Amitrole 9.6 lbs + atrazine 4 lbs.
7. Amitrole 9.6 lbs + monolinuron 2.5 lbs.
8. Amitrole 9.6 lbs + linuron 2.5 lbs.
9. Amitrole 9.6 lbs.

3. Initial + residual kill + moderate soil persistence.

Residual effect on the treated plant and persistence in the soil for at least 10 weeks.

1. TCA 100 lbs
2. Dalapon 40 lbs
3. "Triuron" 100 lbs

4. Residual plant kill + excellent soil persistence

Residual effect on the treated plants and the persistence in the soil for at least 4 weeks.

1. Bromacil 6.4 lbs
2. Bromacil 6.4 lbs + Amitrole .8 lbs
3. Double sprays of (a) Bromacil 3.2 lbs
(b) Dalapon 40 lbs.

(c) Paraquat 1.5 lbs + diuron 4 lbs + surfactant.

From the above classification, it is evident that the most effective compounds or mixtures are those which include a soil acting herbicide which prevents the resprouting of mother tubers, the sprouting of dormant tubers and the production of new daughter tubers. Because of their restricted selectivity most of these soil acting herbicides are not suited for use in the production of annual crops in the Highlands Region.

From the foregoing list, however, it is possible to extract chemical treatments with short residual effects, e.g. amino triazole, paraquat and linuron. These could be used as chemical summer fallow treatments on heavily infested sites. These chemicals have a short residual action, they are known to degrade very rapidly in the soil and could be employed during the first half of the growing season for controlling nutgrass infestations on sites destined for teff production. Donnelly and Rahn (1961) and Hill et al. (1962) have shown that amino triazole is translocated acro- and basipetal, in nutgrass, and that the seed germination is significantly reduced following application. In the same way ^{as} staggered cultivations have been suggested for efficient tillage programmes split herbicidal applications would prove to be far more beneficial than a single spray of a persistent chemical.

The most obvious method of controlling nutgrass would be to toxicify the tubers. These as Rahn et al. (1962) have found, resist chemical treatment. While uptake of herbicide during the initial growth stages presents a weak link in the plant, the ability of the tuber in its dormant stage to withstand herbicidal applications renders the complete eradication of nutgrass an impossible task.

b) Selective control.

The ideal herbicide for controlling nutgrass in arable crops would be an inexpensive compound which is effective under a wide range of soil moisture conditions and controlling not only nutgrasses, but other annual weeds as well. The recent introduction of EPTC into the potato industry (Vleser¹⁹⁶⁴) has made possible the selective control of nutgrass and annual grasses without any deleterious effect to the crop. On maize selective control of nutgrass is possible but certain modifications in the planting technique and careful supervision are necessary to prevent injury to the crop. Where heavy infestations occur, growers would still enjoy tremendous benefits from EPTC applications despite the attendant hazards. The relatively high cost and difficulties associated in application have militated to some extent against the general use of EPTC.

The current extensive usage of triazine derivatives in the maize growing areas has met with great success in regard to the control of annual weeds. The results on nutgrass are somewhat conflicting and deserve further consideration. The results reported by American workers concerning the efficacy of triazine against nutgrass have not been confirmed in South Africa. Most of the overseas trials appear to have been conducted on loam sands which may account for greater herbicidal movement. In South Africa, the efficacy of atrazine against nutgrass appears to be confined mainly to sandy and loess soils. To obtain satisfactory control of nutgrass with atrazine, a rate of 4 lbs per acre is necessary (Santelman and Meade 1962). Atrazine at rates of 2 lbs per acre has been shown to preclude the growing of all crops but maize or sorghum, and its usage must therefore be confined to areas where continuous production of maize or sorghum takes place. At present the use of atrazine and simazine in maize in the U.S.A does not permit the planting of any crop but corn during the season of treatment or the following season

(Anon; 1965).

The residues of several soil acting herbicides such as monoluron, monuron and TCA as measured in terms of plant response, while not conclusive, suggest a rapid deterioration of monoluron in a loamsoil at Bupefontein. The detoxification rate appears to be fairly rapid. The results demonstrated that certain crops such as beans and maize may be planted within a short period after spraying of high herbicidal concentrations. These results also confirm the findings of Danielson (1956) with regard to crop toxicity period of monuron, and illustrate that under high ultra violet irradiation, a feature of the Highveld Region's summer climate, rapid photochemical degradation of substitute urea and triazine derivatives may be expected (Jordan et al. 1964 and Combs and Timmons 1965). Generally, the use of pre-planting treatments necessitate fairly high rates of application, rendering the treatment uneconomical. From an agronomic and economic point of view, judicious tillage, followed by a single spray of a short residual herbicide, would probably be far more beneficial than a single preplanting treatment.

In recent years, the application of directed band sprays in row crops has enjoyed considerable interest in the U.S.A, particularly when conditions were unfavourable for pre-emergence spraying, where the weed flora, e.g. nutgrass shows resistance to pre-emergence treatments or where the pre-emergence treatment had failed.

The incorporation of surfactants in the herbicidal spray has greatly enhanced the efficacy of the treatment and, in some cases, made possible the control of species which are normally resistant to the same chemical when applied pre-emergence. A good example is that of linuron which, if used pre-emergence on maize, exerts little effect against nutgrass at the recommended dosages (1 lb - .2 lb a.i per acre). When applied in conjunction with a surfactant as a directed spray, nutgrass can be controlled. Shear (1965) found that apart from the top kill, an application of linuron (1.5 lbs a.i per acre) resulted in reduced numbers of tubers and reduced viability. Excellent selective control in maize with 2 lbs linuron + surfactant has been reported by Habbethwaite (1965).

The use of directed spraying permits control of the nutgrass in crop rows. Successful application is dependent on the availability of suitable spray apparatus, especially where soil topography is irregular and a height differential exists between the maize and nutgrass.

To avoid phytotoxicity to the maize, it is essential to direct the spray under the maize leaves at the base of the plant and ensure that no spray be deposited on the upper foliage or in the funnel. Bottom leaves which are sprayed will ultimately become necrotic but will not retard the growth of the maize plant.

As previously stated, high ultra violet irradiation, particularly during the summer months, is a contributing factor to herbicidal degradation. Photochemical decomposition of linuron is considerably reduced by applying the herbicide some 4 weeks after sowing, thereby extending the longevity of herbicidal control up and until the crop canopy stage. From this stage onwards, shading will reduce or exclude weed competition, particularly under conditions of high plant populations and nutrient supply.

Contact herbicides such as dincoseb, PCP and perquat may also be considered for directed row spraying in maize. These chemicals tend to produce severe phytotoxicity and their use in grain crops is therefore not recommended.

Hormone regulator herbicides are seldom, if ever, used pre-emergence for control of nutgrass in maize. Despite the shortcomings of MCPA and 2,4-D under adverse soil moisture conditions, both chemicals exercise a degree of inhibition and retard the growth of nutgrasses when applied at relatively high rates in a moist seedbed.

A number of selective herbicides which show varying degrees of toxicity to nutgrasses, have made their appearance in recent years. The choice of chemical and the method of application will depend mainly on prevailing climatic and soil conditions. At present, all the promising treatments possess certain disadvantages and involve certain restrictive usage or specialised methods of application. They do, however, offer the grower a means of utilising moderately or lightly infested nutgrass sites for crop production. The use of selective treatments on heavily infested areas is not advocated before the necessary cultural or chemical

control measures, as listed earlier, have been successfully applied.

Selective control of nutgrass in turf remains a problem deserving further investigation. Either the selectivity or the residual effect appears to be lacking in most chemicals (Fisher and MacIntosh 1957). With the exception of hormone type herbicides, no herbicide was found which offered a suitable selective control. Atrazine is well tolerated by most turf species and may be a future candidate for this type of problem on sandy soil. Repeated sprays of high concentrations of 2,4-D and MCPA are well tolerated by turf, giving excellent suppression of nutgrass and controlling a wide spectrum of most troublesome broadleaf and annual grasses. From an economic point of view, this treatment is extremely low in price.

The use of EPTC as a pre-planting treatment in turf does not appear to be safe, even where planting is delayed after treatment.

The application of EPTC to disturbed turf swards where sods are being periodically removed, appears to hold out considerable promise against invading nutgrass.

3. DISPERSAL AND DISSEMINATION OF C. ESCULENTUS.

A knowledge of the manner of reproduction of weeds and of the agencies responsible for dispersal, forms a basis for the prevention of this introduction and the spread, (Crafts and Robbins 1952). By means of efficient dispersal or dormancy, weed species are able to invade and colonize new areas at a distance and persist through acts of cultivation or weed control, although the seed output from any given year may be destroyed (Harper 1960). Furthermore, there is a close relationship between the seeds of certain weeds and the kind of crop in which they occur (Wellington 1960).

Sellechop and Hattingh (1956) have indicated that the dispersal of nutgrass results principally from the use of nutgrass contaminated turf seed. The authors are of the opinion that because of the hard varnish-like cover, nutgrass seed germinates gradually over a number of years and as a confirmation they quote the results of Rheinhold's (1942) studies on the acid treatment of nutgrass seed. Mac (1951) also attributed the lack of germination to the hard seed coat.

control measures, as listed earlier, have been successfully applied.

Selective control of nutgrass in turf remains a problem deserving further investigation. Either the selectivity or the residual effect appears to be lacking in most chemicals (Fisher and Deshields 1957). With the exception of hormone type herbicides, no herbicide was found which offered a suitable selective control. Atrazine is well tolerated by most turf species and may be a future candidate for this type of problem on sandy soil. Repeated sprays of high concentrations of 2,4-D and MCPA are well tolerated by turf, giving excellent suppression of nutgrass and control of a wide spectrum of most troublesome broadleaf and annual grasses. From an economic point of view, this treatment is extremely low in price.

The use of EPTC as a pre-planting treatment in turf does not appear to be safe, even where planting is delayed after treatment.

The application of EPTC to disturbed turf wards where sands are being periodically removed, appears to hold out considerable promise against invading nutgrass.

3. DISPERSAL AND DISSEMINATION OF C. ESCULENTUS.

A knowledge of the manner of reproduction of weeds and of the agencies responsible for dispersal, forms a basis for the prevention of this introduction and the spread, (Crefts and Robbins 1952). By means of efficient dispersal or dormancy, weed species are able to invade and colonize new areas at a distance and persist through acts of cultivation or weed control, although the seed output from any given year may be destroyed (Harper 1960). Furthermore, there is a close relationship between the seeds of certain weeds and the kind of crop in which they occur (Wellington 1960).

Schachop and Hattingh (1956) have indicated that the dispersal of nutgrass results principally from the use of nutgrass contaminated turf seed. The author holds the opinion that because of the hard varnish-like cover, nutgrass seed germinates gradually over a number of years and as a confirmation they quote the results of Rheinhold's (1942) studies on the acid treatment of nutgrass seed. Mas (1951) also attributed the lack of germination to the hard seed coat.

The present Seed Purity Act prohibits the sale of teff seed containing a total of more than 50 weed seeds per 1 oz of teff seed. Because Rheinhold (1942 a) and Hae (1951) failed to obtain nutgrass seed germination, it was postulated that the sale of nutgrass-contaminated teff seed did not contribute an agronomic hazard. From the evidence presented in Appendix Table 20 and Figure 32 it is quite apparent that most of the teff seed samples submitted to the Seed Testing Station of the Department of Agriculture are infested with nutgrass seed. The analysis of the data accumulated over three years revealed that in regard to nutgrass seed contamination, 42 percent of the teff seed samples submitted for approval contained more than the permissible contamination level. It is therefore quite inexplicable that the regulations governing the purity of teff seed were officially reduced during 1964/65. Due to a temporary shortage of "clean" teff seed, the permissible contamination level was increased from 50 to 500 weed seeds per 1 oz of teff seed sample. The implications of reduced standards of seed purity are fairly obvious, influencing the rate of dispersal and extending the zones of infestation. On the other hand the leniency with regard to the reduced purity standards may have been influenced by the information previously available. Firstly, it was generally accepted that nutgrass seed was not viable, no distinction being made between the relative viability of C. esculentus and C. rotundus. Secondly, germination of C. esculentus could only be achieved by means of a drastic acid treatment and, thirdly, the scarcity of nutgrass seedlings in the field was employed as evidence to verify low seed viability.

Another salient feature emerging from the analysis of the Seed Testing Station's records was the fact that most of the teff seed which was either contaminated or rejected, principally originated from specific areas or districts. In other words, most of the areas which are currently employed for the production of teff seed are completely unsuitable. There is an urgent need to carefully examine and reconsider the entire system of teff production in South Africa, and to explore the possibilities of producing pure teff seed in select areas. The latter would have to conform to specific requirements and the production confined to fields where nutgrass infestation is either non-existent, where weed population

density levels are low and where stringent field inspection is maintained. It should be borne in mind that the major percentage of teff seed marketed in the Republic passes directly from the seed producer to the commercial grower without any seed certification.

From the evidence presented in Chapter VIII there is little doubt that the cultivation of teff is the mechanism of introduction and dispersal of nutgrass in the eastern sections of the Highveld. The conditions necessary for the successful establishment are:-

- a) A high potential sowing rate;
- b) early maturation of the nutgrass seed prior to harvesting of the companion crop;
- c) dormancy and longevity of the seed;
- d) Adaptation of seedling and mature plant to the prevailing environmental conditions.

In the case of nutgrass it is not essential to have available a continual source of seed inoculum. The longevity (Sallow 1946)

as well as the dormancy of seed, permit extended survival of the seed. The sensitivity of the seedling during the early stages to adverse weather conditions is more than compensated for by the rate of proliferation from tubers and the rapid distribution by means of mechanical implements. While it is impossible to achieve complete eradication of every nutgrass site, it is generally agreed that the elimination of the source of inoculum will be in the greatest interests of the entire agricultural community. It is perhaps advisable to reiterate the findings of Justice and Whitehead (1946), which are confirmed by the present experimental data, namely, that one inflorescence is able to furnish the equivalent of 1521 seedlings. It is therefore recommended that the permissible contamination level of teff seed should be drastically reduced and a more stringent legislation enforced.

The Standerton District, renowned as one of the worst nutgrass infested areas, presents a unique problem. The district is responsible for the production of 45.9% of the teff seed crop in South Africa. In common with that of many milk producing reservoirs for the Witwatersrand complex, the milk industry in this district has developed a marked degree of specialisation. Fodder production has therefore assumed considerable

prominence in this type of agriculture. Due to limitations imposed by soil, topography and altitude, the agriculture of these areas is necessarily restricted in variety. Maize predominates as the principal cultivated crop. The practice has been to introduce teff either as a rapid catch crop following an early summer season potato crop, where residual fertilizer benefits are utilized, or on sites which have suffered crop losses earlier in the season. Though teff is often sown prior to 1st-December, the majority of plantings are confined to the second half of the season.

A further aggravating feature of the teff seed industry is that not much effort has been made to implement sound cultural practices or to introduce a systematic seed cleaning programme. Precautionary measures such as early summer tillage, selection of non-infested fields, utilising the first cut for fodder and the second for seed are not common practice. (1957)

Dr Plooy/states that if teff seed is to be harvested, every possible precaution should be taken to eradicate nutgrass (wintjies) before the teff seed is sown, as teff and nutgrass seed are difficult to separate. Generally, growers are reluctant to utilize second cuts for seed purposes because of the lower yields. Where teff is sown on nutgrass-infested sites, mature nutgrass seed is available two months after the tuber has sprouted. If no precautions are taken to reduce the nutgrass infestation as is often the case on the heavy, black turfs in Standerton, teff seed produced from the first cut will be severely infested.

Similarly, the introduction of selective hormone type herbicides in maize, e.g. 2,4-D and MCPA approximately 10 years ago has also aggravated the problem. By selectively eliminating or reducing annual weed competition, the spread of nutgrass has been promoted.

Although many weed seeds are destroyed in passing through animals and more are destroyed by storage in manure, still a considerable number of viable weed seeds may reach the field (Draffs and Robins 1952). In the case of nutgrass the hard seedcoat would probably act as a protectant, and it is postulated that digestive acids might reduce dormancy and enhance germination. Dispersal by means of animals is more restricted than the movement of contaminated seed.

They nonetheless represent a further link in ensuring distribution especially on one and the same farm.

The development of techniques for removing weed seeds from agricultural seed has lagged behind the development of methods for eradicating the plants themselves (Wellington 1960). In recent years several local co-operatives and seed merchants have installed seed cleansing machinery, capable of separating teff and nutgrass seed very efficiently. The unit, known as the "Kipp Kelly", fitted with a canvas deck, is alleged to deliver teff seed free from weeds and may prove to be a valuable tool in confining the future spread of nutgrass seed.

During normal seasons, nutgrass produces seed of uniform size. During drought periods, however, the nutgrass seeds are of irregular size and the teff growth is retarded. Teff and nutgrass seed are thus harvested simultaneously making seed separation difficult. The Kipp Kelly unit, however, appears to be able to cope with all the situations.

The economic eradication of nutgrass over an extended area is a problem which has not yet been solved and which does not appear possible of solution. However, in recent years, ^{that} ~~no~~ means of control and even eradication have become available. It would appear ^{that} the implementation of control measures are the best approach in the production of weed-free teff seed. In order to implement such a scheme, the following is advocated:-

1. Elimination of nutgrass in the field prior to seeding. Pre-treatment of the soil by means of tillage or with a short residual herbicide.
2. Appointment of certified teff seed producers who will receive premiums on their certified seed. Such growers to sow the first cut early before the nutgrass seed has matured, and utilise only second cuts for seed production.
3. Raising of the weed contamination standards for teff seed. For example an arbitrary figure of no more than 10 - 20 nutgrass seeds per ounce of teff seed.

4. Stringent sanitary field inspection.
5. Restrict by law the sale of uncertified tef seed by unauthorized growers.
6. Confine the production of tef seed to those areas where nutgrass infestation is of a low level.
7. Explain and bring to the notice of tef producers the seriousness of the pest and emphasize the urgency of material control.

C. DISTRIBUTION OF CYPERUS ROTUNDUS

Having defined the nutgrass infested areas of South Africa, and postulated a tentative reason for the specific distribution of C. rotundus, the question which poses itself is why the absence of C. rotundus in the high rainfall areas of the Highveld? C. rotundus, by nature of its greater ramified underground system would, at a first glance appear to be more resistant to adverse conditions, and should therefore have readily established itself on the Highveld. Day and Russell (1935) have shown that despite a larger and more robust tuber, C. rotundus is more tolerant of desiccating conditions than C. rotundus. In California, both species are known to occur, while on the Natal sugar belt both species often occur simultaneously in the same field with some evidence of seasonal aspect. Generally, there appears to be a tendency for C. rotundus to assume the dominant role.

On the Highveld, C. rotundus is conspicuous by its absence and occurs in very isolated cases. Where C. rotundus occurs on the Highveld, its presence is usually linked with infested manure or planting material. According to Sellschop and Hettingh (1956), C. rotundus is found principally on irrigated lands and on the dry lands in areas with an annual rainfall of 20 - 25 inches.

Jaier (1953), summarizing the temperature distribution of the Highveld Region, points out that the lowest maxima occur in the south and over part of Harrismith and Bethlehem districts, and the highest maxima in an area which extends from the Potchefstroom district to the western border of the Highveld Region. An examination of the relevant temperatures of each sub-region for the period September till January reveal the following:-

	Mean Maxima	Mean Minima	Mean Highest Maxima
Eastern Free State	21.7 - 27.2°C	5.1 - 13.0°C	32.1°C
Eastern Highveld	23.5 - 27.2°C	4.8 - 13.2°C	32.2°C
N.W. Free State	24.2 - 30.3°C	6.3 - 15.6°C	35.6°C
N.W. Transvaal	25.1 - 29.8°C	7.1 - 15.7°C	34.3°C

From a temperature point of view there does not appear to be marked differences between the four sub-regions. Conditions in the eastern half of the Highveld are theoretically well suited for the growth and development of C. rotundus.

Tests carried out by Justice and Whitehead (1946) proved that 4.77 inflorescences would be required to yield a single seedling, (compare yellow nutgrass with 1 inflorescence capable of producing 1521 seedlings). From a total of 13,430 heavy seeds, they obtained a mere 4.12 percent normal and 1.69 percent abnormal seedlings. C. rotundus therefore propagates essentially by means of tubers. Seed dispersal is therefore practically of no significance.

Although tefl may be grown throughout the summer rainfall area, it does best in the cooler districts and in those areas having a well distributed rainfall. The young tefl plants are readily scorched by the sun where protracted dry periods are the rule (Du Plooy 1957). It is therefore quite plausible to suggest that the eastern Highveld has been protected against the widespread invasion of C. rotundus principally because this species fails to set viable seed.

F. UTILIZATION OF NUTGRASS.

It has been suggested that an efficient and well adapted weed may find itself taken up and converted into a crop. (Sunting 1960). Indeed there appears to be sufficient data available to reflect on the potential usages of nutgrass, especially in certain areas where eradication is practically impossible or uneconomical. Such sites, low-lying or poorly drained, are generally not suitable for arable purposes.

provided the necessary precautions are taken to prevent seeding and mechanical transmission, there appears to be a strong case in favour of utilizing well fertilized nutgrass pastures.

In view of the fact that C. esculentus is able to maintain a high level of herbage, and that frequently clipped herbage (10 times per season), contains an average of 15.4 percent protein, it becomes apparent that C. esculentus is well suited for a pasture programme. Further studies in respect of palatability, tolerance to grazing pressure etc., warrant further investigation.

SUMMARY

1. Cyperus seculentus (nutgrass) is an indigenous species which has extensively invaded and proliferated the most valuable arable land within the Highveld Region of South Africa. The origin and present distribution of C. seculentus in South Africa has been described, and the literature relevant to the medicinal, nutritional and economic uses of this species has been summarized.
2. The identification of, and differentiation between C. seculentus and C. rotundus, have been listed and illustrated. The life history of C. seculentus has been described in detail and a study made of its growth and spread.
3. Literature relevant to the morphology, physiology, as well as the cultural, chemical and biological methods of control has been reviewed. The evidence on the ecological significance of toxic substances in the competition between higher plants has also been included.
4. Methods and materials employed in the study have been described in detail.
5. The influence of fertilizer on the growth of nutgrass, revealed a positive nitrogen and phosphate response. A highly positive correlation was obtained between the results obtained from field and pot experiments.
6. Of the nitrogen carriers tested, urea gave the highest yields. Nutgrass growth was not depressed when fertilized with high dressings of urea.
7. On old established turf plots at Frankensvald, the turf and nutgrass grew more vigorously on the fertilized than on the unfertilized plots, despite a sharp decline in soil pH.
8. Changes in the soil pH or nutrient level by means of heavy dressings of ammonium sulphate or lime, failed to depress the growth of nutgrass. Lime (calcium hydroxide or calcium carbonate) exerted no influence, whereas nitrogen increased the growth.
9. Alternating temperatures in the presence of light, sulphuric acid treatment and abscisic acid, exercised a pronounced influence on the germination of nutgrass seed. Chilling of the seed had no deleterious effect on germination.
10. A seasonal effect on germination was established. In a normal season, mature seed was available at the beginning of January.

11. The production of seed per umbel was established and the presence of seedlings in arable fields investigated.
12. An examination of several hundred tuff seed samples revealed that a high percentage were heavily contaminated with nutgrass seed.
13. An analysis of the principal tuff producing areas, confirmed a striking similarity in the pattern of distribution between the former and the nutgrass infested areas of South Africa. The cultivation of tuff appears to be mainly responsible for the introduction and dispersal of nutgrass in the western sub-regions of the Highveld. A suggested pathway for the introduction and dispersal of nutgrass seed has been compiled.
14. An investigation of nutgrass tubers, showed that the tubers were present in large numbers, confined principally to the top 6 inch layer of soil, sprouted from specific depths under a wide temperature range. Washing and inoculation of the tubers had a pronounced influence on the sprouting of the tuber.
15. In the presence of adequate fertilizer, nutgrass plants showed exceptional tolerance to frequent clipping, yielding herbage of remarkably high quality. Sprouted tubers were capable of resprouting repeatedly if the vertical rhizome was clipped back.
16. Inoculation of the plant reduced the vigour of the exposed plants.
17. Competition studies revealed that when heavy dressings of fertilizer were applied to a mixed population of nutgrass and maize, the nutgrass utilized the nutrients more efficiently than the maize. The competitive effect of nutgrass was largely offset by altering the nutrient status of the soil.
18. The seasonal water consumption of nutgrass was not significantly higher than an equal number of annual weeds. Where the weeds were grown in conjunction with maize, the total water uptake of the unit (weed and maize) remained constant, irrespective of the weed species. In both moisture studies, however, the underground weight of nutgrass was comparatively heavier than that of the two weed species.
19. The investigations designed to examine whether the living nutgrass liberates a physiologically active toxin capable of inhibiting germination or retarding growth, produced negative results. Growth suppression was, however, obtained with aqueous extracts and homogenates depending on the concentration and method of preparation. A growth stimulation of a transitory nature was observed when germinating seeds, together with nutgrass tubers.

20. Diecing proved to be an efficient method of controlling nutgrass, the degree of control being dependant on the time of treatment and the particular nature of the site.
21. Biological control by means of entomophagous insects deserves further investigation.
22. Of the wide range of herbicides tested, several gave excellent control, but persistence was lacking in most of the chemicals. Bromacil was one of the most promising compounds tested but, because of its extended residual action, cannot be considered for the Highveld Region.
23. Of the selective control measures tested in arable crops, contact herbicides gave a very short residual effect, whereas high dosages of pre-planting herbicidal treatments appear to be uneconomical. Directed sprays containing linuron plus surfactant, showed considerable promise. In turf, repeated applications of hormone herbicides gave the most economical and satisfactory control.
24. From the ecological studies undertaken at Frankenseld, it would appear that nutgrass is confined solely to the early stages of succession, and in disturbed areas within plant communities higher in the succession. Sprouted nutgrass tubers were, however, able to grow and develop in soils removed from sites representing the advanced stages of succession.
25. The significance of the results has been discussed in relation to the present findings and those reported by previous workers.

ACKNOWLEDGMENTS.

The author wishes to express his sincere appreciation to Mr. T.E.Clark, Managing Director of Hoochat S.A (Pty) Ltd. for his kind permission to undertake and complete certain phases of the investigation.

Grateful thanks are expressed to Mr.G.Hyam of Messrs. African Explosives and Chemical Industries, Ltd. for his invaluable assistance and co-operation in respect of statistical and chemical analyses, as well as for granting certain experimental facilities at the Kynoch-Capex Experimental Station at Bapafontein. The writer is equally indebted to Mr. G.J.Strydom of Messrs. African Explosives and Chemical Industries, Ltd., for the statistical analysis of the experimental data.

Sincere thanks to Dr. C.F.Cresswell of the Department of Botany, University of the Witwatersrand, for his invaluable suggestions and advice in the compilation and presentation of this study, as well as to Dr. S.L.Davidson for the initial guidance.

The assistance rendered by Mr. T.Dainoff, Mr.P.L.Machinles, Dr. L. Maathling, Mr. D.E.E.Minnear, Mr. P.J.Lewis and Miss E.Robert, is hereby gratefully acknowledged.

To Mrs. J.Griffiths and Mr. C.Chappell, a special word of thanks for their drawings and paintings.

Mr. H.Piorra and Mr. F.J.S. Abel are thanked for their excellent assistance in the experimental programme; and to Mrs. S.Stableford, a special word of mention for typing the manuscript.

REFERENCES

- ALTONA, R.E. 1950. A preliminary report on the control of weeds in maize with Methoxone and 2,4-D. S.A. Jour. of Science 46 : 295 - 296.
- ALTONA, R.E. and BENTZ, W.J. 1953. Weed control in maize lands with woodkillers. S.A. Jour. of Science 49 : 340 - 343.
- ANDREWS, F.W. 1940. The control of nutgrass in the Sudan Gezira. Empire Jour. of Exp. Agric. 8 : 215 - 222.
- ANON. 1963. Water Grass. Soil and Crops. The Director of Land Utilization, Farmers Weekly, March 6th, 1963, Page 89.
- ANON. 1964. Corbilles - a dangerous nuisance. Farming in South Africa. December 1964 : 33 - 39.
- ANON. 1965 a. 1965 Wood Control Guide. Reprint from Farm Chemicals and Farm Technology. March 1965. Mositer Publishing Company, U.S.A.
- ANON. 1965 b. Supertone in South Africa - its production and management. Bulletin No. 1. The Experiment Station of the S.A. Sugar Association, pp. 23.
- ANON. 1965 c. "Nume werktuig vir uitjagader". Landbouweekblad 15th June, 1965. Page 49.
- BAIER, W.B. 1963. Studies on macroclimates and microclimates and their influence on crops. Unpublished thesis. Univ. of Pretoria pp. 191.
- BAUGHMAN, W.F., and JAMESON, G.S. 1923. The constituents of "Chufa" oil, a fatty oil from the tubers of *Cyperus esculentus* L. Jour. of Agric. Res. 26 : 77-82
- BAYER, O.E and DREVER, H.R. 1965. The effects of surfactants on efficiency of foliar-applied diuron. Weeds 13 : 222 - 226.
- BELLUE, D.K. 1946. Wood Seed Handbook Series V. State of California. Department of Agriculture Bulletin. Vol. 35. No. 2. 21 - 94.
- BELL, R.S. and GARDNER, P.B. 1962. Nutgrass control studies in corn with atrazine and the residual effects on a forage seeding. Preceding N.E. Wood Control Conference 16 : 306 - 311.
- BIRCH, E.B. 1964. An investigation of the effect of certain herbicidal treatments on maize and weeds, and the persistence of Simazin. Unpublished B.Sc. Agric. thesis University of Natal. pp. 232.
- BONZER, J. 1950. The role of toxic substances in the interactions of higher plants. Botanical Review 16 : 61 - 65.
- BURNER, H. 1960. Liberation of organic substances from higher plants and their role in the soil sickness problem. Botanical Review 26 : 393 - 424.
- BOSHOFF, D.N. 1965 Die invloed van uitjag- en kaffiesboomwerktuie op die groei en chemiese samestelling van 'n-sonal kultuurgewasse. Unpublished B.Sc. thesis, Potchefstroomse Universiteit.
- BUNTING, A.H. 1940. Some reflections on the ecology of weeds. The Biology of Weeds. A symposium of the British Ecological Society. Edited by J.L. Harper. Blackwell Scientific Publications, Oxford.
- BURTT-DAY, J. 1904. Report of the Government Agrologist and Botanist for the year ending June 30th, 1904. Report of the Transvaal Department of Agriculture, 1st July, 1903, to 30th June, 1904: 289 - 292.

- CORDES, R.D. and VANDERHART, F.L. 1955. Effect of sunlight on the phytotoxicity of some phenylureas and triazine herbicides on a soil surface. *Weeds* 13 : 81 - 84.
- CRAFTS, A.S. and NOCHINS, W.W. 1962. *Weed Control*. McGraw-Hill Book Company, New York, pp. 660.
- DANIELSON, L.L. 1956. The crop toxicity of CMU in a sandy clay loam soil. *Weeds* 4 : 255 - 263.
- DANIELSON, R.L. 1960 a. An experimental study of succession in the Transvaal Highveld. Frankenburg Field Research Station, University of the Witwatersrand, Johannesburg.
- DANIELSON, R.L. 1960 b. The influence of edaphic factors on the species composition of early stages of the subsera. Interim report to the Dept. of Agriculture, Pretoria. Frankenburg Field Research Station, University of the Witwatersrand, Johannesburg.
- DAY, C.E. 1953 a. Present status of nutgrass problem. *California Citriculture* 30 : 292 - 296.
- DAY, C.E. 1953 b. Soil fumigation with chlorobromopropane for the control of nutgrass. *Hilgardia* 21 : 593 - 604.
- DICKSON, J.C. and RUSSELL, R.C. 1955. The effect of drying on survival of nutgrass tubers. *California Agric. Experiment Station Bulletin* 753 : 1 - 6.
- DICKINSON, W.F. and RAHN, E.H. 1961. Translocation of amitrole, atrazine, dalapon and EPTC in Northern Nutgrass. *Proceedings N.E.W.C.C.* 15 : 45.
- DICKSON, W.F. and WHITWORTH, J. 1952. CMU for Grass Control. *Agric. Exp. Sta. New Mexico Press Bulletin* 1067. Preliminary Report, Agricultural Experiment Station.
- DUNLOP, J. 1957. Handbook for Farmers in S.A. Vol. III. *Stock Farming and Pasture* : 682 - 683.
- DUNPREZ, W.B. 1944. The Nutgrass (Urtica) Pest. *Farming in South Africa* 19 : 21 - 20.
- EDGES, A.J. 1940. Comparative effects of spray treatments with growth regulating substances. *American Journal of Botany* 26 : 571 - 584.
- FAIR, H. 1963. Hottelation destroys rhizomatous weeds. *Farmers Weekly*, Feb. 20, 1963 : 16 - 17.
- FAURE, J.C. 1955. Thysanoptera from *Myrmica* in the Sudan. *Journal of Ent. Soc. S. Africa*, 19 : 100 - 117.
- FERTIG, S. 1963. Nutedge (*Cyperus maculatus*) control in corn. *Proceedings N.E.W.C.C.* 18 : 259 - 264.
- FINK, R.J. and FLETCHALL, D.H. 1963. Foreign crop establishment in soil containing atrazine or alachlor residues. *Weeds* 11 : 81 - 83.
- FISHER, J. 1955. Evaluation of substituted ureas as pre-emergence weed-killers in maize. African Explosives & Chemical Industries Ltd. Research Department, Agricultural Group. Annual Report, 1957.

- FISHER, J. 1957 a. Influence of weed control on maize growth and production. A.E. & C.I. Ltd., Annual Report 1957.
- _____ 1957 b. Influence of nutgrass, cultivation and plant populations in maize production. A.E. & C.I. Ltd., Annual Report 1957.
- _____ and MACHTELSE, P.L. 1957. Influence of herbicidal spraying in conjunction with nitrogen and liming on the growth of nutgrasses in newly planted turf grasses. A.E. & C.I. Ltd. Annual Report, 1957.
- _____ and STIVEN, G. 1958. Weed and maize competition studies. A.E. & C.I., Ltd., Annual report 1958.
- FRONO, F. 1942. The eradication of nutgrasses. Science 96 : 337 - 338.
- GILVER, P.E. 1937. A contribution to the ecology of the Highveld flora. S.A. Jour. of Science 34 : 224 - 259.
- GODFREY, G.H. 1939. The control of nutgrass with chloropicrin. Soil Science 47 : 391-395.
- COSNELL, J.M. 1964 a. Unpublished Experimental Report HW 19/54/P. S.A. Sugar Association Experiment Station, Mount Edgecombe.
- _____ 1964 b. The use of herbicides in sugar. Recent developments in Metal. International Sugar Journal 66 : 375 - 378.
- _____ 1965 a. Herbicide trials in Metal sugarcane 1964-1965. Proceedings of the S.A. Sugar Technologists Association March 1965.
- _____ 1965b. Private communication.
- GOVERNMENT GAZETTE, 1945. Proclamation 132 Section 3(1)(a). "Wintjes on Aertappolgradering".
- GRUNER, G and BEYER, H. 1960. The influence exerted by species of Comelina on flax by means of toxic substances. The Biology of Weeds. Blackwell Scientific Publications pp.256.
- HALL, T.C., MEREDITH, D.B.D. and ALTONA, R.E. 1948. Better turf-through research. Experiments with Cynodon dactylon and other species at the South African Turf Research Station. Published by African Explosives and Chemical Industries, Ltd., and the South African Turf Research Fund.
- HALL, T.C., MEREDITH, D.B.D., ALTONA, R.E., BENTZ, W.J., WHITWALL, A.B.W. and LILFORD, E.A. 1955. Grasses for sporting purposes, parks and aerodromes in South Africa. The grasses and pastures of South Africa. Central News Agency, 771.
- HOPKIN, R.P., BAYER, G.M., CIALONE, J.C and SWEET, R.D. 1962. Some factors influencing nutgrass response to chemicals. Proceedings of the Northeastern Weed Control Conference 17 : 333-338.
- MARRIS, C.I and WARREN, G.F. 1964. Adsorption and Desorption of herbicides by soil. Weeds 12 : 120 - 126.
- MERLETHWAITE, J.F. 1965. Selective Weed control in maize. African Explosives & Chemical Industries, Ltd., Technical Services Dept. Report PE/P/1268.
- MILL, E.R., LACKMAN, W.H. and DAYWARD, D.H. 1963a. Reproductive potential of yellow nutsedge by seed. Weeds 11., 160-161.

- HILL, E.R., LACHMANN, W.H. and SHAWARD, D.N. 1963b. Translocation of amitrole in yellow woods and its effect on seed germination. *Woods* 11 : 165-166.
- HILL, G.D., BELASCO, I.J. and PLOEK, H.I. 1964. Influence of surfactants on the activity of diuron, laruron and bromacil of foliar spray on woods. 1964. Meeting of the Wood Society of America.
- HOLDSN, R.W. and ROBBINS, W.W. 1947. A textbook of general botany for colleges and universities. John Wiley and Sons pp. 664.
- JANSEN, L.L., GERTNER, W.A. and SHAW, W.C. 1961. Effects of surfactants on the herbicidal activity of several herbicides in aqueous spray systems. *Woods* 9 : 381 - 405.
- JONG, K. and ROUX, E.R. 1955. A further investigation of the nitrogen sensitivity of veld grasses. *S.A. Jour. of Science* 52 : 27 - 28.
- JONES, L.S., COGGI'S, C.W., DAY, B.E. and CLERY, 1964. Photo-decomposition of substitutedphenylureas. *Woods* 12 : 1 - 4.
- JUSTICE, G.L. and WHITEHEAD, M.D. 1946. Seed production, viability and dormancy in the nutgrasses, *Cynopus seculentus* and *C. rotundus*. *Jour. of Agricultural Research* 73 : 303-318.
- KILLINGER, G.B., and STOKES, W.E. 1946. Ch'fas in Florida. University of Florida Agricultural Experiment Station Bulletin 419 : 1 - 16.
- KITCHIN, J.T., LUCEY, R.F. and KENNEDY, K.B. 1962. Weed control in field corn with atrazine, Eptan and Tillam. *Proceedings W.E.W.C.C* 16 : 312 - 315. (Fino sandy loam).
- KOENIG, T., KUTHIER, J.B. and BERNARDINE, J.V. 1959. The effects of quackgrass on germination and seedling development of certain crop plants. *Woods* 7 : 1 - 12.
- LEWAND, D.A. and HARRIS, V.C. 1950. Methyl bromide for controlling nutgrasses. Information Sheet 445. Agricultural Experiment Station, Mississippi State College.
- LE TOURNEAU, J., FAILES, G.D. and HEGGENESS, H.G. 1956. The effect of aqueous extracts of plant tissues on germination of seeds and growth of seedlings. *Woods* 4 : 363 - 368.
- LE TOURNEAU, D. and HEGGENESS, H.G. 1957. Germination and growth inhibitors on leafy spurge foliage and quackgrass rhizomes. *Woods* 5 : 12 - 19.
- LUTIN, P., and RADENACHER, M. 1960. Studies on the mutual influence of weeds and crops. The Biology of Weeds. Blackwell Scientific Publications, pp 256.
- DAYTON, E.L., SMITH, E.V., and KING, D. 1945. Nutgrasses eradication studies : IV. Use of chlores and gases in the control of nutgrasses, *Cynopus rotundus* L. *Jour. American Society Agron.* 37 : 785 - 791.
- ROBERTS, C.G. 1963. Effects of surfactant on the herbicidal activity of foliar sprays of diuron. *Woods*, 11 : 265 - 269.
- ROBERTS, I. 1965. (A.E. & CI, Research Dept). Private communication.

- MEREDITH, D.B.D. 1948. The effect of fertilizers on grasses in certain areas in South Africa, with special reference to nutgrass. Published D.Sc. thesis, AE & CI Ltd., and Department of Botany, University of the Witwatersrand, pp. 166.
- MES, D.G. 1951. Growth and reproduction of Cyperus osculentus. Progress Report 1951 and 1951/52. Plant Physiological Research Institute, University of Pretoria.
- NEL P.C. and VENTER, J.J. 1964. "Die-baai van uintjies (Cyperus setosus) met EPTC." South African Journal of Agricultural Sciences 7 : 457 - 472.
- OHAN, J.H. and KOMBEDAHL, T. 1961. Relative toxicity of extracts from vegetative organs of quackgrass to alfalfa. Weeds 8, 666 - 670.
- OHAN, J.H. and KOMBEDAHL, T. 1964. Plant extracts, residues and soil minerals in relation to competition of quackgrass with oats and alfalfa. Weeds 12 : 222 - 231.
- OSTRUTZEL, H.J. 1964. The biological control of Lantana camara L. in Natal. The Journal of the Entomological Society in Southern Africa 27 : 3 - 16.
- OSVALL, H. 1948. Toxic oxides from the roots of Agropyron repens. Journal of ecology 36 : 192 - 193.
- PALMER, R.D. and PORTER, W.K. Jr. 1959. Weeds 7 : 481 - 489.
- PATERSON, D.D. 1939. Statistical techniques in agricultural research. McGraw-Hill Book Company pp. 263.
- PETTAN, C. 1913. Afrianderisme. Langmans, Green & Company pp. 579.
- PLUMB, 1906. The comparative anatomy and phytochemistry of the Cyperaceae. Annals of Botany 20 : 1 - 33.
- POINAR, G.O. 1964. Studies on nutgrass insects in Southern California and their effectiveness as biological control agents. Journal of Economic Entomology 57 : 379 - 383.
- POLLOCK, W.A.R. 1925. Eradication of nutgrass. Queensland Agricultural Journal 23. 53 - 55.
- PRELLER, J.H. and P. VAN WYK. 1956. "Uintjies as die is getal". Boarders in S.A. 34 : 54 - 56.
- POWER, F.B. and V.K. CHESNUT. 1923. Chemical examination of "Chufa", the tubers of Cyperus osculentus Linn. Jour. of Agric. Res. 25 : 69 - 75.
- RAHN, E.H., LACHMANN, W.H., SWEET, R.D. and BELL, R.S. 1952. Life history studies as related to weed control in the Northeast. 1- Nutgrass. Agricultural Experiment Station, University of Rhode Island, Kingston, Rhode Island Bulletin 350. November, 1952.
- REPORT ON AGRICULTURAL AND PASTORAL PRODUCTION 1959-60. Agricultural Census No. 34. Bureau of Statistics, Republic of South Africa. The Government Printer, Pretoria pp. 202.

- RHEINHOLD, L. 1942 a. A preliminary investigation into the biology and control of *Cyperus seculentus*, Linn. Unpublished B.Sc. Honours thesis. University of the Witwatersrand.
- RHEINHOLD, L. 1942 b. An investigation into the morphology and anatomy of *Cyperus seculentus*, Linn. Unpublished B.Sc. Honours thesis. University of the Witwatersrand.
- WHEB, S. 1953. Control of nutgrass in vegetable crops. Farming in South Africa 30 : 224 - 227.
- RIES, S.K. and JACOB, W.C. 1954. Design and analysis in chemical weed control research. Weeds 3 : 152 - 159.
- ROBINSON, J.B.O. 1959. Chemical weed control in coffee. Reprint Kenya Coffee, November, 1959.
- ROUX, E.R. 1953. The effect of antibiotics produced by *Trichoderma* species on the germination of the *Knautia* (*Knautia* *miranda*). S.A. Journal of Science 49 : 334.
- SANTERMAN, P.W., and MEADE, J.A. 1962. The response of nutgrass to herbicides applied at varying stages of growth. Rep. S.A.S.O.C. 16 : 321 - 324. Soil not specified (Kynland).
- SATTERTHWAITE, A.F. 1932. How to control billbugs destructive to cereal and forage crops. U.S.O.R. Farmers Bulletin No. 2003. pp. 1 - 22.
- SATTERTHWAITE, A.F. 1942 a. Weevils (Coleoptera, Curculionidae) affecting Chufa (*Cyperus seculentus*). Entomological News 55 : 11 - 15.
- SATTERTHWAITE, A.F. 1942 b. Weevils (Coleoptera, Curculionidae) affecting Chufa (*Cyperus seculentus*). Entomological News 53 : 37 - 42.
- SCHOMLAND, S. 1922. The South African Cyperaceae. Survey of South Africa Memoir No. 5.
- SELLSCHOP, J. and HATTINGH, I.D. 1956. Control of nutgrass on lands in the summer rainfall area. Farming in South Africa. June, 1956 : 49 - 52 and 77 - 80.
- SHEAR, G.W. 1956. Nutgrass (*Cyperus seculentus*) control in corn with linuron. Proceedings 18th Annual Meeting of the Southern Weed Conference. January, 1965, Dallas, Texas.
- SHEETS, I.J. 1958. The comparative toxicities of four phenylurea herbicides in several soil types. Weeds 6 : 413 - 424.
- STEEL, R.G.D. and TORRIE, J.H. 1960. Principles and Procedures of Statistics. McGraw-Hill Book Company, pp. 481.
- SMITH, E.V. and MAYTON, E.L. 1937. Nutgrass eradication studies. II. The eradication of nutgrass, *Cyperus seculentus* L. by certain tillage treatments. Journal of the American Society of Agronomy 30 : 18 - 21.

- SMITH E.V. and MAYTON, E.L. 1942. Nutgrass eradication studies.
 111. The control of nutgrass, *Cyperus rotundus*,
 on several soil types by tillage. Journal of the
 American Society of Agronomy, 42 : 151-159.
- STEWART, R.J. 1955. A survey of chemical weed control in sugarcane.
 S.A. Sugar Journal 39 : 393 - 407.
- SUMNERVILLE, W.A.T. 1933. Two insect enemies of nutgrass. Queensland
 Agricultural Journal 40 : 284 - 287.
- SUNDERLAND, N. 1960. Germination of seeds of erigeronaceous root parasites.
 The Biology of Weeds. Blackwell Scientific
 Publications pp. 256.
- TERES, S.B. and JIMENEZ, J.C. 1963. *Cyperus rotundus* and its dissemination
 through herbicides. Weed Abstracts 12 :
 Abstract 530.
- TEMPLE, R.E. and HILTON, H.W. 1963. The effect of surfactants on the
 water solubility of herbicides and the foliar
 phytotoxicity of surfactants. Weeds 11 : 297 -
 299.
- THISELTON-DYER, W.T. 1902. Flora of Tropical Africa, Volume VIII :
 pp.548. Lovell Reeve and Company.
- THISELTON-DYER, W.T. 1900. Flora Capensis, Volume VII. : pp. 791.
 Lovell Reeve and Company.
- THOMPSON, C.D. and GOSNELL, J.M. 1963. The results of herbicide trials
 conducted in the cane belt of Natal, 1962/1963.
 Proceedings of the S.A. Sugar Technologists'
 Association, April 1963.
- THURSTON, J.M. 1960. Dormancy in Weed Seeds. The Biology of Weeds.
 Blackwell Scientific Publications : pp. 256.
- TURBLESON, M.C. and KOMMEDAHL, T. 1960. Reproductive potential of yellow
 nutgrass. Proceeding 17, Annual Meeting North
 Centr. Weed Contr. Conf. Milwaukee, Wisconsin,
 Dec.1960 : pp. 106.
- TURBLESON, M.C. 1960. Germination inhibitor in tubers of yellow nutgrass.
 Proceeding 17 Annual meeting North Centr. Weed
 Contr. Conf. Milwaukee, Wisconsin, Dec.1960 :
 pp. 106.
- VENCIS, J. 1963. Nutgrass control in field corn, 1962, Proceedings of
 the Northern Weed Control Conference 17 : 306-311
 (*C. setulatus*).
- VISSER, H.C. 1960. African Explosives and Chemical Industries, Ltd.,
 Research Department, Agricultural Group.
 Annual Report, 1960.
- VISSER, H.C. 1961. African Explosives & Chemical Industries Ltd.,
 Research Department, Agricultural Group.
 Annual Report 1961.
- WITT, J.M. and GREYER-BRANDEIJX, M.C. 1962. The medicinal and poisonous
 plants of Southern and Eastern Africa. Livingstone
 Ltd. : pp 1457.
- WELBAH, P.J. 1960. Toxin production from *Agropyron repens*. The Biology
 of Weeds. Blackwell Scientific Publications : pp. 256.
- WELLINGTON, P.S. 1960. Assessment and control of the dissemination of weeds
 by crop seeds. The Biology of Weeds. Blackwell
 Scientific Publications : 256 pp.

WILD, M. 1955. Common Rhodesian Woods. The Government Printer,
Salisbury : Figure 102.

WILLARD C.J. 1958. Rating scales for wood control experiments.
Woods 6 : 327 - 328.

APPENDIX TABLE 1 : GREEN AND AIR-DRY WETWEIGHTS OF MUDGRASS.
GRAMS PER POT.

TREATMENT	GREEN WEIGHT				AIR-DRY WEIGHT			
	I	II	III	TOTAL	I	II	III	TOTAL
D	11.43	7.69	12.72	31.83	3.43	2.18	3.42	9.00
N	25.30	20.25	14.75	60.30	6.42	5.51	3.94	15.87
P	11.61	17.17	14.54	43.32	3.17	4.23	3.96	11.36
K	12.65	15.91	13.45	42.01	3.74	4.05	3.52	11.31
NP	49.50	40.45	48.50	146.45	13.62	13.54	12.07	39.23
NK	39.65	16.38	17.05	73.08	9.63	5.05	4.34	19.03
PK	12.05	16.10	11.14	39.29	3.29	4.13	3.05	10.47
NPX	45.58	55.57	32.82	133.97	11.93	14.14	9.14	35.21
KN	56.94	51.46	44.82	153.22	14.58	13.93	11.57	40.06

ANALYSIS OF VARIANCE

DF	MEAN SQ.	F
1	2772.6400	**
1	1003.88500	**
1	789.59400	**
1	2.0650	
1	1.1440	
1	66.8670	
1	5.6660	
16	44.1794	

ANALYSIS OF VARIANCE

DF	MEAN SQ.	F
1	190.4067	**
1	71.6222	**
1	61.5040	**
1	0.0010	
1	0.2992	
1	4.8420	
1	0.7993	
10	2.2901	

APPENDIX TABLE 2 : GREEN HERBAGE WEIGHTS OF NUTCRASS IN GRAMS PER
+ SQUARE METRE QUADRAT

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
D	30.4	24.0	66.8	120.9	40.3
N	47.6	49.5	42.7	139.8	46.6
P	34.5	24.8	38.7	98.0	32.7
K	47.9	21.8	33.0	102.6	34.2
NP	55.9	60.3	86.5	202.3	67.4
NK	68.4	45.2	26.8	140.4	46.8
PK	29.4	35.0	39.1	103.5	34.5
NPK	72.0	54.0	59.8	185.8	61.9
CON	62.6	90.3	77.2	190.1	63.4

ANALYSIS OF VARIANCE

Blocks

N

P

NxP

K

NxK

PxK

NxPxK

Error

DF	MEAN SQ.	F
2	234.8750	
1	2466.4500	**
1	307.4500	
1	703.0800	
1	34.3200	
1	0.4010	
1	1.8710	
1	69.7000	
14	192.1151	

APC-201X TABLE 3 1. GREENHOUSE WEIGHTS OF MIDGESS IN GRAMS PER PLANT

TREATMENT	21/12/61 (18 days)				22/1/62 (24 days)				26/2/62 (35 days)				TOTAL FOR SEASON
	I				I				I				
	I	II	III	TOTAL	I	II	III	TOTAL	I	II	III	TOTAL	
D	271.4	322.4	370.2	964.0	346.4	350.4	373.2	1070.0	324.7	349.3	405.5	1080.5	3114.5
N	328.5	641.8	482.4	1452.7	335.3	519.5	434.6	1289.5	1271.2	983.4	771.8	2986.4	5736.5
P	430.0	423.5	310.8	1164.4	321.5	556.4	436.9	1314.8	726.4	542.4	420.7	1689.5	4163.7
K	412.0	236.9	200.0	848.9	581.5	342.7	317.4	1241.6	550.6	315.6	377.8	1254.2	3344.7
NP	548.4	941.5	688.7	2178.6	710.0	739.5	525.4	1973.9	1135.0	1271.2	1772.4	4178.5	8331.1
NK	521.1	509.3	423.4	1453.8	388.5	566.5	465.1	1420.2	786.3	1534.4	1371.6	3792.3	6666.3
PK	512.0	416.2	397.5	985.7	232.3	734.9	466.5	1433.7	304.5	581.0	635.6	1521.1	4040.5
NPK	532.3	974.0	662.2	2188.5	515.2	648.7	996.7	2160.6	1190.4	1509.0	1407.4	4176.8	8525.9
COM	624.9	700.0	572.0	2006.9	552.9	889.2	757.4	2199.4	1427.4	1452.8	1095.8	3979.0	8385.3

ANALYSIS OF VARIANCE

DF	MEAN SQ.	F
2	377289.00	
1	5873754.00	**
1	16027550.00	**
1	304227.00	
1	52473.00	
1	43397.00	
1	13242.00	
1	9834.00	
14	122867.54	

Blocks
N
P
K
NP
NK
PK
MPK
Error

APPENDIX TABLE 4 INFLUENCE OF NITROGEN CARRIERS ON THE GROWTH OF C. SCUTELLARIS
WEIGHT OF AERIAL AND UNDERGROUND FRAGMENTS IN GRAMS PER POT.

TREATMENT	POT NUMBER	1st Cutting			2nd Cutting			TUBER NO.	TUBER WT.
		STEM NO.	ROOT WEIGHT	GREEN WEIGHT	DRY WEIGHT	STEM NO.	GREEN WEIGHT		
Calcium nitrate	11)	8	3.8	12.6	1.87	10	6.9	22	2.2
	22)	7	6.8	12.4	2.32	17	12.6	30	3.6
	33)	7	5.8	14.2	2.00	11	13.6	30	3.6
	44)	8	3.5	17.7	2.61	11	10.9	23	3.3
TOTAL MEAN		30	19.9	56.9	9.90	51	45.0	115	11.9
Potassium nitrate	55)	10	10.8	17.4	2.95	11	16.6	37	3.2
	66)	8	9.4	20.4	3.35	15	15.0	30	4.7
	77)	8	13.3	17.4	3.70	14	17.4	39	4.7
	88)	9	13.3	17.8	2.41	12	17.9	30	2.7
TOTAL MEAN		34	41.4	80.1	11.95	56	70.9	165	15.3
Ammonium sulphate	99)	1	5.9	14.3	2.12	15	9.6	43	3.6
	110)	9	11.1	17.6	3.68	21	13.3	49	5.3
	121)	9	7.7	17.6	3.32	19	10.0	49	5.0
	132)	10	5.8	14.3	1.91	17	12.4	39	2.9
TOTAL MEAN		35	29.5	63.0	10.43	72	45.3	179	15.6
Limestone ammonium nitrate	143)	8	8.3	14.4	2.39	11	19.1	35	5.2
	154)	10	14.6	26.4	4.70	22	15.4	53	7.0
	165)	9	9.8	20.3	3.43	22	15.0	49	6.7
	176)	8	7.3	14.3	2.69	16	15.4	34	2.4
TOTAL MEAN		36	40.2	75.3	13.02	71	55.9	191	25.0
Urea	187)	8	9.3	16.9	2.62	19	10.8	65	5.7
	198)	9	14.9	27.2	4.96	20	18.0	35	2.0
	209)	10	6.3	27.4	4.68	28	14.8	49	4.5
	220)	8	4.2	21.3	3.02	17	15.0	51	4.5
TOTAL MEAN		35	34.7	92.8	15.20	84	53.1	186	18.4

APPENDIX TABLE 4 (CONT.)

TREATMENT	POT NUMBER	1st Cutting		2nd Cutting	
		STEM NO.	ROOT WEIGHT	STEM NO.	TUBER NO.
Ammonium nitrate	24.1	8	13.5	14	37
	24.2	8	13.7	26	52
	24.3	8	15.6	25	33
	24.4	10	3.9	19	45
TOTAL		35	55.7	63	167
CONTROL	25.1	9	2.4	7.5	22
	25.2	9	5.7	4.1	31
	27.3	7	6.0	6.1	31
	28.4	8	2.6	4.7	23
TOTAL		33	23.7	36	105
		6.8		24.1	12.6

ANALYSIS OF VARIANCE

NITROGEN CARRIERS

a) Green Weights (1st Clipping)

	DF	MEAN SQ.	F
N	6	156.6287	**
Error	21	15.2073	

b) Green weights (2nd Clipping)

	DF	MEAN SQ.	F
N	6	58.1332	**
Error	21	7.1056	

c) Total weights (Combined 1st and 2nd Clippings).

	DF	MEAN SQ.	F
N	6	396.7472	**
Error	21	29.1616	

d) Tuber Numbers.

	DF	MEAN SQ.	F
N	6	322.65	**
Error	21	77.83	

e) Tuber weights.

	DF	MEAN SQ.	F
N	6	6.1875	**
Error	21	1.0116	

APPENDIX TABLE 5 : GREEN HERBAGE WEIGHTS OF RUTGRASS IN GRAMS
PER POT

TREATMENT	GREEN WEIGHT
0	6.0
1	7.9
13	5.7
16	4.7
Total	24.3
50	11.4
8	15.2
13	13.4
26	14.0
Total	54.0
100	23.3
2	17.6
13	17.0
24	17.3
Total	75.2
200	23.0
12	23.2
16	24.0
24	22.8
Total	93.0
400	26.0
12	23.7
13	26.7
23	19.0
Total	95.4
800	25.0
12	24.5
16	26.7
24	25.6
Total	101.9

ANALYSIS OF VARIANCE

	DF	MEAN SQ.	F
Nitrogen Levels	5	223.4449	***
Error	18	4.4297	

APPENDIX TABLE 4 : SOIL ANALYSIS OF TURF PLOTS.

GRASS VARIETY	D			P			NP			MPK		
	P	K	Ph	P	K	Ph	P	K	Ph	P	K	Ph
1. Magnifica	22	70	725	40	6.1		53	70	690	40	5.6	
2. Turpan	22	60	775	40	6.1		58	50	525	70	5.5	
3. Turpan	32	60	550	60	5.5		58	50	525	70	5.5	
4. Ballia	32	60	550	60	5.5		58	50	525	70	5.5	
5. Selection	51	80	825	70	6.3		68	60	400	60	6.1	
6. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
7. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
8. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
9. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
10. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
11. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
12. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
13. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
14. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
15. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
16. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
17. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
18. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
19. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
20. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
21. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
22. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
23. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
24. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
25. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
26. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
27. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
28. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
29. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
30. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
31. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
32. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
33. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
34. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
35. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
36. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
37. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
38. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
39. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
40. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
41. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
42. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
43. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
44. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
45. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
46. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
47. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
48. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
49. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
50. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
51. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
52. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
53. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
54. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
55. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
56. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
57. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
58. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
59. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
60. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
61. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
62. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
63. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
64. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
65. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
66. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
67. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
68. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
69. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
70. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
71. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
72. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
73. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
74. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
75. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
76. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
77. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
78. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
79. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
80. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
81. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
82. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
83. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
84. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
85. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
86. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
87. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
88. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
89. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
90. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
91. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
92. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
93. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
94. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
95. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
96. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
97. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
98. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
99. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
100. Swetland-	51	80	825	70	6.3		68	60	400	60	6.1	
TOTAL	497	1400	9510	1470	94.2		692	1346	9560	940	84.2	
MEAN	35.5	93.3	610	71.3	8.3		59.5	89.3	643	82.6	8.2	

APPENDIX TABLE 7 : NUMBER OF RUTGRASS SHOOTS PER CIRCULAR
FRAME 7.5 INCH DIAMETER - 2/7/1965.

VARIETY	NPK			P			O			NP		
	1	2	3	1	2	3	1	2	3	1	2	3
1. Megennis	9	14	15	0	0	0	0	0	41	4	27	
2. Bloupan	58	49	38	20	0	0	11	2	4	23	25	46
3. Tiffine	12	35	25	11	7	0	5	6	0	40	3	22
4. Hall's Selection	42	2	0	4	3	0	0	0	10	0	0	0
5. Sueziland- ensis	42	50	35	0	0	6	4	0	1	30	17	52
6. Dolore mouth	21	40	59	0	4	6	2	0	0	17	18	20
7. Skasaplaas medium	31	24	35	4	0	1	0	3	1	0	18	20
8. Skasaplaas fine	38	3	12	0	0	0	0	0	0	20	6	15
9. Floride	32	54	58	0	0	0	0	0	0	49	39	39
10. Tifloun	51	63	57	0	2	0	0	0	0	39	33	40
11. Royal Cups	23	6	10	5	6	0	4	0	2	20	31	10
12. Uganda	79	48	69	0	0	0	0	0	0	25	44	36
13. Windsor	35	33	59	8	1	0	4	0	0	22	10	21
14. Bradley v Balen	36	61	71	6	0	3	1	1	2	17	43	17
15. Zoyzia japonica	63	49	15	0	0	3	0	3	3	58	39	51
TOTAL	573	531	558	56	23	19	31	16	24	408	330	402
MEAN	36.9			22			1.6			25.3		

APPENDIX TABLE 8 : pH OF SOIL SAMPLES - 21/11/60

TREATMENT	PLOT		TREATMENT	PLOT	
L1	1	5.5	A1	1	4.7
	2	5.1		2	4.5
S	3	5.1	1	3	4.7
Total		15.7			13.9
Mean		5.2			4.6
L2	1	5.6	A2	1	4.8
	2	5.6		2	4.5
G	3	5.1	2	3	4.8
Total		16.3			13.6
Mean		5.4			4.5
L3	1	5.7	A3	1	4.8
	2	5.2		2	4.6
7	3	5.5	3	3	4.7
Total		17.4			13.9
Mean		5.8			4.6
L4	1	5.5	A4	1	4.7
	2	5.3		2	4.5
8	3	5.3	4	3	4.9
Total		16.1			14.0
Mean		5.4			4.7
L5	1	5.8	CONTROL	1	5.2
	2	5.6		2	5.5
9	3	5.5		3	5.4
Total		17.7			15.1
Mean		5.9			5.0
L6	1	5.8		1	5.1
	2	5.4		2	5.1
10	3	5.5		3	5.0
Total		16.7	Total		45.5
Mean		5.7	Mean		5.2

ANALYSIS OF VARIANCE

	DF	MEAN SQ.	F
Blocks	2	0.0933	
Treatments	12	0.6300	**
Error	24	0.0627	

C.V. 4.84%

APPENDIX TABLE 9: GREEN HERBAGE WEIGHTS OF ROTURASS IN GRAMS
PER 4 (18" x 18") QUADRATS. 30/11/68.

TREATMENT	PLOT	WEIGHT	TREATMENT	PLOT	WEIGHT
L1	1	296.0	A1	1	322.0
	2	159.0		2	511.3
	3	122.0		3	235.3
Total Mean		577.0 192.3			1068.6 356.2
L2	1	184.0	A2	1	402.3
	2	114.8		2	414.3
	3	211.0		3	188.7
Total Mean		509.8 169.9			1005.3 335.1
L3	1	169.6	A3	1	498.8
	2	126.4		2	433.3
	3	151.0		3	268.2
Total Mean		447.0 149.0			1200.3 400.1
L4	1	146.9	A4	1	484.0
	2	82.1		2	359.3
	3	247.0		3	255.0
Total Mean		496.0 165.3			1098.3 366.1
L5	1	228.8	CONTROL	1	172.5
	2	202.0		2	209.7
	3	143.0		3	237.4
Total Mean		373.8 124.6		1	106.6
L6	1	193.0		2	103.0
	2	207.0		3	210.0
	3	80.8		1	154.0
				2	243.2
Total Mean		480.8 160.3		3	189.6
			Total Mean		1628.0 542.7

ANALYSIS OF VARIANCE

	DF	MEAN SQ.	F
Blocks	2	14267.20	*
Treatments	12	26782.80	
Error	24	6787.47	

C.V. 35.59%

APPENDIX TABLE 10 : NUMBER OF NUTCRASS PLANTS AND GREEN HERBAGE WEIGHTS PER 2 QUADRATS (3' x 3'), 23/12/66 (GRAMS)

TREATMENTS	PLOT	NUTCRASS POPULATIONS PER 2 FRAMES		GREEN WEIGHT OF NUT-CRASS PER 2 FRAMES	
			TOTAL		TOTAL
L1	1	140		1 273 gms	
	2	134		2 268	
	3	124	398	3 297	796
L2	1	158		1 235	
	2	141		2 251	
	3	98	403	3 195	582
L3	1	256		1 340	
	2	123		2 208	
	3	367	416	3 526	1136
L4	1	325		1 360	
	2	124		2 219	
	3	223	677	3 385	964
L5	1	220		1 298	
	2	120		2 270	
	3	420	760	3 513	1081
L6	1	385		1 488	
	2	108		2 213	
	3	413	906	3 500	1301
A1	1	136		1 150	
	2	265		2 365	
	3	112	513	3 198	723
A2	1	267		1 320	
	2	157		2 267	
	3	315	749	3 402	989
A3	1	221		1 398	
	2	241		2 451	
	3	350	812	3 450	1279
A4	1	360		1 420	
	2	134		2 280	
	3	420	914	3 595	1205
CONTROL	1	321	Mean	1 256	Mean
	2	196		2 210	
	3	238		3 246	
	1	144		1 251	
	2	168		2 242	
	3	321		3 233	
	1	372		1 493	
	2	157		2 233	
	3	102	2019	3 130	2334

NUTCRASS COUNTS
(SQ. ROOT)

Blocks
Treatments
Error

ANALYSIS OF VARIANCE

DF	MEANS	SS	F
2	46.26		
12	9.47		
24	9.75		

C.V. 21.21%

GREEN WEIGHTS

DF	MEANS	SS	F
2	29795.66		
12	15338.64		
24	10731.33		

C.V. 52.39%

APPENDIX TABLE 11 : SOIL ANALYSIS OF UNDESICED SUB-PLOTS.

S. No	P.P.M				Cm %				PH				TOTAL N %			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
1. N	185	182	179	115	693	0.092	0.114	0.102	0.400	5.6	5.6	5.9	0.102	0.186	0.099	0.111
2. H	231	160	170	85	676	0.104	0.096	0.094	0.096	5.7	5.6	5.6	0.142	0.165	0.096	0.103
3. N2	169	111	205	282	727	0.109	0.062	0.090	0.104	5.5	5.7	6.0	0.109	0.103	0.093	0.106
4. N3	139	217	174	217	748	0.092	0.092	0.096	0.094	5.3	5.9	5.5	0.101	0.132	0.112	0.090
5. N4	163	61	171	61	406	0.096	0.064	0.102	0.092	5.1	4.9	4.6	0.122	0.113	0.120	0.097
6. N5	121	50	104	70	345	0.090	0.090	0.084	0.080	5.1	4.9	4.5	0.111	0.135	0.113	0.116
7. C	178	219	202	117	716	0.100	0.140	0.098	0.096	5.0	5.1	5.7	0.106	0.107	0.109	0.100
8. C2	194	181	200	160	743	0.108	0.114	0.112	0.100	5.8	5.7	5.9	0.044	0.104	0.100	0.078
9. C3	194	209	208	165	784	0.102	0.160	0.108	0.205	5.8	5.3	5.1	0.111	0.109	0.101	0.094
10. C4	201	210	181	200	792	0.106	0.156	0.118	0.104	5.7	5.4	5.6	0.129	0.102	0.104	0.092
11. CA	281	276	236	190	937	0.108	0.108	0.103	0.080	5.0	5.8	5.4	0.111	0.102	0.109	0.100
12. E3	255	281	224	240	964	0.118	0.118	0.110	1.194	7.2	7.2	7.1	0.134	0.107	0.090	0.091

ANALYSIS OF VARIANCE

1. Air-dry Aerial Weights.

C. DISCED AND NON-DISCED

	A. DISCED		
	DF	MEAN SQ	F
Blocks	3	1.6300	
Treatments	11	3.6511	**
Error	33	0.4588	

C.V. 37.11%

	B. NON-DISCED		
	DF	MEAN SQ	F
3	2.1950		
11	4.8131	**	
33	0.4810		

C.V. 28.05%

C.V. 22.96%

2. Soil Analysis

A. MAGNESIUM CONTENT P.P.M

	DF	MEAN SQ	F
Blocks	3	0.476223	
Treatments	11	0.098788	**
Error	33	1515.86	

C.V. 22.09%

B. CALCIUM CONTENT %

	DF	MEAN SQ	F
3	0.000873		
11	0.020885	**	
33	0.001287		

C.V. 27.61

C. TOTAL N %

	DF	MEAN SQ	F
Blocks	3	0.000376	
Treatments	11	0.000322	
Error	33	0.000186	

C.V. 12.96%

D. pH

	DF	MEAN SQ	F
3	0.4257		
11	1.5620	**	
33	0.0604		

C.V. 4.18%

APPENDIX TABLE 12 : HERBAGE WEIGHTS OF NUTGRASS - GRAMS PER SQUARE FOOT.

A. DISCED SUB-PLOTS.

TREATMENTS	I	II	III	IV	TOTAL	MEAN
1. N 0	.58	.84	.64	.9	2.96	0.74
2. N 1	1.78	1.7	0.8	1.48	5.76	1.44
3. N 2	1.94	4.82	.76	1.38	9.90	2.225
4. N 3	3.24	2.46	2.74	2.18	10.62	2.655
5. N 4	3.68	4.82	3.38	3.18	15.06	3.765
6. N 5	4.04	2.35	2.38	2.54	11.32	2.83
7. C 0	.04	1.00	.62	.86	3.12	0.78
8. C 1	1.3	1.8	.46	1.08	4.64	1.16
9. C 2	.68	1.02	.46	1.44	3.62	0.905
10. C 3	1.48	1.28	.72	1.0	4.48	1.12
11. C 4	1.12	2.42	2.24	1.46	7.24	1.81
12. C 5	1.2	1.62	.54	1.64	5.00	1.25

B. NON-DISCED

TREATMENTS (PER ACRE)	I	II	III	IV	TOTAL	MEAN
1. Ammonium sulphate, 0 lbs N0	1.82	1.63	0.88	1.66	5.89	1.47
2. " " 100 lbs N1	4.06	5.02	1.87	3.74	12.69	3.17
3. " " 200 lbs N2	3.26	4.33	1.18	4.52	13.29	3.32
4. " " 400 lbs N3	4.19	4.43	4.96	3.69	17.27	4.31
5. " " 800 lbs N4	4.38	5.37	3.65	4.81	18.21	4.55
6. " " 1600 lbs N5	4.13	4.82	3.89	3.95	16.79	4.199
7. Hydrated Lime 0 lbs C0	2.69	2.02	1.31	2.76	8.78	2.195
8. " " 500 lbs C1	1.56	3.01	1.66	1.31	7.54	1.885
9. " " 1000 lbs C2	2.94	3.64	2.37	1.24	9.59	2.398
10. " " 2000 lbs C3	3.04	1.81	1.56	1.33	7.74	1.935
11. " " 4000 lbs C4	3.32	2.26	2.69	2.01	10.28	2.57
12. " " 8000 lbs C5	2.50	1.43	0.76	1.50	5.19	1.298

APPENDIX TABLE A3 INFLUENCE OF INCREASING LEVELS OF LIME ON GROWTH OF *S. ESCULENTUS*
WEIGHT OF URBANE AND TUBERS IN GRAMS PER POT.

TREATMENT	POT NUMBER	ROOTS + TUBERS WEIGHT 1/9/65	STEM WEIGHT	2ND CUTTING GREEN WEIGHT	2ND CUTTING 9/9/65 DRY WEIGHT	ROOT WEIGHT	2ND CUTTING GREEN WEIGHT	10/9/65 DRY WEIGHT	TUBERS NUMBER	TUBERS WEIGHT
1000 lbs	1	3.8	8	5.3	1.3	2.8	4.5	0.4	14	1.0
	2	3.1	15.1	4.4	0.7	2.3	8.7	1.5	18	1.4
	3	2.6	7	4.4	0.7	2.3	5.6	0.6	11	0.3
TOTAL		10.3		15.7	3.4	8.4	18.4	2.5	43	2.7
2000 lbs	1	4.9	7	4.2	1.2	4.3	5.9	0.9	27	2.4
	2	4.1	8	7.7	0.9	4.3	6.3	1.5	18	1.4
	3	2.8	6	4.2	0.9	2.2	4.8	0.9	12	0.7
TOTAL		11.8		16.1	3.3	10.8	17.0	3.3	57	4.5
4000 lbs	1	4.6	9	7.5	1.7	4.3	8.1	1.7	23	1.3
	2	5.7	8	7.0	1.7	4.2	8.9	1.2	32	2.8
	3	15.0	13.6	19.5	5.2	13.5	25.5	4.4	73	5.0
TOTAL										
6000 lbs	1	4.6	10	16.8	1.9	9.5	12.3	2.9	28	2.8
	2	3.5	10	3.8	1.0	3.1	8.5	0.9	18	1.8
	3	5.7	9	15.6	8.4	9.7	19.2	1.9	27	3.4
TOTAL		15.3		27.7	4.4	22.3	25.0	5.7	73	8.0
8000 lbs	1	5.2	6	11.6	1.1	5.1	6.5	1.2	29	2.4
	2	3.3	9	12.8	1.2	2.7	5.8	1.3	27	1.4
	3	3.8	2	11.5	5.1	10.2	18.2	3.7	17	1.0
TOTAL		14.3		35.7	7.4	14.3			65	5.3

APPENDIX TABLE 13 (CONT.)

TREATMENT	POT NUMBER	ROOTS + TUBERS WEIGHT	STEM NO. TUBERS	1st EDITION (9/2/65) GREEN WEIGHT	AIR-DRY WEIGHT	2nd Edition 10/3/66 ROOT WEIGHT	GREEN WEIGHT	AIR-DRY TUBERS WEIGHT	TUBERS NUMBER	ROOTS WEIGHT
10,000 lbs 6	16 1	3.2	8	7.6	1.0	2.5	4.4	0.8	21	1.1
	17 2	3.8	9	19.2	1.4	4.4	12.4	1.5	23	2.4
	18 3	4.8	8	9.5	1.2	4.6	4.8	0.8	32	2.2
TOTAL		11.8		13.7	3.6	11.5	21.6	3.1	76	5.7
12,000 lbs 7	11 1	5.4	7	11.3	1.1	5.0	6.2	1.1	19	1.9
	12 2	5.1	6	7.9	1.2	4.8	4.9	0.8	32	2.4
	13 3	4.1	10	10.2	1.0	3.6	9.8	1.1	18	1.4
TOTAL		14.6		12.5	3.3	13.4	16.7	3.0	69	5.7
14,000 lbs	1 1	2.9	9	6.9	0.9	2.6	4.6	0.6	12	0.4
	2 2	5.9	7	5.1	1.0	8.4	4.9	1.1	23	1.4
	3 3	5.2	10	11.6	0.8	9.5	15.9	2.5	60	3.9
TOTAL		14.0		12.5	2.8	10.5	15.9	4.2	95	5.7
CONTROL	1 1	4.0	7	14.2	1.1	4.4	9.1	1.2	24	3.2
	2 2	4.2	10	10.6	1.0	4.1	5.9	1.1	19	2.3
	3 3	4.5	8	9.3	1.2	2.4	19.1	1.0	19	2.3
TOTAL		12.7		15.2	3.3	10.9	34.1	3.3	62	5.8

ANALYSIS OF VARIANCE

a) Green Weights

1st Clipping

	DF	MEAN SQ.	F
Line	8	7.4298	NS
Error	18	5.0922	

b) Green Weights (combined 1st and 2nd Clippings)

	DF	MEAN SQ.	F
Line	8	21.6445	NS
Error	18	18.4218	

c) Root Weights

	DF	MEAN SQ.	F
Line	8	5.6553	NS
Error	18	3.5040	

2nd Clipping

	DF	MEAN SQ.	F
Line	8	4.8878	NS
Error	18	4.4748	

APPENDIX TABLE 1A - SPREAD OF NUTRIENTS (1968)

Plot No.	10/1	14/1	17/1	21/1/65	24/1/65	27/1/65	7/2/65	14/2/65	21/2/65	28/2/65	3/3/65	10/3/65	17/3/65	24/3/65	31/3/65	7/4/65	14/4/65	21/4/65	28/4/65	5/5/65	12/5/65	19/5/65	26/5/65	2/6/65	9/6/65	16/6/65	23/6/65	30/6/65	7/7/65	14/7/65	21/7/65	28/7/65	4/8/65	11/8/65	18/8/65	25/8/65	1/9/65	8/9/65	15/9/65	22/9/65	29/9/65	6/10/65	13/10/65	20/10/65	27/10/65	3/11/65	10/11/65	17/11/65	24/11/65	1/12/65	8/12/65	15/12/65	22/12/65	29/12/65	5/1/66	12/1/66	19/1/66	26/1/66	2/2/66	9/2/66	16/2/66	23/2/66	1/3/66	8/3/66	15/3/66	22/3/66	29/3/66	5/4/66	12/4/66	19/4/66	26/4/66	3/5/66	10/5/66	17/5/66	24/5/66	31/5/66	7/6/66	14/6/66	21/6/66	28/6/66	4/7/66	11/7/66	18/7/66	25/7/66	1/8/66	8/8/66	15/8/66	22/8/66	29/8/66	5/9/66	12/9/66	19/9/66	26/9/66	3/10/66	10/10/66	17/10/66	24/10/66	31/10/66	7/11/66	14/11/66	21/11/66	28/11/66	4/12/66	11/12/66	18/12/66	25/12/66	1/1/67	8/1/67	15/1/67	22/1/67	29/1/67	5/2/67	12/2/67	19/2/67	26/2/67	3/3/67	10/3/67	17/3/67	24/3/67	31/3/67	7/4/67	14/4/67	21/4/67	28/4/67	4/5/67	11/5/67	18/5/67	25/5/67	1/6/67	8/6/67	15/6/67	22/6/67	29/6/67	5/7/67	12/7/67	19/7/67	26/7/67	3/8/67	10/8/67	17/8/67	24/8/67	31/8/67	7/9/67	14/9/67	21/9/67	28/9/67	4/10/67	11/10/67	18/10/67	25/10/67	1/11/67	8/11/67	15/11/67	22/11/67	29/11/67	5/12/67	12/12/67	19/12/67	26/12/67	2/1/68	9/1/68	16/1/68	23/1/68	30/1/68	6/2/68	13/2/68	20/2/68	27/2/68	3/3/68	10/3/68	17/3/68	24/3/68	31/3/68	7/4/68	14/4/68	21/4/68	28/4/68	4/5/68	11/5/68	18/5/68	25/5/68	1/6/68	8/6/68	15/6/68	22/6/68	29/6/68	5/7/68	12/7/68	19/7/68	26/7/68	3/8/68	10/8/68	17/8/68	24/8/68	31/8/68	7/9/68	14/9/68	21/9/68	28/9/68	4/10/68	11/10/68	18/10/68	25/10/68	1/11/68	8/11/68	15/11/68	22/11/68	29/11/68	5/12/68	12/12/68	19/12/68	26/12/68	2/1/69	9/1/69	16/1/69	23/1/69	30/1/69	6/2/69	13/2/69	20/2/69	27/2/69	3/3/69	10/3/69	17/3/69	24/3/69	31/3/69	7/4/69	14/4/69	21/4/69	28/4/69	4/5/69	11/5/69	18/5/69	25/5/69	1/6/69	8/6/69	15/6/69	22/6/69	29/6/69	5/7/69	12/7/69	19/7/69	26/7/69	3/8/69	10/8/69	17/8/69	24/8/69	31/8/69	7/9/69	14/9/69	21/9/69	28/9/69	4/10/69	11/10/69	18/10/69	25/10/69	1/11/69	8/11/69	15/11/69	22/11/69	29/11/69	5/12/69	12/12/69	19/12/69	26/12/69	2/1/70	9/1/70	16/1/70	23/1/70	30/1/70	6/2/70	13/2/70	20/2/70	27/2/70	3/3/70	10/3/70	17/3/70	24/3/70	31/3/70	7/4/70	14/4/70	21/4/70	28/4/70	4/5/70	11/5/70	18/5/70	25/5/70	1/6/70	8/6/70	15/6/70	22/6/70	29/6/70	5/7/70	12/7/70	19/7/70	26/7/70	3/8/70	10/8/70	17/8/70	24/8/70	31/8/70	7/9/70	14/9/70	21/9/70	28/9/70	4/10/70	11/10/70	18/10/70	25/10/70	1/11/70	8/11/70	15/11/70	22/11/70	29/11/70	5/12/70	12/12/70	19/12/70	26/12/70	2/1/71	9/1/71	16/1/71	23/1/71	30/1/71	6/2/71	13/2/71	20/2/71	27/2/71	3/3/71	10/3/71	17/3/71	24/3/71	31/3/71	7/4/71	14/4/71	21/4/71	28/4/71	4/5/71	11/5/71	18/5/71	25/5/71	1/6/71	8/6/71	15/6/71	22/6/71	29/6/71	5/7/71	12/7/71	19/7/71	26/7/71	3/8/71	10/8/71	17/8/71	24/8/71	31/8/71	7/9/71	14/9/71	21/9/71	28/9/71	4/10/71	11/10/71	18/10/71	25/10/71	1/11/71	8/11/71	15/11/71	22/11/71	29/11/71	5/12/71	12/12/71	19/12/71	26/12/71	2/1/72	9/1/72	16/1/72	23/1/72	30/1/72	6/2/72	13/2/72	20/2/72	27/2/72	3/3/72	10/3/72	17/3/72	24/3/72	31/3/72	7/4/72	14/4/72	21/4/72	28/4/72	4/5/72	11/5/72	18/5/72	25/5/72	1/6/72	8/6/72	15/6/72	22/6/72	29/6/72	5/7/72	12/7/72	19/7/72	26/7/72	3/8/72	10/8/72	17/8/72	24/8/72	31/8/72	7/9/72	14/9/72	21/9/72	28/9/72	4/10/72	11/10/72	18/10/72	25/10/72	1/11/72	8/11/72	15/11/72	22/11/72	29/11/72	5/12/72	12/12/72	19/12/72	26/12/72	2/1/73	9/1/73	16/1/73	23/1/73	30/1/73	6/2/73	13/2/73	20/2/73	27/2/73	3/3/73	10/3/73	17/3/73	24/3/73	31/3/73	7/4/73	14/4/73	21/4/73	28/4/73	4/5/73	11/5/73	18/5/73	25/5/73	1/6/73	8/6/73	15/6/73	22/6/73	29/6/73	5/7/73	12/7/73	19/7/73	26/7/73	3/8/73	10/8/73	17/8/73	24/8/73	31/8/73	7/9/73	14/9/73	21/9/73	28/9/73	4/10/73	11/10/73	18/10/73	25/10/73	1/11/73	8/11/73	15/11/73	22/11/73	29/11/73	5/12/73	12/12/73	19/12/73	26/12/73	2/1/74	9/1/74	16/1/74	23/1/74	30/1/74	6/2/74	13/2/74	20/2/74	27/2/74	3/3/74	10/3/74	17/3/74	24/3/74	31/3/74	7/4/74	14/4/74	21/4/74	28/4/74	4/5/74	11/5/74	18/5/74	25/5/74	1/6/74	8/6/74	15/6/74	22/6/74	29/6/74	5/7/74	12/7/74	19/7/74	26/7/74	3/8/74	10/8/74	17/8/74	24/8/74	31/8/74	7/9/74	14/9/74	21/9/74	28/9/74	4/10/74	11/10/74	18/10/74	25/10/74	1/11/74	8/11/74	15/11/74	22/11/74	29/11/74	5/12/74	12/12/74	19/12/74	26/12/74	2/1/75	9/1/75	16/1/75	23/1/75	30/1/75	6/2/75	13/2/75	20/2/75	27/2/75	3/3/75	10/3/75	17/3/75	24/3/75	31/3/75	7/4/75	14/4/75	21/4/75	28/4/75	4/5/75	11/5/75	18/5/75	25/5/75	1/6/75	8/6/75	15/6/75	22/6/75	29/6/75	5/7/75	12/7/75	19/7/75	26/7/75	3/8/75	10/8/75	17/8/75	24/8/75	31/8/75	7/9/75	14/9/75	21/9/75	28/9/75	4/10/75	11/10/75	18/10/75	25/10/75	1/11/75	8/11/75	15/11/75	22/11/75	29/11/75	5/12/75	12/12/75	19/12/75	26/12/75	2/1/76	9/1/76	16/1/76	23/1/76	30/1/76	6/2/76	13/2/76	20/2/76	27/2/76	3/3/76	10/3/76	17/3/76	24/3/76	31/3/76	7/4/76	14/4/76	21/4/76	28/4/76	4/5/76	11/5/76	18/5/76	25/5/76	1/6/76	8/6/76	15/6/76	22/6/76	29/6/76	5/7/76	12/7/76	19/7/76	26/7/76	3/8/76	10/8/76	17/8/76	24/8/76	31/8/76	7/9/76	14/9/76	21/9/76	28/9/76	4/10/76	11/10/76	18/10/76	25/10/76	1/11/76	8/11/76	15/11/76	22/11/76	29/11/76	5/12/76	12/12/76	19/12/76	26/12/76	2/1/77	9/1/77	16/1/77	23/1/77	30/1/77	6/2/77	13/2/77	20/2/77	27/2/77	3/3/77	10/3/77	17/3/77	24/3/77	31/3/77	7/4/77	14/4/77	21/4/77	28/4/77	4/5/77	11/5/77	18/5/77	25/5/77	1/6/77	8/6/77	15/6/77	22/6/77	29/6/77	5/7/77	12/7/77	19/7/77	26/7/77	3/8/77	10/8/77	17/8/77	24/8/77	31/8/77	7/9/77	14/9/77	21/9/77	28/9/77	4/10/77	11/10/77	18/10/77	25/10/77	1/11/77	8/11/77	15/11/77	22/11/77	29/11/77	5/12/77	12/12/77	19/12/77	26/12/77	2/1/78	9/1/78	16/1/78	23/1/78	30/1/78	6/2/78	13/2/78	20/2/78	27/2/78	3/3/78	10/3/78	17/3/78	24/3/78	31/3/78	7/4/78	14/4/78	21/4/78	28/4/78	4/5/78	11/5/78	18/5/78	25/5/78	1/6/78	8/6/78	15/6/78	22/6/78	29/6/78	5/7/78	12/7/78	19/7/78	26/7/78	3/8/78	10/8/78	17/8/78	24/8/78	31/8/78	7/9/78	14/9/78	21/9/78	28/9/78	4/10/78	11/10/78	18/10/78	25/10/78	1/11/78	8/11/78	15/11/78	22/11/78	29/11/78	5/12/78	12/12/78	19/12/78	26/12/78	2/1/79	9/1/79	16/1/79	23/1/79	30/1/79	6/2/79	13/2/79	20/2/79	27/2/79	3/3/79	10/3/79	17/3/79	24/3/79	31/3/79	7/4/79	14/4/79	21/4/79	28/4/79	4/5/79	11/5/79	18/5/79	25/5/79	1/6/79	8/6/79	15/6/79	22/6/79	29/6/79	5/7/79	12/7/79	19/7/79	26/7/79	3/8/79	10/8/79	17/8/79	24/8/79	31/8/79	7/9/79	14/9/79	21/9/79	28/9/79	4/10/79	11/10/79	18/10/79	25/10/79	1/11/79	8/11/79	15/11/79	22/11/79	29/11/79	5/12/79	12/12/79	19/12/79	26/12/79	2/1/80	9/1/80	16/1/80	23/1/80	30/1/80	6/2/80	13/2/80	20/2/80	27/2/80	3/3/80	10/3/80	17/3/80	24/3/80	31/3/80	7/4/80	14/4/80	21/4/80	28/4/80	4/5/80	11/5/80	18/5/80	25/5/80	1/6/80	8/6/80	15/6/80	22/6/80	29/6/80	5/7/80	12/7/80	19/7/80	26/7/80	3/8/80	10/8/80	17/8/80	24/8/80	31/8/80	7/9/80	14/9/80	21/9/80	28/9/80	4/10/80	11/10/80	18/10/80	25/10/80	1/11/80	8/11/80	15/11/80	22/11/80	29/11/80	5/12/80	12/12/80	19/12/80	26/12/80	2/1/81	9/1/81	16/1/81	23/1/81	30/1/81	6/2/81	13/2/81	20/2/81	27/2/81	3/3/81	10/3/81	17/3/81	24/3/81	31/3/81	7/4/81	14/4/81	21/4/81	28/4/81	4/5/81	11/5/81	18/5/81	25/5/81	1/6/81	8/6/81	15/6/81	22/6/81	29/6/81	5/7/81	12/7/81	19/7/81	26/7/81	3/8/81	10/8/81	17/8/81	24/8/81	31/8/81	7/9/81	14/9/81	21/9/81	28/9/81	4/10/81	11/10/81	18/10/81	25/10/81	1/11/81	8/11/81	15/11/81	22/11/81	29/11/81	5/12/81	12/12/81	19/12/81	26/12/81	2/1/82	9/1/82	16/1/82	23/1/82	30/1/82	6/2/82	13/2/82	20/2/82	27/2/82	3/3/82	10/3/82	17/3/82	24/3/82	31/3/82	7/4/82	14/4/82	21/4/82	28/4/82	4/5/82	11/5/82	18/5/82	25/5/82	1/6/82	8/6/82	15/6/82	22/6/82	29/6/82	5/7/82	12/7/82	19/7/82	26/7/82	3/8/82	10/8/82	17/8/82	24/8/82	31/8/82	7/9/82	14/9/82	21/9/82	28/9/82	4/10/82	11/10/82	18/10/82	25/10/82	1/11/82	8/11/82	15/11/82	22/11/82	29/11/82	5/12/82	12/12/82	19/12/82	26/12/82	2/1/83	9/1/83	16/1/83	23/1/83	30/1/83	6/2/83	13/2/83	20/2/83	27/2/83	3/3/83	10/3/83	17/3/83	24/3/83	31/3/83	7/4/83	14/4/83	21/4/83	28/4/83	4/5/83	11/5/83	18/5/83	25/5/83	1/6/83	8/6/83	15/6/83	22/6/83	29/6/83	5/7/83	12/7/83	19/7/83	26/7/83	3/8/83	10/8/83	17/8/83	24/8/83	31/8/83	7/9/83	14/9/83	21/9/83	28/9/83	4/10/83	11/10/83	18/10/83	25/10/83	1/11/83	8/11/83	15/11/83	22/11/83	29/11/83	5/12/83	12/12/83	19/12/83	26/12/83	2/1/84	9/1/84	16/1/84	23/1/84	30/1/84	6/2/84	13/2/84	20/2/84	27/2/84	3/3/84	10/3/84	17/3/84	24/3/84	31/3/84	7/4/84	14/4/84	21/4/84	28/4/84	4/5/84	11/5/84	18/5/84	25
----------	------	------	------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	--------	--------	---------	---------	---------	---------	----------	----------	----------	---------	----------	----------	----------	---------	---------	----------	----------	----------	--------	---------	---------	---------	--------	--------	---------	---------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	--------	--------	---------	---------	---------	--------	---------	---------	---------	---------	----------	----------	----------	----------	---------	----------	----------	----------	---------	----------	----------	----------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	---------	----------	----------	----------	---------	---------	----------	----------	----------	---------	----------	----------	----------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	---------	----------	----------	----------	---------	---------	----------	----------	----------	---------	----------	----------	----------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	---------	----------	----------	----------	---------	---------	----------	----------	----------	---------	----------	----------	----------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	---------	----------	----------	----------	---------	---------	----------	----------	----------	---------	----------	----------	----------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	---------	----------	----------	----------	---------	---------	----------	----------	----------	---------	----------	----------	----------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	---------	----------	----------	----------	---------	---------	----------	----------	----------	---------	----------	----------	----------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	---------	----------	----------	----------	---------	---------	----------	----------	----------	---------	----------	----------	----------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	---------	----------	----------	----------	---------	---------	----------	----------	----------	---------	----------	----------	----------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	---------	----------	----------	----------	---------	---------	----------	----------	----------	---------	----------	----------	----------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	---------	----------	----------	----------	---------	---------	----------	----------	----------	---------	----------	----------	----------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	---------	----------	----------	----------	---------	---------	----------	----------	----------	---------	----------	----------	----------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	---------	----------	----------	----------	---------	---------	----------	----------	----------	---------	----------	----------	----------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	---------	----------	----------	----------	---------	---------	----------	----------	----------	---------	----------	----------	----------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	---------	----------	----------	----------	---------	---------	----------	----------	----------	---------	----------	----------	----------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	---------	----------	----------	----------	---------	---------	----------	----------	----------	---------	----------	----------	----------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	---------	----------	----------	----------	---------	---------	----------	----------	----------	---------	----------	----------	----------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	---------	----------	----------	----------	---------	---------	----------	----------	----------	---------	----------	----------	----------	--------	--------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	---------	---------	--------	---------	---------	---------	--------	---------	---------	----

APPENDIX TABLE 15 : INFLUENCE OF ACID TREATMENT ON THE GERMINATION OF NUTCRASS SEED. PERCENTAGE GERMINATION.

SUBSTRATE	DATE	ACID TREATED					UNTREATED				
		I	II	III	IV	TOTAL	I	II	III	IV	TOTAL
SOIL	28/9/61	47	49	43	41		4	6	11	1	
	12/10/61	65	65	64	62		7	16	17	6	
	24/10/61	65	66	64	62		9	17	18	8	
		65	66	64	62	257	9	17	16	9	53
SAND	28/9/61	42	41	29	52		8	9	1	8	
	12/10/61	66	60	41	64		13	16	6	11	
	24/10/61	66	61	42	68		13	17	6	12	
		66	61	42	68	237	13	17	6	12	48
FILTER PAPER	28/9/61	55	54	51	51		9	13	10	12	
	12/10/61	66	65	58	61		23	27	32	26	
	24/10/61	67	67	63	63		27	33	39	30	
		67	67	63	63	260	27	33	39	30	129

ANALYSIS OF VARIANCE

PERCENTAGE GERMINATION OF NUTCRASS SEED.
(ANGULAR TRANSFORMATION)

	DF	MEAN SQ.	F
SUBSTRATES	2	176.6390	* *
ACID TREAT- MENTS	1	4460.5640	
S X A	2	99.6670	* *
ERROR	18	16.0419	

APPENDIX TABLE 16 : GERMINATION OF NUTGRASS HARVESTED AT VARIOUS STAGES DURING THE GROWING PERIOD. .. NUMBER OF GERMINATED SEEDS.

TREATMENT		UNTREATED							ACID TREATED						
Seed		Num. germinated after							Num. germinated after						
Harvested	Soan	7	14	21	28	35	40	TOT	7	14	21	28	35	40	TOT
		days							days						
1. 30/12/63	4/1/64														*
	A	0	0	10	8	18	13	49	0	1	10	15	12	7	45
	B	0	0	7	15	17	13	53	0	0	16	14	13	7	50
	C	0	0	5	13	17	16	49	0	1	7	18	14	6	43
	D	0	2	2	12	10	16	40	0	2	10	7	20	10	49
TOTAL								190							187
2. 10/1/64	30/1/64														*
	A	0	1	5	2	1	2	12	0	2	5	4	4	3	20
	B	0	4	12	3	2	2	23	0	8	5	3	0	4	20
	C	0	4	4	5	3	2	18	0	11	9	2	4	1	27
	D	0	2	10	6	3	1	22	0	4	6	5	4	2	22
TOTAL								75							69
3. 24/1/64	30/1/64														*
	A	0	23	33	7	3	2	68	0	23	29	5	5	6	69
	B	0	23	18	14	9	4	70	0	28	3	7	4	0	45
	C	0	11	23	10	2	3	49	0	27	30	0	3	1	61
	D	0	12	22	10	5	3	62	0	24	3	5	3	5	40
TOTAL								242							222
4. 3/1/64	12/2/64														*
	A	0	13	16	4	4	3	39	17	8	0	8	1	1	38
	B	0	11	18	0	0	3	29	16	6	0	6	0	0	39
	C	0	14	3	8	4	3	32	15	12	7	3	0	1	33
	D	0	7	13	7	0	4	30	23	12	2	2	1	1	41
TOTAL								130							136
5. 14/2/64	4/3/64														*
	A	0	12	18	5	6	3	44	0	42	17	4	5	1	69
	B	0	5	14	9	10	3	42	0	47	12	3	9	0	62
	C	0	9	20	11	7	1	48	0	33	12	4	4	2	55
	D	0	5	16	13	6	6	51	0	39	3	4	5	2	59
TOTAL								185							235
6. 21/2/64	4/3/64														*
	A	0	0	4	3	7	2	16	0	1	4	7	8	1	21
	B	0	0	2	5	5	6	18	0	0	2	5	11	4	22
	C	0	0	1	2	4	2	9	0	3	5	8	7	6	28
	D	0	0	1	2	5	5	20	0	1	5	3	3	3	15
TOTAL								63							86

Num = Number

* = 70 nutgrass seeds per replication

ANALYSIS OF VARIANCE

PERCENT GERMINATION AFTER 40 DAYS (ANGULAR TRANSFORMATION).

	DF	MEAN SQ	F
HARVESTING DATES	6	869.5752	**
ACID TREATMENT	5	611.6960	**
HxH	5	62.5178	
ERROR	36	18.0030	

APPENDIX TABLE 17
GERMINATION OF NUTGRASS SEED (PERCENT GERMINATION)

[illegible]

ANALYSIS OF VARIANCE - PERCENT GERMINATION
(ANGULAR TRANSFORMATION)

TREATMENTS	DF	MEANS SQ.	F
TREATMENTS	5	475.8500	**
ERROR	21	13.5152	

APPENDIX TABLE 1A: NUMBER OF SEEDS PER MUTGRASS
INFLORESCENCE.

INFLORESCENCE	SPIKES PER UMBEL	SPIKELET PER SPIKE								TOTAL	TOTAL SEEDS PER UMBEL*
		1	2	3	4	5	6	7	8		
1	7	8	8	13	12	6	13	14		72	854
2	8	20	6	25	24	23	22	10	15	141	1692
3	6	28	23	7	27	14	21			120	1440
4	6	16	21	23	20	26	30			136	1632
5	8	21	26	14	6	12	22	28	20	149	1788
6	8	28	21	26	9	14	22	16	21	157	1884
7	7	15	26	10	16	27	8	22		124	1488
8	6	14	21	16	6	24	16			97	1164
9	7	23	7	12	16	22	23	19		122	1464
10	8	18	9	20	26	8	11	23	12	128	1536
TOTAL	71									1240	14952

* Based on 12 seeds per spikelet.

APPENDIX TABLE 13: NUMBER OF SEEDS PER WYTBASS
INFLORESCENCE.

INFLORESCENCE	SPIKES PER UMBEL	SPIKELET PER SPIKE								TOTAL	TOTAL SEEDS PER UMBEL*
		1	2	3	4	5	6	7	8		
1	7	8	6	13	12	6	13	14		72	864
2	8	20	6	25	24	23	22	10	15	141	1692
3	5	26	23	7	27	14	21			120	1440
4	6	16	21	23	20	26	30			136	1632
5	8	21	26	14	5	12	22	28	20	149	1788
6	8	28	21	26	9	14	22	16	21	157	1884
7	7	15	26	10	16	27	8	22		124	1488
8	6	14	21	16	5	24	10			97	1164
9	7	23	7	12	16	22	23	19		122	1464
10	8	18	9	20	25	9	11	23	12	128	1536
TOTAL	71									1245	14952

* Based on 12 seeds per spikelet.

APPENDIX TABLE 19 : CYPERUS ESCULENTUS INFLORESCENCE

NUMBER	STEM HEIGHT MM.	SPIKES	TOTAL SPIKELETS PER UMBEL	TOTAL SEEDS PER UMBEL *
1	44	8	117	1404
2	37	9	196	2376
3	39	7	142	1704
4	45	7	103	1236
5	33	9	475	5700
6	50	8	118	1416
7	44	7	99	1188
8	39	6	131	1572
9	45	7	116	1392
10	48	7	135	1632
11	45	5	85	1020
12	44	6	114	1368
13	44	9	203	2436
14	50	8	214	2568
15	34	7	212	2544
16	45	8	217	2604
17	45	8	145	1740
18	46	7	180	2160
19	40	7	198	2376
20	50	9	214	2568
TOTAL	86.7	147	3437	41244

* Based on 12 seeds per spikelet.

APPENDIX TABLE 20 : NUMBER OF TEFF SEED SAMPLES SUBMITTED TO THE DEPARTMENT OF AGRICULTURE, PRETORIA, DURING THE PERIOD 1963/65
NUMBER OF TEFF SEED SAMPLES (20.3 GRAMS) CONTAMINATED WITH NUTCRASS SEED

YEAR	NUMBER OF SAMPLES	NUMBER OF NUTCRASS SEEDS PER TEFF SAMPLE															
		0 - 0	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 100	100 - 250	250 - 500	500 - 1000	1000 - 2000	2000 - 3000	3000 - 4000	4000 - 5000	5000 - 14000	14000 - 50000
1963	63	22	5	1	4	1	4	5	10	6	3	2	0	0	0	0	0
1964	35	3	12	0	2	7	1	5	3	2	0	0	0	0	0	0	0
1965	109	9	21	15	3	7	3	19	20	6	1	4	1	2	1	2	1
TOTAL	207	34	38	16	9	15	8	28	31	14	4	6	1	2	1	2	1

APPENDIX TABLE 21 : DISTRIBUTION OF RUTGRASS TUBERS IN A SOIL
PROFILE AT BARSFONTEIN.

SAMPLE NO	0 - 3" Layer		3 - 6" Layer		6 - 9" Layer	
	Normal	Depleted	Normal	Depleted	Normal	Depleted
1	519	124	296	84	149	52
2	837	144	343	78	171	32
3	791	74	280	39	43	14
4	956	96	154	18	86	29
5	1094	178	343	118	182	125
6	694	154	452	109	120	72
TOTAL	4891	770	1698	425	531	335
MEAN	815	128	316	70	138	57

APPENDIX TABLE 22.1. INFLUENCE OF TEMPERATURE ON THE SPROUTING OF NUTGRASS TUBERS

[illegible]

ANALYSIS OF VARIANCE

PERCENT SPROUTED TUBERS (ANGULAR TRANSFORMATION) - 29/12/61.

	DF	MEAN SQ.	F
TREATMENTS	5	427.97	
ERROR	12	12.55	

PERCENT SPROUTED TUBERS(ANGULAR TRANSFORMATION) - 26/1/62.

	DF	MEAN SQ.	F
TREATMENTS	6	548.76	
ERROR	14	13.36	

APPENDIX TABLE 23. INFLUENCE OF WINDING ON THE BROODING OF NUTCRACKERS, TURKEYS,
AND OTHER BIRDS. (BASED ON DATA FROM THE BUREAU OF BIRDS, WASHINGTON, D. C.)

WINDING	WINDING ON THE BROODING OF NUTCRACKERS, TURKEYS, AND OTHER BIRDS										WINDING ON THE BROODING OF NUTCRACKERS, TURKEYS, AND OTHER BIRDS									
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
1	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
2	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
3	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
4	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
5	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
6	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
7	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
8	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
9	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
10	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10

ANALYSIS OF VARIANCE

WINDING	DE. DEAN. BIL.	
	1	2
WINDING	1	2
WINDING	1	2

APPENDIX TABLE 24 : INFLUENCE OF EXPOSURE ON THE VIABILITY OF
NUTGRASS TUBERS - PERCENTAGE SPROUTED TUBERS.

2 DAY EXPOSURE					4 DAY EXPOSURE				
Date of Count	Treatments				Date of Count	Treatments			
	Grass cover	Un- covered	Sand cover	Leb.		Grass cover	Un- covered	Sand cover	Leb.
8/1/61	17	22	14	15	25/1/61	6	4	9	5
30/1/61	9	6	6	6	30/1/61	18	9	13	20
3/2/61	4	1	8	1	3/2/61	5	-	2	2
6/2/61	1	3	2	3	6/2/61	5	1	4	2
13/2/61	-	-	1	2	13/2/61	1	1	1	-
28/2/61	6	-	3	4	28/2/61	4	5	6	11
Total	37	32	34	33	Total	39	18	35	40

7 DAY EXPOSURE					12 DAY EXPOSURE				
Date of Count	Treatments				Date of Count	Treatments			
	Grass cover	Un- covered	Sand cover	Leb.		Grass cover	Un- covered	Sand cover	Leb.
30/1/61	7	4	22	11	3/2/61	10	-	4	6
3/2/61	4	4	7	12	6/2/61	6	-	4	4
6/2/61	3	-	3	3	13/2/61	6	-	10	12
13/2/61	7	-	3	5	28/2/61	15	-	10	18
28/2/61	7	-	5	7					
Total	28	8	40	38		38	-	28	46

APPENDIX TABLE 25 : INFLUENCE OF EXPOSURE ON THE VIABILITY OF NUTGRASS TUBERS
PERCENTAGE SPROUTED TUBERS.

TREATMENT	PLANTING DATE	DAYS AFTER PLANTING															31	TOT.									
		7	8	9	10	11	12	13	14	15	16	17	18	19	20	21			22	23	24	25	26	27	28	29	30
Glasshouse Uncovered	1	21/4	27	25	27	32	35	33	29	34	27	33	27	33	27	33	27	33	27	33	27	33	27	33	27	33	56
	2	22/4	26	32	35	33	29	34	29	34	29	34	29	34	29	34	29	35	29	35	31	35	32	35	35	67	
	3	23/4	40	24	40	24	40	24	40	24	40	24	40	25	41	27	41	27	41	29	41	29	41	29	41	70	
	4	24/4	25	27	32	37	29	27	29	29	28	31	32	31	32	31	32	31	32	31	32	31	32	31	32	55	
	5	25/4	6	3	9	12	13	11	12	17	15	19	16	20	18	25	18	27	18	27	18	27	18	27	18	27	46
Laboratory	1	21/4	37	32	37	37	39	40	39	40	35	40	35	40	35	41	39	41	39	41	39	41	39	41	39	80	
	2	22/4	24	24	26	28	27	28	27	31	27	31	28	31	28	31	28	31	28	31	28	31	28	31	52		
	3	23/4	20	17	22	19	25	19	25	19	25	19	25	19	26	21	27	21	29	21	29	21	29	21	50		
	4	24/4	9	11	10	12	11	12	11	12	11	12	11	12	14	12	14	12	14	12	14	12	14	12	27		
	5	25/4	3	0	0	0	5	14	6	15	6	16	9	16	10	15	14	15	14	15	14	15	14	15	14	28	

APPENDIX TABLE 26 : PERCENTAGE SPROUTED TUBERS FOLLOWING EXPOSURE OF TUBERS TO INSULATION.

TREATMENT	24/1	25/1	27/1	28/1	31/1	3/2	7/2	10/2	14/2	TOTAL		MEAN
										Repl	TST	
1st Sampling (24/1)												
Glasshouse uncovered A	2	6	5	8	3	2	0	0	0	28	58	29.0
Glasshouse covered A	10	7	2	1	4	0	1	0	0	10	12	14.0
Laboratory	8	0	0	2	5	1	0	0	0	17	35	18.0
2nd Sampling (22/1)												
Glasshouse uncovered A	0	0*	2	1	1	4	2**	0	2	12	35	17.5
Glasshouse covered A	1	4*	1	0*	3	2	2**	0	1	13	18	15.5
Laboratory	6	5	1	2	4	1	1	0	0	20	31	15.5
3rd Sampling (24/1)												
Glasshouse uncovered A	0	0*	2	2	4	4	6**	1	1	20	51	25.5
Glasshouse covered A	0	0*	2	2	2	5	6**	0	0	21	31	15.5
Laboratory	0	0	2	1	2	0	0	0	0	15	27	13.5
4th Sampling												
Glasshouse uncovered A	0	0	0	1*	6	12*	1*	0	2	24	45	23.0
Glasshouse covered A	0	0	0	1	9	7	1	0	1	22	39	19.0
Laboratory	0	0	1	0	10	4	3	0	0	20	38	19.0
5th Sampling												
Glasshouse uncovered A	0	0	0	0	7	10	8	0	0	13	28	14.0
Glasshouse covered A	0	0	0	0	7	4	0	0	0	11	21	10.5
Laboratory	0	0	0	0	5	1	0	0	0	6	11	5.5

* = Tubers mouldy
 * = Tubers mouldy but sprouting
 ** = Tubers vary mouldy
 Repl. = Replication
 TST = Treatment

APPENDIX TABLE 27 : INFLUENCE OF CLIPPING FREQUENCY ON GREEN HERBAGE WEIGHT OF NUTGRASS .
WEIGHTS IN GRAMS PER POT

TREATMENT	DATE OF CLIPPING										TOTAL	MEAN
	17/1	22/1	27/1	9/2	14/2	21/2	28/2	7/3	17/3	2/4		
10 Clippings	15.9	17.6	5.5	40.5	18.9	15.9	9.2	14.4	17.2	42.8	198.9	
2	14.5	15.1	7.6	43.0	15.4	17.4	9.3	11.7	20.1	57.8	222.8	
3	28.8	25.4	5.8	39.2	15.4	22.1	8.5	11.4	35.2	53.9	658.6	211.8
TOTAL	59.2	58.1	18.9	122.7	50.7	55.4	27.0	37.5	60.1	254.7		
5 Clippings		68.2		72.1			24.5		19.6	68.6	279.5	
2		57.3		80.3			30.4		44.6	69.4	279.5	
3		55.8		80.3			30.4		25.7	45.4	226.7	
TOTAL		180.3		232.6			85.6		87.1	182.1	785.9	261.6
4 Clippings			60.0			58.1			39.4	58.5	233.5	
1			49.4			58.1			39.6	64.2	243.6	
3			110.3			49.4			46.3	39.0	215.3	
TOTAL			179.7			265.6			124.5	163.0	710.4	236.8
3 Clippings				133.4			60.5		53.9	298.2		
1				135.0			51.7		53.3	271.0		
2				141.3			51.8		53.3	266.4		
TOTAL				410.7			154.4		158.3	234.2	265.2	
2 Clippings									17.8	17.8	232.3	
1									210.6	20.1	230.7	
TOTAL									228.4	75.6	297.2	232.3

ANALYSIS OF VARIANCE : GREEN HERBAGE WEIGHT

TREATMENTS ERROR	DF	MEAN SQ.		F
		4	10	
		2255.68	294.30	7.67 *

APPENDIX TABLE 28: INFLUENCE OF CLIPPING FREQUENCY ON THE
AIR-DRY WEIGHT OF THE UNDERGROUND
FRACTIONS OF WUTGRASS. (GRAMS PER POT).

TREATMENT		WEIGHT OF ROOTS	NUMBER OF TUBERS	WEIGHT OF TUBERS
10 Clippings	1	32.1	128	13.3
	2	37.5	63	12.6
	3	39.0	258	16.2
TOTAL		108.4	449	42.1
MEAN		36.1	149	14.0
5 Clippings	1	41.5	190	13.7
	2	38.0	281	14.5
	3	28.7	423	22.8
TOTAL		108.2	894	51.0
MEAN		36.0	298	17.0
4 Clippings	1	61.4	375	23.7
	2	40.3	259	16.3
	3	43.2	408	22.8
TOTAL		144.9	1042	62.8
MEAN		48.3	347	20.9
3 Clippings	1	66.7	367	29.0
	2	56.5	337	20.1
	3	70.1	362	23.6
TOTAL		193.3	1066	72.7
MEAN		64.4	355	24.2
2 Clippings	1	70.1	443	45.3
	2	54.3	633	75.7
	3	54.5	319	25.6
TOTAL		178.9	1394	146.6
MEAN		59.6	465	48.9

ANALYSIS OF VARIANCE

AIR-DRY WEIGHT OF WETGRASS ROOTS

	DF	MEAN SQ.	F
TREATMENTS	4	504.18	7.89 **
ERROR	10	65.87	

AIR-DRY WEIGHT OF TUBERS

	DF	MEAN SQ.	F
TREATMENTS	4	539.97	
ERROR	10	129.09	

NUMBER OF TUBERS

	DF	MEAN SQ.	F
TREATMENTS	4	383.32	
ERROR	10	120.76	

APPENDIX TABLE 29 :WEIGHT, HEIGHT, AND NUMBERS OF
MAIZE AND NUTGRASS.

[illegible]

APPENDIX TABLE 30A: FRESH ROOT WEIGHTS OF UNDERGROUND FRACTIONS
IN GRAMS PER TRAY.

TREATMENT		MAIZE ROOTS	NOTGRASS ROOTS	TOTAL
CIF1	1	58.6	581.7	640.3
	2	44.0	518.2	562.2
	3	58.7	633.1	691.8
TOTAL		161.3	2033.0	
CIFo	1	51.9	549.4	601.3
	2	47.8	440.6	488.4
	3	35.2	544.2	679.4
TOTAL		134.9	1534.2	
CoF1	1	213.6	520.7	734.3
	2	220.2	459.0	679.2
	3	191.5	521.3	712.8
TOTAL		625.3	1501.0	
CoFo	1	126.7	512.2	638.9
	2	131.8	470.2	602.0
	3	145.1	355.3	500.4
TOTAL		404.6	1337.7	

APPENDIX TABLE 30 B:

AIR-DRY WEIGHTS OF UNDERGROUND
FRACTIONS OF MAIZE AND RUTGRASS IN GRAMS
PER TRAY.

TREATMENT		MAIZE ROOTS	RUTGRASS ROOTS	TUBER WEIGHT	TUBER NUMBER
C1F1	1	27.0	354.3	66.8	256
	2	17.8	534.6	86.7	394
	3	23.6	396.5	66.2	302
		68.4	1285.4	209.7	550
C1F0	1	17.1	295.2	69.4	291
	2	17.4	212.0	64.6	251
	3	15.5	369.1	77.8	347
		50.0	876.3	211.8	888
C0F1	1	123.8	275.9	65.2	328
	2	96.9	272.8	33.5	166
	3	110.4	318.4	39.6	196
		331.1	867.1	138.3	591
C0F0	1	68.8	301.6	40.4	178
	2	74.4	248.2	65.3	289
	3	79.2	197.3	45.1	232
		222.4	747.1	151.8	709

ANALYSIS OF VARIANCE

1. GREEN WEIGHT OF MAIZE STEMS

	DF	MEAN SQ.	F
Planting	1	12551.79	**
Fertilizer	1	45620.98	**
P x F	1	3913.27	**
Error	8	204.32	

2. GREEN WEIGHT OF NUTGRASS STEMS

	DF	MEAN SQ.	F
Planting	1	8629.00	**
Fertilizer	1	24201.10	**
P x F	1	3906.00	**
Error	8	407.34	

3. GREEN STEM WEIGHT OF MAIZE AND NUTGRASS COMBINED

	DF	MEAN SQ.	F
Planting	1	1369.60	
Fertilizer	1	136277.50	**
P x F	1		
Error	8	548.16	

4. FRESH WEIGHT OF MAIZE ROOTS

	DF	MEAN SQ.	F
Planting	1	44859.63	**
Fertilizer	1	5088.20	**
P x F	1	3146.05	**
Error	8	118.59	

5. FRESH WEIGHT OF NUTGRASS ROOTS

	DF	MEAN SQ.	F
Planting	1	57200.30	*
Fertilizer	1	26339.80	
P x F	1	4621.60	
Error	8	8432.77	

6. FRESH ROOT WEIGHT OF MAIZE AND NUTGRASS COMBINED

	DF	MEAN SQ.	F
Planting	1	749.00	
Fertilizer	1	54667.00	*
P x F	1	141.00	
Error	8	7136.32	

7. AIR-DRY WEIGHT OF MAIZE ROOTS

	DF	MEAN SQ.	F
Planting	1	15776.0010	**
Fertilizer	1	1346.2010	**
P x F	1	679.5080	**
Error	8	57.6693	

8. AIR-DRY WEIGHT OF NUTGRASS ROOTS

	DF	MEAN SQ.	F
Planting	1	24686.50	
Fertilizer	1	23417.20	
P x F	1	7013.20	
Error	8	4590.84	

9. AIR-DRY TUBER WEIGHTS

	DF	MEAN SQ.	F
Planting	1	1346.2010	*
Fertilizer	1	10.6410	
P x F	1	65.9410	
Error	8	184.8282	

10. TUBER NUMBERS

	DF	MEAN SQ.	F
Planting	1	16075	
Fertilizer	1	96	
P x F	1	545	
Error	8	4696	

11. MAIZE HEIGHTS

	DF	MEAN SQ.	F
Planting	1	10.45	
Fertilizer	1	263.20	**
P x F	1	2.08	
Error	8	3.33	

APPENDIX TABLE 31A : COMPETITION BETWEEN NUTGRASS AND INDICATOR CROPS.
WEIGHT OF AERIAL FRACTION - NUTGRASS - GRAMS/POI

REPLICATION	TREAT.A	TREAT.B	TREAT.C	TREAT.D*	TOTAL
1	14.3	17.8	16.6	11.3	
2	9.8	23.7	15.6	23.0	
3	16.7	16.8	14.6	16.8	
4	13.2	6.4	8.7	8.7	
5	14.3	16.2	18.8	11.6	
TOTAL	70.3	80.9	73.4	61.4	285.0
MEAN	14.06	16.18	14.68	12.28	56.90

* Combined weights of both compartments.

ANALYSIS OF VARIANCE

	DF	MEAN SQ.	F
TOTAL	14	22.95	-
TREATMENTS	2	15.68	-
ERROR	12	2.23	-

WEIGHT OF AERIAL FRACTION - SORGHUM - GRAMS/POI

REPLICATION	TREAT.C	TREAT.D
1	17.2	23.5
2	26.1	27.4
3	24.5	37.2
4	36.4	16.1
5	35.1	22.4
TOTAL	142.3	126.6
MEAN	28.46	25.32

APPENDIX TABLE 316 : COMPETITION BETWEEN NUTRARS AND INDICATOR CROPS.

HEIGHT OF AERIAL FRACTION - CUCUMBERS. - GRAMS/PLT

REPLICATION	TREAT. A	TREAT. B*	TREAT. C	TOTAL
1	39.2	53.7	33.8	
2	48.9	56.3	42.6	
3	44.5	38.5	46.4	
4	44.3	48.3	39.7	
5	37.4	46.9	48.2	
TOTAL	214.3	243.7	209.3	668.3
MEAN	42.86	48.74	41.86	44.22

* Combined weights of both compartments.

ANALYSIS OF VARIANCE

	DF	MEAN SQ.	F
TOTAL	14		
TREATMENTS	2	88.66	1.60 N.S.
ERROR	12	30.39	

APPENDIX TABLE 31C : COMPETITION BETWEEN WITCHGRASS AND INDICATOR CROPS.
TOTAL UNDERGROUND FRACTION - GRAMS/ROOT
(WEIGHTS OF INDICATOR CROPS AND WITCHGRASS).

TREATMENTS

REPLICATION	TREAT. A	TREAT. B	TREAT. C	TREAT. D	TREAT. E	TOTAL
1	15.8	26.8	7.8	5.8	19.3	
2	12.7	21.4	11.5	14.5	19.3	
3	31.4	13.2	10.0	16.3	16.1	
4	16.3	14.0	13.9	9.1	16.2	
5	17.1	25.5	18.2	11.5	18.7	
TOTAL	93.3	103.9	59.1	51.4	59.8	395.4

ANALYSIS OF VARIANCE

	DF	MEAN SQ.	F
TOTAL	24		
TREATMENTS	4	93.22	2.4
ERROR	20	25.28	1.1

APPENDIX TABLE 32 : INFLUENCE OF INCREASING NITRATES POPULATIONS
ON GROWTH OF SORGHUM (18/7/55)

TREATMENT	Nitrate		Sorghum Control-Int		Sorghum Control	
	Number	Weight %	Number	Weight %	Number	Weight %
1 Tubers	1	18.7	5	3.6	5	15.1
2	7	19.1	5	6.7	5	19.1
3	5	15.3	5	4.7	5	12.1
4	5	15.2	5	7.5	5	15.1
TOTAL MEAN		69.3		22.6		
6 Tubers	1	15.5	5	3.1	5	15.1
2	6	24.9	5	5.6	5	15.1
3	9	21.6	5	1.5	5	15.1
4	7	22.1	5	3.5	5	15.1
TOTAL MEAN		65.4		12.3		
12 Tubers	1	27.4	5	5.2	5	15.1
2	9	19.4	5	6.2	5	15.1
3	10	21.3	5	2.3	5	15.1
4	11	21.5	5	1.0	5	15.1
TOTAL MEAN		86.9		7.2		
15 Tubers	1	22.1	5	1.2	5	15.1
2	15	35.5	5	2.8	5	15.1
3	12	25.8	5	2.0	5	15.1
4	22	32.6	5	1.8	5	15.1
TOTAL MEAN		116.0		7.8		
20 Tubers	1	23.3	5	0.5	5	15.1
2	16	26.8	5	1.1	5	15.1
3	16	31.1	5	1.1	5	15.1
4	18	31.2	5	1.5	5	15.1
TOTAL MEAN		122.4		4.8		

* Same for Pot.

ANALYSIS OF VARIANCE

GREEN WEIGHT OF NITRATE

	DF	MEAN SQ.	F
TREATMENTS	4	99.0607	**
ERROR	15	16.1054	

GREEN WEIGHT OF SORGHUM

	DF	MEAN SQ.	F
TREATMENTS	4	12.6217	**
ERROR	15	1.0705	

APPENDIX TABLE 35 : INFLUENCE OF PLANT POPULATION DENSITY ON THE GROWTH OF NUTCRASS.

NO. OF SPROUTED TUBERS PER POT	STEM		TUBER		ROOT WEIGHT	UNDERGROUND WEIGHT
	NUMBER	AVE-DRY WT	NUMBER			
1 Plant per pot						
1 (2 1	1	0.4	7		0.008	0.031
(3 2	1	0.35	13		0.006	0.03
(15 3	1	0.3	12		0.006	0.04
TOTAL		0.95	32		0.021	0.08
MEAN		0.32	11		0.006	0.03
2 Plants per pot						
2 (4 1	5	1.3	25		0.09	1.4
(6 2	3	0.3	14		0.004	0.2
(12 3	4	0.6	16		0.004	0.2
TOTAL		2.1	69		0.094	2.1
MEAN		0.7	23		0.031	0.7
4 Plants per pot						
3 (2 1	5	0.65	19		0.004	0.7
(6 2	6	1.46	44		0.06	0.47
(16 3	4	0.79	36		0.003	1.7
TOTAL		2.91	99		0.065	2.4
MEAN		0.97	33		0.022	0.8
8 Plants per pot						
4 (8 1	8	1.3	26		0.01	2.08
(15 2	8	6.72	35		0.004	1.05
(17 3	8	0.85	32		0.02	3.04
TOTAL		1.97	115		0.031	7.12
MEAN		0.89	38		0.010	2.38
16 plants per pot						
5 (7 1	17	2.23	69		0.04	6.35
(8 2	18	0.9	71		0.03	4.8
(10 3	16	2.4	72		0.02	5.8
TOTAL		5.83	212		0.09	15.75
MEAN		1.94	71		0.03	5.25
24 plants per pot						
6 (11 1	23	1.10	72		0.02	3.4
(14 2	18	1.29	76		0.01	4.1
(18 3	17	2.57	88		0.03	4.9
TOTAL		5.96	231		0.08	12.4
MEAN		1.32	77		0.02	4.3

ANALYSIS OF VARIANCE

STEM WEIGHTS			
DF	MEAN SQ.	F	
5	0.8209	*	
12	0.2145		

TUBER NUMBERS			
DF	MEAN SQ.	F	
5	2176.15	**	
12	54.58		

UNDERGROUND WEIGHTS			
DF	MEAN SQ.	F	
5	12.2166	**	
12	1.2769		

APPENDIX TABLE 3A-14: MEAN DAILY AND ACCUMULATIVE WATER CONSUMPTION OF THREE WEED SPECIES (MEANS OF 4 REPLICATIONS) IN POUNDS.

DATE	DAYS AFTER PLANTING	N Fe			N Fi			Ag Fo			Ag Fi			B Fo			B Fi			CONTROL		
		Da	Ac	Da	Da	Ac	Da	Da	Ac	Da	Da	Ac	Da	Da	Ac	Da	Da	Ac	Da	Da	Ac	
14/1/62	16	2.88	2.88	2.39	2.42	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	
16/1/62	18	1.94	4.82	5.81	5.81	5.81	5.81	5.81	5.81	5.81	5.81	5.81	5.81	5.81	5.81	5.81	5.81	5.81	5.81	5.81	5.81	
18/1/62	20	1.10	5.22	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	
24/1/62	26	1.51	9.10	10.41	10.41	10.41	10.41	10.41	10.41	10.41	10.41	10.41	10.41	10.41	10.41	10.41	10.41	10.41	10.41	10.41	10.41	
24/1/62	28	1.01	10.11	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24	12.24	
30/1/62	30	1.34	11.45	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	2.44	
30/1/62	33	1.46	12.89	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	
2/2/62	35	1.19	13.86	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	
4/2/62	37	0.56	16.42	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	
5/2/62	42	1.21	16.92	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	
11/2/62	44	1.38	17.15	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	
13/2/62	46	0.15	20.00	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	
13/2/62	48	0.15	20.00	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	
20/2/62	53	1.13	21.19	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	
22/2/62	55	1.28	22.47	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	
26/2/62	59	1.36	22.47	3.31	3.31	3.31	3.31	3.31	3.31	3.31	3.31	3.31	3.31	3.31	3.31	3.31	3.31	3.31	3.31	3.31	3.31	
28/2/62	61	3.13	23.95	4.53	4.53	4.53	4.53	4.53	4.53	4.53	4.53	4.53	4.53	4.53	4.53	4.53	4.53	4.53	4.53	4.53	4.53	
9/3/62	70	3.13	23.95	3.13	3.13	3.13	3.13	3.13	3.13	3.13	3.13	3.13	3.13	3.13	3.13	3.13	3.13	3.13	3.13	3.13	3.13	
12/3/62	73	3.14	33.00	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	3.14	
20/3/62	81	2.85	35.63	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	

Da = Daily

N = Nilpotent

Ac = Accumulative

Da = Daily

N = Nilpotent

Ac = Accumulative

Fo = Fertilized

Fi = Fertilized

Da = Daily

N = Nilpotent

Ac = Accumulative

Da = Daily

APPENDIX TABLE 35 : AIR-DRY WEIGHT OF WEED STEMS AND ROOTS IN GRASS PER BUCKET.

		WEIGHTS OF		WEIGHTS OF		2) AIR-DRY STEM WEIGHT OF WEEDS			
		WEED STEMS		ROOTS			DF	MEAN SQ.	F
I.	Nutgrass	O	40.5		23.4	WEEDS	2	105.30	
		FI	86.6		69.7	FERTILIZER	1	6720.10	**
	Eleusine	O	81.0		23.3	W x F	2	260.56	
		FI	28.9		29.6	ERROR	18	570.11	
	Tagetes	O	86.4		3.1				
		FI	86.4		21.1				
Control									
II.	Nutgrass	O	39.2		21.6	3) AIR-DRY ROOT WEIGHTS OF WEEDS			
		FI	95.2		72.5		DF	MEAN SQ.	F
	Eleusine	O	39.1		27.2	WEEDS	2	3276.34	**
		FI	71.2		40.3	FERTILIZER	1	1840.80	**
	Tagetes	O	24.3		3.6	W x F	2	368.62	**
		FI	91.1		12.9	ERROR	18	62.75	
Control									
III.	Nutgrass	O	30.1		59.7				
		FI	74.5		60.1				
	Eleusine	O	54.7		26.2				
		FI	63.6		41.8				
	Tagetes	O	36.0		5.7				
		FI	69.8		12.3				
Control									
IV.	Nutgrass	O	105.3		48.2				
		FI	101.1		73.6				
	Eleusine	O	39.6		19.9				
		FI	115.5		26.2				
	Tagetes	O	43.1		8.6				
		FI	119.0		12.2				
Control									

ANALYSIS OF VARIANCE

1) TOTAL WATER CONSUMPTION (LBS)

	DF	MEAN SQ.	F
WEEDS	2	689.4510	**
FERTILIZER	1	2386.2250	**
W x F	2	62.5050	*
ERROR	18	11.3607	

APPENDIX TABLE No. 1. ACCUMULATIVE GREASE CONSUMPTION (TOTAL & BUCKETS IN POUNDS)

DATE	MILKWEISS	TACKLES	SLUING
1/1/55	1.92	2.25	2.10
1/9/55	4.77	4.70	6.10
1/17/55	7.87	7.25	7.95
1/24/55	9.37	10.09	10.10
2/1/55	13.17	20.04	14.25
2/8/55	13.12	13.74	14.25
2/15/55	20.27	22.04	21.10
2/22/55	23.52	23.44	23.40
2/29/55	25.52	23.24	25.40
3/6/55	28.37	23.24	28.40
3/13/55	30.15	30.69	30.45
3/20/55	36.15	36.08	36.50
3/27/55	43.42	42.34	43.40
4/3/55	50.37	50.09	50.40
4/10/55	57.37	57.32	57.35
4/17/55	64.37	64.32	64.35
4/24/55	71.37	71.32	71.35
5/1/55	78.37	78.32	78.35
5/8/55	85.37	85.32	85.35
5/15/55	92.37	92.32	92.35
5/22/55	99.37	99.32	99.35

DATE	MILKWEISS	TACKLES	SLUING
1/1/56	99.32	101.44	102.40
1/8/56	116.17	120.54	120.45
1/15/56	133.07	134.79	134.20
1/22/56	149.87	150.54	146.05
1/29/56	166.67	166.54	162.00
2/5/56	183.47	183.00	182.05
2/12/56	200.27	200.00	200.00
2/19/56	217.07	217.00	217.00
2/26/56	233.87	233.00	233.00
3/5/56	250.67	250.00	250.00
3/12/56	267.47	267.00	267.00
3/19/56	284.27	284.00	284.00
3/26/56	301.07	301.00	301.00
4/2/56	317.87	317.00	317.00
4/9/56	334.67	334.00	334.00
4/16/56	351.47	351.00	351.00
4/23/56	368.27	368.00	368.00
4/30/56	385.07	385.00	385.00

APPENDIX TABLE 37 : WEIGHTS OF VARIOUS PLANT FRACTIONS IN DZS AND GMS PER BUCKET.

TREATMENT	REPLICATE	MAIZE		WEED		TOTAL		ATROPHY	
		STEMS		STEMS		ROOTS		STEMS AND	
		GREEN DZS	AIHRY GMS	GREEN DZ	AIHRY GMS	ROOTS GMS	WEEDS MAIZE GMS	WEEDS MAIZE GMS	ROOTS GMS
Cyperus seculentus	1	5.25	30.6	7.9	35.6	54.3	66.4	100.7	
	2	17.0	90.5	2.9	18.7	43.8	69.2	112.8	
	3	20.0	56.0	2.0	11.7	66.2	67.7	132.9	
	4	16.3	41.9	4.95	25.8	52.9	67.7	131.9	
	5	13.45	48.8	5.70	28.2	55.3	73.8	150.2	
TOTAL		72.90	225.0	23.45	119.9	325.6	344.5	668.4	
Fagates minuta	1	16.3	29.4	4.25	12.8	39.3	42.2	61.2	
	2	14.9	45.9	3.65	19.8	22.4	35.4	57.6	
	3	18.6	45.2	1.2	6.8	28.6	61.7	80.5	
	4	14.8	41.4	2.0	15.8	34.9	58.2	73.1	
	5	19.3	52.5	1.75	10.3	36.1	69.8	86.9	
TOTAL		83.9	214.4	10.85	65.9	139.3	269.3	461.2	
Eleusine indica	1	6.80	23.4	7.75	67.8	36	91.2	121.6	
	2	10.0	24.4	7.05	63.7	40.5	92.1	132.0	
	3	8.9	30.0	8.0	53.0	33.1	83.6	117.2	
	4	6.05	20.0	11.15	68.9	34.2	86.8	121.1	
	5	12.5	37.5	9.5	78.5	44.4	88.8	130.2	
TOTAL		43.25	140.3	42.35	269.1	188.2	439.4	622.7	

ANALYSIS OF VARIANCE

1) TOTAL WATER CONSUMPTION (POUNDS)

	DF	MEAN SQ.	F
Treatments	2	3.6705	N.S.
Error	12	3.4611	

2) GREEN WEIGHT OF MAIZE STEMS (OUNCES)

	DF	MEAN SQ.	F
Treatments	2	87.9031	*
Error	12	13.3948	

3) AIR-DRY WEIGHT OF MAIZE STEMS (GMS)

	DF	MEAN SQ.	F
Treatments	2	226.9090	*
Error	12	69.6199	

4) GREEN WEIGHT OF WEED STEMS (OUNCES)

	DF	MEAN SQ.	F
Treatments	2	51.3630	**
Error	12	2.7616	

5) AIR-DRY WEIGHT OF WEED STEMS (GMS)

	DF	MEAN SQ.	F
Treatments	2	2980.3630	**
Error	12	59.4102	

6) AIR-DRY WEIGHT OF WEED AND MAIZE ROOTS (COMBINED GMS)

	DF	MEAN SQ.	F
Treatments	2	1280.3330	
Error	12	133.5039	

APPENDIX TABLE 36 : INFLUENCE OF NUTRASS EXTRACTS ON THE GERMINATION AND LENGTH OF SEEDLINGS OF TEST CROPS. (LENGTH IN CMS (BASED ON 25 SEEDLINGS)).

TREATMENT		MAIZE		SORGHUM		SUNFLOWER	
		% Germin.	Length	% Germin.	Length	% Germin.	Length
TUBER EXTRACT	1	94	2.22	92	2.96	66	1.30
	2	96	1.32	94	1.20	74	1.51
	3	94	1.53	89	2.71	70	1.91
	4	98	2.24	84	2.35	84	1.09
MEAN		95.5	1.92	89.6	2.36	75.5	1.46
STEM EXTRACT	1	86	1.88	94	3.08	70	0.62
	2	88	1.96	93	2.48	70	0.81
	3	90	2.04	95	1.99	28	1.06
	4	94	2.29	92	2.31	82	1.23
MEAN		89.5	1.71	93.2	2.45	77.0	0.91
ROOT EXTRACT	1	96	2.30	88	3.53	60	2.87
	2	80	2.54	90	2.46	50	2.19
	3	89	3.28	93	1.71	76	2.58
	4	86	2.64	86	4.05	85	2.86
MEAN		88	2.78	88.5	3.39	63.5	2.77
CONTROL	1	96	5.00	88	4.46	88	7.02
	2	98	5.04	92	6.38	90	7.00
	3	90	4.86	80	4.12	80	3.29
	4	94	4.10	87	2.04	83	2.28
MEAN		94.5	4.75	89.3	4.00	85	5.23

ANALYSIS OF VARIANCE

1. LENGTH OF SEEDLINGS

	MAIZE		SORGHUM		SUNFLOWER	
	DF	MEANS SQ. F	DF	MEANS SQ. F	DF	MEANS SQ. F
EXTRACTS	3	7.9152	EXTRACTS	3 2.5578	EXTRACTS	3 20.1944
ERROR	12	0.1764	ERROR	12 0.8163	ERROR	12 0.8537

2. PERCENTAGE GERMINATION ANGULAR TRANSFORMATION.

	MAIZE		SORGHUM		SUNFLOWER	
	DF	MEANS SQ. F	DF	MEANS SQ. F	DF	MEANS SQ. F
EXTRACTS	3	60.2596	EXTRACTS	3 19.5273	EXTRACTS	3 142.5153
ERROR	12	19.1232	ERROR	12 8.2177	ERROR	12 25.8871

APPENDIX TABLE 39A : NUMBER AND WEIGHT OF NUTCRACK TUBERS AND ROOTS PER QUARTAL.

TREATMENT	NUMBER OF TUBERS										WEIGHT OF TUBERS (IN GRAMS)										
	DISCED					CONTROL					DISCED					CONTROL					
	A	B	C	D	TOTAL	A	B	C	D	TOTAL	A	B	C	D	TOTAL	A	B	C	D	TOTAL	
Disceding	1	10	27	46	41	124	147	43	125	144	459	1.1	1.4	2.8	2.6	7.9	14.6	3.7	10.8	15.3	49.2
Disceding	2	5	43	44	53	49	9	58	25	138	138	0.3	0.3	3.2	0.4	4.2	5.5	0.7	3.6	1.5	11.3
Disceding	3	2	43	44	55	144	14	37	4	96	101	0.1	2.5	2.3	4.2	9.1	1.3	4.1	0.3	4.5	10.7
Total					331					689					21.2					59.7	
Disceding	1	0	8	14	2	24	22	47	52	5	126	0	0.3	0.7	0.2	1.2	2.1	0.6	1.1	0.5	14.3
Disceding	2	8	20	24	7	59	28	46	30	23	127	0.5	1.2	1.3	0.5	2.5	5.3	0.9	1.6	0.8	9.0
Disceding	3	19	15	11	12	58	47	52	37	10	146	0.7	0.6	0.6	0.7	2.6	6.6	3.1	3.9	0.8	32.5
Total					144					245					7.3						
Disceding	1	33	4	5	3	45	23	37	48	27	245	2.7	0.2	0.3	0.5	3.7	10.6	2.5	5.8	7.7	26.5
Disceding	2	6	21	2	5	33	44	80	67	51	249	0.5	1.6	0.1	0.5	2.8	3.6	8.6	4.9	3.8	24.9
Disceding	3	4	10	6	23	45	7	22	27	67	172	0.1	0.5	0.8	1.0	2.1	0.7	1.8	2.5	5.7	10.7
Total					134					537					8.5						59.2

TREATMENT	NUMBER OF NUTS (GRAMS)										WEIGHT OF NUTS (GRAMS)									
	DISCED					CONTROL					DISCED					CONTROL				
	A	B	C	D	TOTAL	A	B	C	D	TOTAL	A	B	C	D	TOTAL	A	B	C	D	TOTAL
Disceding	1	1	1	1	4	1	1	1	1	4	1	1	1	1	4	1	1	1	1	4
Disceding	2	3	4	5	15	3	4	5	6	18	3	4	5	6	18	3	4	5	6	18
Disceding	3	1	2	3	7	1	2	3	4	10	1	2	3	4	10	1	2	3	4	10
Total					28					32					32					32
Disceding	1	2	3	4	9	2	3	4	5	14	2	3	4	5	14	2	3	4	5	14
Disceding	2	1	2	3	7	1	2	3	4	10	1	2	3	4	10	1	2	3	4	10
Disceding	3	1	2	3	7	1	2	3	4	10	1	2	3	4	10	1	2	3	4	10
Total					28					32					32					32

INFLUENCE OF DISCING ON THE PERSISTENCE OF NATGRASS

APPENDIX TABLE 398. NUMBER OF TUBES (EQ. ROOT TRANSFORMATION)

TREATMENT	REPL. 1	REPL. 2	REPL. 3	TOTAL	MEAN
1 Discing	11.11	7.64	12.08	31.05	10.35
2 Discing	4.90	7.68	7.62	20.20	6.73
3 Discing	7.14	6.16	6.71	20	6.67
Control	21.42	11.75	10.65	43.82	14.61
Control	11.22	11.04	12.09	34.34	11.45
Control	18.65	15.76	11.05	45.46	15.15
TOTAL	71.44	60.36	56.54	188.34	10.35

ANALYSIS OF VARIANCE

	S.S	DF	MEAN SQ	F
TOTAL	277.90	17		
BLOCKS	14.73	2		
TREATMENTS	159.04	3	53.01	6.23**
ERROR	104.13	12	8.68	

$$\left(\frac{8.68}{3} + \frac{8.68}{9} \right) \frac{1}{2} = 1.9641$$

$$\left(\frac{8.68}{5} + \frac{8.68}{3} \right) \frac{1}{2} = 2.4057$$

$$\frac{10.35 - 6.67}{2.4057} = 1.53 \text{ Not significant}$$

$$\frac{13.34 - 6.73}{1.9641} = 3.37**$$

APPENDIX TABLE 3DC : WEIGHT OF TUBERS (SQUARE ROOT TRANSFORMATIONS)

TREATMENT	REPL. 1	REPL. 2	REPL. 3	TOTAL	MEAN
1 Dicing	2.81	2.05	1.02	5.88	2.53
2 Dicing	1.10	1.87	1.61	4.58	2.53
3 Dicing	1.92	1.67	1.45	5.04	2.53
Control	6.72	5.35	3.10	15.17	
Control	3.76	3.00	4.02	10.78	4.12
Control	5.16	4.87	3.27	13.30	
Total	21.49	16.82	16.56	54.87	2.53

ANALYSIS OF VARIANCE

	S.S.	DF	MEAN SQ.	F
TOTAL	95.82	12		
BLOCKS	2.72	2		
TREATMENTS	23.41	3	7.80	9.55
ERROR	9.69	12	0.812	

$$(0.812) \times \frac{117}{9} = 0.6025$$

$$(0.812) \times \frac{117}{9} = 0.7381$$

$$2.65 - 1.63 = 1.02 \quad \text{Avg. significant}$$

$$4.12 - 2.65 = 1.47$$

$$0.6025$$

APPENDIX TABLE 40 : NUMBER AND WEIGHTS (GMS) OF NUTGRASS AND ANNUAL GRASSES FROM 1 SQ. METRE QUADRAT.

	A	B	C	D	TOTALS	WEIGHTS	NUMBERS	WEIGHTS	NUMBERS
NUTGRASS	N	149	142	92					
Hand-hoeing	W	11,125	10,25	7,00	42,500	425	466	10,425	121,25
Control	N	306	258	423					
Hand-hoeing	W	17,25	5,125	16,75	61,875	625	1045	15,466	303
Control	N	14,25	207	213					
Hand-hoeing	W	16,50	11,25	16,25	55,500	558	1045	13,915	260
GRASSES	N	12	73	79					
Hand-hoeing	W	0,275	5,50	5,125	10,925	125	245	4,666	61
Control	N	3,127	4,375	6,125	20,375	225	651	5,004	163
Hand-hoeing	W	3,00	5,50	2,125	11,875	225	287	5,620	72

1. NUTGRASS WEIGHTS

TREATMENTS	DF	MEANS SQ.
ERROR	5	20,375
		11,481

4. NUTGRASS OF GRASSES

TREATMENTS	DF	MEANS SQ.
ERROR	5	22,203
		11,575

2. WEIGHTS GRASSES

TREATMENTS	DF	MEANS SQ.
ERROR	9	21,929

ANALYSIS OF VARIANCES

3. NUTGRASS OF NUTGRASS

TREATMENTS	DF	MEANS SQ.
ERROR	5	3,625

N = 600gms
W = Weights

APPENDIX TABLE - 41. 1. WHEED CONTROL RATINGS.

TREATMENTS	RATINGS (22 DAYS AFTER SPRAYING)									
	NITRATES					ANNUAL CRASSES				
	I	II	III	TOTAL	MEAN	I	II	III	TOTAL	MEAN
One-linuron 4 lbs	4	2	5	12	4	6	4	8	18	6
Monolinuron 5 lbs	5	10	8	24	8	10	6	10	28	9.3
Al-linuron 4 lbs	8	2	8	18	6	8	6	8	24	8
Monuron 8 lbs	6	6	6	18	6	10	8	10	28	9.3
TEA 25 lbs	8	8	8	24	8	6	8	6	20	6.7
TEA 50 lbs	10	10	8	28	9.3	10	10	10	30	10
SCOUTED	2	2	2	7		0	0	0	0	
	2	2	2	7		0	0	0	0	
	2	2	2	7		0	0	0	0	
	2	2	2	7		0	0	0	0	
TOTAL FOR SCOUTED	10	4	6	20	1.7	12	8	0	20	1.7

ANALYSIS OF VARIANCE
(LOWERING TRANSFORMATION)

1) PERCENT GENERAL RATING

	DF	MEAN	SD.
Blocks	2	96.46	
Treatments	5	641.03	
Error	10	179.44	
			C.V. = 20.05%

2) PERCENT RATING NITRATES

	DF	MEAN	SD.
Blocks	2	5.69	
Treatments	5	665.23	
Error	10	241.84	
			C.V. = 28.46%

3) PERCENT RATING ANNUAL CRASSES

	DF	MEAN	SD.
Blocks	2	128.17	
Treatments	5	740.72	
Error	10	261.56	
			C.V. = 15.15%

GENERAL RATING 34 DAYS AFTER SPRAYING

	I	II	III	TOTAL	MEAN
2	6	8	16	5.3	
9	10	9	28	9.3	
9	6	6	21	7.0	
9	10	9	28	9.3	
5	9	7	21	7.0	
10	9	10	29	9.7	
0	1	1	2		
0	1	1	2		
0	1	1	2		
0	1	1	2		
8	4	3	15	1.3	

APPENDIX TABLE 41. WEED CONTROL RATINGS.

TREATMENTS	RATINGS (22 DAYS AFTER SPRAYING)									
	MUGGRASS					ANNUAL GRASSES				
	I	II	III	TOTAL	MEAN	I	II	III	TOTAL	MEAN
benzinuron 1 lbs	4	2	6	12	4	6	4	9	19	6
1 lbs	6	10	8	24	8	10	6	10	26	9.3
5 lbs	8	2	6	16	6	8	6	8	22	8
Benuron 4 lbs	6	6	6	18	6	10	6	10	26	9.3
Benuron 8 lbs	8	8	8	24	8	6	6	6	18	6.7
TCA 50 lbs	10	10	8	28	9.3	10	10	10	30	10
CONTROL	2	2	2	6	2	0	0	0	0	0
3	4	0	0	4	1.3	0	0	0	0	0
5	2	2	0	4	1.3	2	2	0	4	1.3
TOTAL FOUR CONTROL	15	6	6	27	1.7	12	8	0	20	1.7

ANALYSIS OF VARIANCE
(ANGULAR TRANSFORMATION)

1) PERCENT GENERAL RATINGS

	OF	SEAN NO.
Blocks	2	96.46
Treatments	5	641.03
Error	10	179.44
	C.V.	20.06%

2) PERCENT ANNUAL RATINGS

	OF	SEAN NO.
Blocks	2	5.69
Treatments	5	465.23
Error	10	241.84
	C.V.	25.44%

3) PERCENT RATING ANNUAL GRASSES

	OF	SEAN NO.
Blocks	2	180.17
Treatments	5	916.71
Error	10	292.58
	C.V.	13.75%

APPENDIX TABLE 42 : SURVEY OF WEED POPULATION (BASED ON 10" NUMBER OF WEED SPECIES PER 3, 18" X 18" FRAMES (34 DAYS AFTER SPRAYING)).

TREATMENTS	WEED SPECIES				YOUNG ANNUAL GRASSES				OLD ANNUAL GRASSES				BIOMULCH SPECIES			
	WEED SPECIES				YOUNG ANNUAL GRASSES				OLD ANNUAL GRASSES				BIOMULCH SPECIES			
	I	II	III	TOTAL	MEAN*	I	II	III	TOTAL	MEAN*	I	II	III	TOTAL	MEAN*	
Spodopurion - 4 lbs	203	74	336	59	37.3	49	213	10	300	33.6	0	0	0	0	0	1
Monoluron - 8 lbs	68	26	56	10.6	10.6	8	0.5	0	0	0	0	0	0	0	0	1
Monuron - 4 lbs	54	41	113	12.0	12.0	3	0.3	0	0	0	0	0	0	0	0	1
Monuron - 8 lbs	2	5	29	3.2	3.2	0	0	0	0	0	0	0	0	0	0	1
YEA	2	2	9	13	1.4	144	36	16	195	22.5	0	0	0	0	0	5
YEA	2	2	13	13	1.4	13	33	0	46	5.1	0	0	19	1.7	2	2
CONTROL	1	130	87	129	165	224	88	333	410	403	6	151	179	131	179	
	2	17	136	47	229	228	251	161	265	519	10	27	3	3	3	
	3	33	11	356	433	680	563	534	165	218	0	48	11	48	11	
TOTAL FOR CONTROL	335	1308	576	1269	36.2	558	1454	1372	3704	102.9	1097	1176	1322	7958	86.3	20

* 1 Frame

ANALYSIS OF VARIANCE

Treatments	NUMBER OF PLANTS		MEAN SD		F
	OF	OF	OF	OF	
Control	1	1	1	1	**
Monuron	2	2	2	2	**
YEA	3	3	3	3	**

6.11 108.5494

APPENDIX TABLE 43 : NUMBER OF NORMAL PLANTS PER PLOT

1ST PLANTING SERIES										2ND PLANTING SERIES									
TREATMENT	REPL.	NO.	TOTAL	MEAN	NO.	TOTAL	MEAN	TREATMENT	REPL.	NO.	TOTAL	MEAN	NO.	TOTAL	MEAN	NO.	TOTAL	MEAN	NO.
collumescens 4 lbs	1	244	149	154	154	154	154	Monilium	4 lbs	1	231	231	231	196	196	196	196	196	196
collumescens 8 lbs	2	228	103	172	172	172	172	Monilium	8 lbs	2	238	238	238	168	168	168	168	168	168
collumescens 16 lbs	3	170	855	220	220	220	220	Monilium	16 lbs	3	207	207	207	166	166	166	166	166	166
collumescens 32 lbs	4	153	103	103	103	103	103	Monilium	32 lbs	4	115	115	115	162	162	162	162	162	162
collumescens 64 lbs	5	126	326	103	103	103	103	Monilium	64 lbs	5	207	207	207	166	166	166	166	166	166
collumescens 128 lbs	6	10	41	14	14	14	14	Monilium	128 lbs	6	115	115	115	162	162	162	162	162	162
collumescens 256 lbs	7	9	9	9	9	9	9	Monilium	256 lbs	7	115	115	115	162	162	162	162	162	162
collumescens 512 lbs	8	6	6	6	6	6	6	Monilium	512 lbs	8	115	115	115	162	162	162	162	162	162
collumescens 1024 lbs	9	48	17	17	17	17	17	Monilium	1024 lbs	9	115	115	115	162	162	162	162	162	162
collumescens 2048 lbs	10	94	206	247	82	82	82	Monilium	2048 lbs	10	115	115	115	162	162	162	162	162	162
collumescens 4096 lbs	11	163	305	102	94	94	94	Monilium	4096 lbs	11	115	115	115	162	162	162	162	162	162
collumescens 8192 lbs	12	19	146	146	146	146	146	Monilium	8192 lbs	12	115	115	115	162	162	162	162	162	162
collumescens 16384 lbs	13	26	92	31	55	295	98	Monilium	16384 lbs	13	115	115	115	162	162	162	162	162	162
collumescens 32768 lbs	14	157	232	232	232	232	232	Monilium	32768 lbs	14	115	115	115	162	162	162	162	162	162
collumescens 65536 lbs	15	221	221	221	221	221	221	Monilium	65536 lbs	15	115	115	115	162	162	162	162	162	162
collumescens 131072 lbs	16	225	261	155	155	155	155	Monilium	131072 lbs	16	115	115	115	162	162	162	162	162	162
collumescens 262144 lbs	17	221	221	221	221	221	221	Monilium	262144 lbs	17	115	115	115	162	162	162	162	162	162
collumescens 524288 lbs	18	228	228	228	228	228	228	Monilium	524288 lbs	18	115	115	115	162	162	162	162	162	162
collumescens 1048576 lbs	19	239	239	239	239	239	239	Monilium	1048576 lbs	19	115	115	115	162	162	162	162	162	162
collumescens 2097152 lbs	20	200	200	200	200	200	200	Monilium	2097152 lbs	20	115	115	115	162	162	162	162	162	162
collumescens 4194304 lbs	21	226	226	226	226	226	226	Monilium	4194304 lbs	21	115	115	115	162	162	162	162	162	162
collumescens 8388608 lbs	22	226	226	226	226	226	226	Monilium	8388608 lbs	22	115	115	115	162	162	162	162	162	162

APPENDIX TABLE 44A : CROP YIELDS AND NUMBERS - 1ST PLANTING SERIES

TREATMENTS	BEANS				SUNFLOWERS			
	I	II	III	TOTAL	I	II	III	TOTAL
NOPLANTING 4 lbs	13.1	13.6	12.8	39.2	13.1	5.5	5.8	19.2
NOPLANTING 8 lbs	22.4	10.6	11.8	44.8	8.5	6.2	3.7	18.4
FURROW	4 lbs	4.5	6.6	2.6	15.7	5.2	5.0	7.5
	8 lbs	4.8	6.2	1.2	6.2	2.1	6.8	2.2
								9.2
25 LBS	0.1	0.6	0.1	1.0	0.3	1.2	6.5	2.2
	0.1	1.0	0.3	1.4	0.5	5.3	4.4	2.8
								12.7
CONTROL	1	5.7	9.4	11.2		5.0	4.6	6.4
	2	12.4	9.6	10.4		6.7	4.4	3.8
	4	8.5	14.4	8.4		4.0	8.5	5.1

MAIZE

TREATMENTS	CROP NUMBER				CROP HEIGHTS				STALK WEIGHT			
	I	II	III	TOTAL	I	II	III	TOTAL	I	II	III	TOTAL
NOPLANTING 4 lbs	16	22	20	58	20	2.5	4.0	2.5	9.0	3.0	11.0	12.3
	50	5	17	63	28	13.2	1.2	2.1	16.5	6.30	13.2	4.8
												27.1
BURN	21	23	12	56	19	2.6	3.8	1.8	6.2	2.7	6.1	10.0
	26	4	3	30	10	4.5	0.2	0.4	5.1	1.7	5.0	2.2
												23.2
A	6	6	12	24	8	1.2	1.0	1.1	3.3	1.2	15.1	12.0
	50 lbs	1	1	2	0	0.1	0.1	0.1	0.2	0.1	2.2	1.4
												5.8
CONTROL	23	11	21	55	3.9	1.4	3.8	2.8	11.2	7.1	8.0	11.4
	3	22	30	55	4.8	2.7	1.5	1.3	13.0	10.3	12.3	10.3
	4	19	19	57	2.9	2.9	1.1	1.1	11.0	11.0	8.4	10.6

ANALYSIS OF VARIANCE
(1ST PLANTING SERIES)

1) SUNFLOWER WEIGHT

	Df	MEAN SQ.	F
Blocks	2	30.50	
Treatments	5	6.00	
Error	40	3.35	

C.V. = 35.17%

2) MAIZE STALK WEIGHT

	Df	MEAN SQ.	F
Blocks	2	3.02	
Treatments	5	44.93	**
Error	10	5.75	

C.V. = 33.72%

APPENDIX TABLE 446 1. CSDP YIELDS AND NUMBERS - 2ND PLANTING SERVICE

TREATMENTS	I	BEANS				SUPPLANTS			
		II	III	TOTAL	MEAN	I	II	III	TOTAL
Monoculture	4 lbs	10.8	2.7	13.5	7.9	1.7	3.8	2.7	8.2
	6 lbs	13.4	9.9	23.3	7.5	3.2	3.5	4.0	10.7
Genuson	4 lbs	5.8	7.4	13.2	4.3	1.3	5.2	5.6	11.1
	6 lbs	5.3	0.3	5.6	2.1	1.9	1.3	2.6	5.8
TCA	25 lbs	0.0	0.2	0.2	0.2	4.4	3.2	4.6	12.2
	50 lbs	0.1	0.0	0.1	0.1	2.3	2.3	2.0	6.6
CONTROL	1	7.2	0.5	7.7	4.1	1.4	1.3	1.3	4.0
	2	1.2	4.1	5.3	2.6	3.0	2.4	2.4	7.8
	4	0.6	0.5	1.1	0.6	1.5	1.9	1.9	5.3

ANALYSIS OF VARIANCE
(2ND PLANTING SERVICE)

1) SAMPLED WEIGHT

DT	MEAN WT.
Blocks	2
Treatments	5
Error	10
	C.V. = 38.22%

2) STAYE STONES WEIGHT

DT	MEAN WT.
Blocks	2
Treatments	5
Error	10
	C.V. = 34.13%

TREATMENTS	I	CSD NUMBER				CSD WEIGHTS				STOUP WEIGHT			
		II	III	TOTAL	MEAN	I	II	III	TOTAL	I	II	III	TOTAL
Monoculture	4 lbs	10	2	12	1.1	0.2	1.1	2.8	4.1	1.8	1.2	1.3	4.3
	6 lbs	24	9	33	2.3	0.9	3.2	6.2	10.3	3.5	3.5	5	12
Genuson	4 lbs	8	1	9	0.8	0.3	0.8	1.0	2.1	0.5	0.5	1	2
	6 lbs	20	4	24	1.1	0.5	0.8	1.0	2.3	1	1	2	4
TCA	25 lbs	1	0	1	0	0	0	0	0	0	0	0	0
	50 lbs	1	0	1	0	0	0	0	0	0	0	0	0
CONTROL	1	11	9	20	1.1	0.5	0.5	0.5	1.5	1.1	1.2	1.3	3.6
	2	4	4	8	0.5	0.2	0.2	0.2	0.6	0.5	0.5	0.5	1.5
	3	1	1	2	0.2	0.2	0.2	0.2	0.6	0.5	0.5	0.5	1.5
	4	1	1	2	0.2	0.2	0.2	0.2	0.6	0.5	0.5	0.5	1.5

ANALYSIS OF VARIANCE
APPENDIX TABLE 50.1. 2. ANY NUMBER (SQUARE ROOT TRANSFORMATION)

1ST PLANTING SERIES

BEANS	DF	MEAN SQ.	F
Blocks	2	0.8094	
Treatments	5	66.3711	**
Error	10	3.6782	

C.V. = 25.56%

SUNFLOWER	DF	MEAN SQ.	F
Blocks	2	45.2776	
Treatments	5	27.9837	
Error	10	8.3884	

C.V. = 35.52%

2ND PLANTING SERIES

BEANS	DF	MEAN SQ.	F
Blocks	2	1.022	
Treatments	5	24.5533	
Error	10	11.3223	

C.V. = 31.52%

SUNFLOWER	DF	MEAN SQ.	F
Blocks	2	52.1659	
Treatments	5	40.3358	
Error	10	13.5286	

C.V. = 27.13%

CROP YIELDS

1ST PLANTING SERIES

MAIZE	DF	MEAN SQ.	F
Blocks	2	4.1795	**
Treatments	5	15.0585	
Error	10	2.3894	

C.V. = 10.22%

SUNFLOWER	DF	MEAN SQ.	F
Blocks	2	30.50	
Treatments	5	6.00	
Error	10	2.75	

C.V. = 35.17%

MAIZE STOVER	DF	MEAN SQ.	F
Blocks	2	3.02	
Treatments	5	44.49	**
Error	10	6.75	

C.V. = 33.72%

2ND PLANTING SERIES

MAIZE	DF	MEAN SQ.	F
Blocks	2	15.7830	
Treatments	5	20.7925	**
Error	10	4.0613	

C.V. = 16.71%

SUNFLOWER	DF	MEAN SQ.	F
Blocks	2	1.02	
Treatments	5	1.63	
Error	10	1.32	

C.V. = 38.22%

MAIZE STOVER	DF	MEAN SQ.	F
Blocks	2	23.72	
Treatments	5	25.78	
Error	10	11.48	

C.V. = 34.95%

NUMBER OF MAIZE PLANTS (SQ. ROOT TRANSFORMATION) 7/2/50

1ST PLANTING SERIES

	DF	MEAN SQ.	F
Blocks	2	1.2026	
Treatments	5	0.1130	
Error	10	0.1459	

C.V. = 2.49%

2ND PLANTING SERIES

	DF	MEAN SQ.	F
Blocks	2	1.4449	
Treatments	5	0.1095	
Error	10	0.2005	

C.V. = 3.13%

MAIZE HEIGHTS

	DF	MEAN SQ.	F
Blocks	2	541.27	
Treatments	5	31.86	
Error	10	45.96	

C.V. 12.07%

NUMBER OF RUTGRASS PLANTS (SQ. ROOT TRANSFORMATION)

1ST PLANTING SERIES

	DF	MEAN SQ.	F
Blocks	2	17.4993	
Treatments	5	3.5697	
Error	10	4.1571	

C.V. 40.52%

2ND PLANTING SERIES

	DF	MEAN SQ.	F
Blocks	2	11.5446	
Treatments	5	5.0729	
Error	10	2.2548	

C.V. = 32.70%

RESIDUAL HERBICIDAL ACTION.
APPENDIX TABLE 48A. NUMBER OF NYCTAGRASS PER 18" x 18" FRAME

TREATMENT	REPL.	1ST PLANTING SERIES								2ND PLANTING SERIES							
		1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Monsaluron 4 lbs	1	21	5	7	9	41	50	18	8	0	2	56	7				
	2	2	12	3	22	5	24	3	4	0	0	21	5				
	3	22	13	9	32	76	19	17	14	14	24	64	17				
Total						139						126					
Mean						17.375						15.75					
Monsaluron 8 lbs	1	7	12	8	9	35	5	4	2	4	5	15	4				
	2	0	0	0	0	0	0	0	0	0	0	0	0				
	3	11	10	5	11	37	9	10	4	4	12	20	8				
Total						72						45					
Mean						9.0						5.625					
Monsaluron 4 lbs	1	19	10	9	7	45	11	2	0	1	6	9	2				
	2	10	3	9	14	36	9	1	4	14	8	27	4				
	3	3	6	6	4	17	5	8	14	3	7	32	8				
Total						106						68					
Mean						13.25						8.5					
Monsaluron 8 lbs	1	4	5	0	7	16	4	0	0	1	0	7	2				
	2	0	2	0	0	2	5	3	4	0	0	7	1				
	3	26	6	21	20	61	20	15	12	23	15	65	16				
Total						99						75					
Mean						13.125						9.375					
TCA 25 lbs	1	14	5	12	8	19	10	5	5	0	2	8	2				
	2	23	0	4	2	28	7	7	12	2	4	26	4				
	3	3	9	2	5	21	5	1	14	5	8	34	5				
Total						69						68					
Mean						23.0						22.666					
TCA 50 lbs	1	15	0	0	8	23	6	5	1	1	43	16	4				
	2	0	1	0	9	1	2	2	0	1	3	13	1				
	3	8	2	14	5	26	3	2	11	4	5	50	5				
Total						50						80					
Mean						16.666						26.666					
CONTROL	1	4	8	23	5	43	11	8	2	4	7	22	4				
	2	37	24	24	30	116	23	24	15	19	13	73	12				
	3	43	32	9	16	100	29	32	15	1	0	93	11				
	4	8	3	1	10	25	4	7	0	1	0	36	10				
	5	10	6	8	19	43	11	16	15	20	5	56	16				
	6	9	4	8	11	32	8	3	6	12	12	36	15				
	7	11	10	0	2	28	7	3	2	3	10	29	17				
	8	7	0	0	2	9	2	2	14	12	13	27	17				
	9	14	5	13	10	50	13	12	20	12	12	42	21				
	10	4	5	8	10	27	7	6	7	17	2	35	9				
	11	17	13	26	20	63	15	5	4	8	3	92	17				
	12	9	1	3	0	18	3	4	5	2	5	42	9				
Total						570						629					
Mean						47.5						52.416					

APPENDIX TABLE 45B: REGIONAL HERBICIDAL ACTION.
NUMBER OF ANNUAL GRASSES PER 10" x 10" FRAME

TREATMENTS	REPL.	1ST COUNTING SERIES							2ND COUNTING SERIES						
		1	2	3	4	5	6	7	1	2	3	4	5	6	7
Monolinuron 4 lbs	1	1	4	3	2	10	3	2	2	1	1	6	2		
	2	4	2	5	3	12	3	4	3	4	2	16	4		
	3	3	4	2	1	10	5	5	1	0	3	9	2		
Total Mean						38						3			
Monolinuron 8 lbs	1	4	7	4	4	14	4	3	4	3	10	4			
	2	2	1	2	4	11	3	3	4	4	2	15	4		
	3	2	2	1	2	7	2	2	1	0	0	7	2		
Total Mean						26						27			
Bromoxynil 4 lbs	1	3	2	1	1	5	4	2	2	2	2	5	2		
	2	3	2	1	1	7	2	3	3	2	2	2	2		
	3	4	3	2		13	5	1	1	0		4	3		
Total Mean						29						21			
Bromoxynil 8 lbs	1	4	4	6	1	18	4	0	0	3	5	16	3		
	2	3	2	2	0	7	2	2	4	3	1	12	2		
	3	1	1	4	4	3	2	1	1	0	2	4	3		
Total Mean						23						24			
TCA 25 lbs	1	1	5	2	3	11	2	2	3	4	4	13	3		
	2	2	5	2	3	10	1	2	2	2	3	7	2		
	3	4	2	1	1	8	2	2	0	2	3	7	2		
Total Mean						29						26			
TCA 50 lbs	1	3	2	5	2	10	7	3	5	2	2	8	2		
	2	3	2	3	3	10	3	1	5	4	4	7	12		
	3	4	5	2	1	13	1	4	0	4	3	11	3		
Total Mean						33						32			
CONTROL	1	4	4	4	1	11	3	1	1	4	4	10	3		
	2	1	3	1	1	3	1	2	1	2	3	11	4		
	3	2	3	4	2	11	3	3	4	5	4	19	5		
	4	2	3	3	3	16	4	4	5	4	6	19	5		
	5	0	3	3	3	11	3	5	4	4	3	14	3		
	6	4	3	3	3	11	3	5	4	4	3	10	3		
	7	2	1	4	3	10	3	1	4	3	2	21	3		
	8	3	5	7	1	15	4	4	2	2	3	8	2		
	9	3	4	6	2	14	4	3	2	1	0	6	2		
	10	3	2	5	5	11	3	5	3	3	3	7	2		
	11	0	3	1	3	10	3	2	2	4	5	1	1		
	12	2	4	1		15						15			
Total Mean						150						155			

APPENDIX TABLE 47A. 1. RESIDUAL HERBICIDAL ACTION
MAIZE PLANT NUMBERS PER PLANT ROW

TREATMENT	REPL.	1ST PLANTING SERIES					2ND PLANTING SERIES					
		1	2	3	4	Total Mean	1	2	3	4	Total Mean	
Monolinuron 4 lbs	1	74	54	49	53	230	57	49	58	61	75	231
	2	89	51	51	52	253	63	47	57	58	58	235
	3	86	59	51	55	251	65	53	59	54	77	242
Total Mean						734						776
Monolinuron 8 lbs	1	51	45	47	54	227	57	49	59	58	61	235
	2	57	40	48	52	237	52	46	54	50	51	223
	3	78	52	56	70	256	64	60	68	61	70	266
Total Mean						599						753
Monuron 4 lbs	1	74	47	50	55	226	55	45	54	51	59	215
	2	72	48	50	55	215	54	46	53	50	55	214
	3	76	57	58	66	257	60	50	58	54	61	263
Total Mean						699						732
Monuron 8 lbs	1	56	49	53	51	219	55	56	57	57	60	235
	2	72	45	49	44	210	53	49	52	75	89	259
	3	54	60	57	55	226	64	55	55	55	78	248
Total Mean						655						743
TCA 25 lbs	1	60	61	49	58	228	57	47	55	58	76	233
	2	80	51	50	50	231	58	50	77	54	55	245
	3	77	55	54	55	241	50	58	53	54	70	235
Total Mean						700						743
TCA 50 lbs	1	58	49	53	55	215	57	55	58	79	77	270
	2	80	48	50	45	223	57	50	54	86	75	265
	3	78	65	57	54	254	64	57	52	57	92	265
Total Mean						702						798
CONTROL	1	65	50	49	51	205	51	55	49	59	55	210
	2	73	64	53	55	235	59	49	55	50	76	239
	3	67	63	46	55	231	58	51	51	50	61	243
	4	70	54	45	54	223	56	51	53	50	51	245
	5	57	52	52	52	213	58	55	49	62	55	246
	6	75	49	50	59	233	59	54	57	57	78	253
	7	64	61	51	52	228	57	55	50	50	60	253
	8	75	47	47	54	223	55	45	50	79	80	262
	9	66	49	52	52	219	60	59	54	57	62	232
	10	54	59	44	54	211	55	52	52	50	66	243
	11	67	58	44	45	212	51	54	54	57	66	251
	12	59	45	54	45	203						
Total Mean						2704						3075

APPENDIX TABLE 47b : RESIDUAL HERBICIDAL ACTION
HEIGHT OF MAIZE PLANTS IN INCHES (25 PLANTS)
(3ST PLANTING SERIES)

TREATMENTS	Repl.	TOTAL	MEAN	TOTAL	MEAN PER PLANT
Monalipuron 4 lbs	1	1547	61.88		
	2	1498	59.96		
	3	1087	53.48	4133	58.11
Monalipuron 8 lbs	1	1595	63.80		
	2	1657	74.28		
	3	1197	47.88	4645	61.99
Monuron 4 lbs	1	1694	67.76		
	2	1407	56.28		
	3	986	39.44	4087	54.25
Monuron 8 lbs	1	1454	58.56		
	2	1762	70.48		
	3	1036	41.44	4292	56.63
TCA 25 lbs	1	1652	66.08		
	2	1894	75.76		
	3	877	35.08	4423	58.95
TCA 50 lbs	1	1350	54.32		
	2	1442	57.68		
	3	1189	47.56	3989	53.17
CONTRL	1	1611	64.44		
	2	1162	46.48		
	3	1122	44.88		
	4	1660	66.40		
	5	1576	63.04		
	6	1317	48.48		
	7	1051	70.04		
	8	1493	59.72		
	9	1336	53.64		
	10	967	38.68		
	11	1160	46.40	14350	59.63
	12	1338	55.32		

APPENDIX TABLE 49: NUMBER OF MAIZE PLANTS PER PLOT

TREATMENT PER ACRE	AFTER 27 DAYS									AFTER 53 DAYS									TOTAL		
	NORMAL			STUNTED			TOTAL			TOTAL			MEAN								
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Monochloruren 0.4 lbs	113	110	98	321	107	83	105	82	270	90	13	3	24	8	56	138	90	294	98		
Monochloruren 0.6 lbs	126	114	147	399	123	108	63	94	265	86.3	12	28	62	62	120	91	116	327	109		
Monochloruren 0.8 lbs	113	116	118	349	118.5	9	77	73	246	82	14	18	31	63	110	95	104	309	103		
Monochloruren 1.0 lbs	122	117	127	366	122	56	52	56	259	66.5	28	31	58	51	30.3	91	93	101	299		
Monochloruren 1.2 lbs	121	118	123	352	120.5	57	50	52	233	77.6	3	39	54	28	124	110	63	317	105.6		
Monocuren 0.4 lbs	145	118	127	387	123	106	67	92	284	84.6	19	16	29	91	30.3	74	101	115	290		
Monocuren 0.6 lbs	208	135	133	323	114.3	26	87	86	229	56.3	48	14	59	59	19.3	101	57	79	207		
Monocuren 0.8 lbs	321	104	77	302	100.6	96	42	49	149	49.0	13	15	30	58	88	54	66	268			
Monocuren 1.0 lbs	76	88	89	289	86.3	21	28	35	85	27	25	31	44	28	115	36	17	353			
Monocuren 1.2 lbs	115	83	42	226	73.3	109	7	2	118	19.3	7	23	15	13	128	138	247	377			
Control 0	1	125	112	144	382	127	114	97	132	245	113	8	15	33	52	110.6	128	138	247		
	2	121	120	115	357	113	112	102	107	107	8	11	7	24	8	119	113	146	115.3		

APPENDIX TABLE A9 : RATE OF WEIGHTS: CDB WEIGHTS IN LBS
PER PLOT

TREATMENTS/ACRE	1	T1	T2	TOTAL
1. Monolinuron 0.4 lbs	28.5	46.4	46.1	121.0
2. Monolinuron 0.6 lbs	36.5	52.2	50.1	138.8
3. Monolinuron 0.8 lbs	35.8	58.8	56.4	151.0
4. Monolinuron 1.0 lbs	31.8	54.8	56.1	142.7
5. Monolinuron 1.2 lbs	27.6	27.1	49.1	103.8
6. Monuron 0.4 lbs	27.8	29.8	31.2	88.8
7. Monuron 0.6 lbs	11.1	45.6	40.1	96.8
8. Monuron 0.8 lbs	23.5	18.5	12.6	54.6
9. Monuron 1.0 lbs	10.0	9.8	10.5	30.3
10. Monuron 1.2 lbs	15.5	9.8	1.0	26.3
Control	1	33.8	36.8	70.6
Control	2	35.0	35.0	70.0

ANALYSIS OF VARIANCE

CDB WEIGHTS

	DF	MEAN SQ.	F
Blocks	8	95.36	
Treatments	11	464.97	**
Error	22	75.97	

C.V. = 28.41%

TOTAL PLANTS (63 Days)

SQUARE ROOT TRANSFORMATION	DF	MEAN SQ.	F
Blocks	2	5.1821	
Treatments	11	5.3883	**
Error	22	1.8084	

C.V. = 12.57%

STUNTED PLANTS (63 Days) ANGULAR TRANSFORMATION

	DF	MEAN SQ.	F
Blocks	2	286.2450	
Treatments	11	339.4776	*
Error	22	143.8086	

C.V. = 41.07%

APPENDIX TABLE E0 : GREEN WEIGHTS OF WEEDS PER 5" x 36" QUADRAT
IN 0.75 PCT QUADRAT.

TREATMENT	I	II	III	TOTAL	MEAN
1. CONTROL	28.78	37.0	38.0	103.78	34.59
2. DNBP 50% 4 pts	8.75	40.0	13.0	61.75	20.58
3. CONTROL	30.50	28.0	35.0	93.50	31.17
4. DNBP 50% 6 pts	19.5	4.5	36.0	60.0	20.00
5. CONTROL	38.0	31.0	27.0	96.0	32.00
6. DNBP 50% 8 pts	8.75	18.0	39.0	65.75	21.92
7. CONTROL	32.0	33.0	32.0	97.00	32.33
8. DNBP 50% 10 pts	7.0	15.0	2.0	24.00	8.00
9. CONTROL	26.0	24.0	26.0	76.00	25.33
10. PCP 5% 8 pts	36.0	6.0	7.5	49.50	16.50
11. CONTROL	24.0	23.0	31.0	78.00	26.00
12. PCP 5% 40 pts	10.5	12.0	7.5	30.00	10.00
13. CONTROL	28.0	24.0	32.0	84.00	28.00

GREEN WEIGHTS OF WEEDS

TREATMENT	I	II	III	TOTAL	MEAN
1. DNBP 50% 4 pts	8.0	40.0	13.0	61.0	20.3
2. " " 6 pts	19.5	4.5	36.0	60.0	20.0
3. " " 8 pts	8.8	18.0	39.0	65.8	21.9
4. " " 10 pts	7.0	15.0	2.0	24.0	8.0
5. PCP 5% 8 pts	36.0	6.0	7.5	49.5	16.5
6. " " 40 pts	10.5	12.0	7.5	30.0	10.0
TOTAL	93.8	93.5	87.5	274.8	31.60

ANALYSIS OF VARIANCE

	S.S.	DF
TOTAL	2103.06	17
REPS	3.63	2
TREATMENT	191.87	5
ERROR	1727.56	10

Not significant

APPENDIX TABLE 51. HERBICIDAL RATING OF BUTERASS CONTROL

5. TREATMENTS	3/27/63				3/28/63				3/29/63				3/30/63				3/31/63			
	I	II	III	MEAN	I	II	III	MEAN	I	II	III	MEAN	I	II	III	MEAN	I	II	III	MEAN
1. TCA - 100 lbs	4	5	4	4.33	4	5	4	4.33	4	5	4	4.33	8	8	8	8.00	7	6	7	6.66
2. Dimeclo - 5.92 lbs DWG	7	3	3	4.33	3	2	6	3.66	1	1	1	1.00	1	1	1	1.00	3	3	3	3.00
3. Dimeclo - 11.1 " "	9	9	9	9.00	8	7	8	7.66	3	3	3	3.00	1	8	4	4.00	0	0	0	0.00
4. 2,4-D - 9 lbs	1	2	1	1.33	1	1	1	1.00	4	4	4	4.00	2	1	1	1.66	0	0	0	0.00
5. Atrazine - 8 lbs	1	1	1	1.00	2	1	1	1.33	1	1	1	1.00	4	0	6	3.33	0	0	2	0.65
6. Linuron - 5 lbs	1	1	1	1.00	1	3	2	2.00	1	2	1	1.33	0	1	0	0.33	6	0	0	2.00
7. Monolinuron - 5 lbs	1	1	1	1.00	1	4	1	2.00	0	1	2	1.00	0	1	0	0.33	0	0	0	0.00
8. Monuron - 5 lbs	2	0	1	1.00	2	0	4	2.00	2	2	2	2.00	2	2	2	2.00	0	1	5	2.00
9. Atrazine - 4 lbs	1	1	1	1.00	4	4	3	3.66	8	8	9	8.33	3	2	7	4.00	2	1	7	3.73
10. Atrazine - 9.6 lbs	1	1	1	1.00	6	7	5	6.00	8	5	8	7.33	5	4	2	3.66	2	1	1	1.35
11. Atrazine - 4 lbs	1	1	1	1.00	3	5	4	2.66	9	9	9	9.00	8	7	8	7.66	0	4	6	3.33
12. Atrazine - 2.4 lbs	4	4	3	3.66	2	2	1	1.66	1	2	2	1.66	1	1	0	0.65	0	0	0	0.00
13. Atrazine - 1 lb	3	5	4	4.00	2	4	3	3.00	1	1	1	1.00	0	0	0	0.00	0	0	0	0.00
14. Atrazine - 4 lbs	7	6	3	5.33	4	4	4	4.00	2	3	6	3.66	4	4	5	4.33	1	4	6	3.66
15. Atrazine - 2.4 lbs	2	2	2	2.00	2	2	5	2.66	1	1	1	1.00	0	0	0	0.00	0	0	0	0.00

APPENDIX TABLE SL: (CONT'D).

TREATMENTS	12/11/53			19/11/53			29/11/53			23/12/53			24/1/54		
	I	II	III	TOT.	MEAN	I	II	III	TOT.	MEAN	I	II	III	TOT.	MEAN
16. (Monuron - 4 lbs) (Dinoseb - 5.82)	8	6	6	20	6.66	8	4	1	13	4.33	4	1	1	6	2.0
17. (Atrazine - 4 lbs) (Dinoseb - 5.82 lbs)	8	7	8	23	7.66	5	4	7	14	4.68	3	3	1	7	2.33
18. (Atrazine (71.22% a.i.) 5.8 lbs)	1	2	2	5	1.66	2	2	2	6	2.0	7	0	8	23	7.66
19. Paraquat - 1.5 lbs	0	8	7	23	7.66	5	4	2	11	3.66	2	1	5	8	1.66
20. Dalapon - 33 lbs	1	2	2	4	1.33	1	1	2	4	1.33	5	7	0	20	5.66
21. Control	0	0	0	0	0.0	0	0	0	0	0.0	0	0	0	0	0.0
22. Control	0	0	0	0	0.0	0	0	0	0	0.0	0	0	0	0	0.0
23. Control	0	0	0	0	0.0	0	0	0	0	0.0	0	0	0	0	0.0
24. Control	0	0	0	0	0.0	0	0	0	0	0.0	0	0	0	0	0.0

ANALYSIS OF VARIANCE
(ANGULAR TRANSFORMATION)

1) 12/11/53

2) 23/12/53

Block#	DF	MEAN SQ.	F
TREAT	2	913.92	**
Error	28	489.56	

Block#	DF	MEAN SQ.	F
TREAT	2	1804.98	**
Error	28	311.10	

CAL = 39.14%

CAL = 57.62%

APPENDIX TABLE 62 : GROSS WEIGHTS OF NITRACROSS HERBAGE 2A/1/64)
HEIGHTS IN OZS. PER 1 SQUARE METRE QUADRAT.

TREATMENT/DATE	IA	IB	IIA	IIB	IIIA	IIIB	TOTAL
1. TCA - 100 lbs	2.625	5.375	4.00	5.625	2.875	3.125	23.750
2. Dicamba - 5.52 lbs CNBP	5.75	7.875	9.50	4.375	8.625	10.875	47.950
3. 2,4-D - 11.4 lbs "	6.00	7.825	10.00	14.00	7.875	10.625	58
4. 2,4-D - 8 lbs	7.875	8.625	9.125	5.625	6.50	6.25	43.000
5. (Atrazine - 8 lbs	10.375	7.50	8.625	11.50	5.875	5.75	48.525
6. (Atrazine - 15 fl.ozs	11.75	9.00	5.375	11.50	6.375	9.125	55.125
7. (Atrazine - 8 lbs	9.50	9.875	7.125	7.625	7.00	7.625	48.750
8. (Atrazine - 15 fl.oz	5.50	8.625	8.00	9.75	9.50	5.125	36.500
9. (Atrazine - 8 lbs	7.50	8.25	9.625	8.125	5.75	6.125	42.375
10. (Atrazine - 2.5 lbs	12.00	11.625	8.875	9.475	5.425	5.625	54.000
11. (Atrazine - 1.5 lbs	2.375	5.25	5.875	11.125	7.125	17.25	48.000
12. (Atrazine - 1 lb	6.375	4.375	5.625	10.625	11.425	10.75	59.125
13. (Atrazine - 1 lb	10.25	12.025	6.425	10.25	10.75	6.25	57.125
14. (Atrazine - 1 lb	10.375	9.475	6.125	6.075	5.00	5.375	48.750

APPENDIX TABLE 52 (CONT.)

TREATMENT/ACRE	IA	IB	IC	IIA	IIIB	TOTAL
15. (Dinoseb - 2.5 lbs (Dinoseb - 5.52 lbs	8.00	6.625	9.875	8.50	10.375	49.250
16. (Dinoseb - 5 lbs (Dinoseb - 5.52 lbs	4.125	3.575	10.25	9.625	9.875	46.375
17. (Atrazine - 4 lbs (Dinoseb - 5.52 lbs	8.125	9.25	5.625	7.00	8.875	49.625
18. Atrazine (7L 22% a.i.) 9.6 lbs	7.40	6.875	5.375	5.50	8.50	39.250
19. Paraquat - 1.5 lbs 10.00	9.30	6.125	8.125	6.50	9.375	52.625
20. Dinoseb - 33 lbs	8.125	5.75	13.125	4.50	5.75	27.125
21. Control	10.75	10.125	13.625	12.625	11.375	74.7
22. Control	7.875	6.25	12.00	9.125	8.50	59.750
23. Control	8.00	8.75	13.125	12.00	9.75	56.425
24. Control	9.62	8.75	16.75	9.875	10.125	57.250

ANALYSIS OF VARIANCE

	DF	MEAN SQ	F
Blocks	4	2.04	
Treatments	15	25.66	
Error	36	12.31	

D.F. 24, 36

APPENDIX TABLE 53: WEED CONTROL SYSTEMS.

TRIAL I:

TREATMENT	REPLICATION	ASSESSMENT AFTER	
		24 weeks	2 months
LINURON 1 lb	1	9.0	4
+	2	8.5	4
AGRAL	3	9.5	7
Mean		9.0	5.0
LINURON 2 lb	1	9.5	5
+	2	9.5	9
AGRAL	3	9.5	7
Mean		9.5	7.0
UNSPRAYED	1	0	0
+	2	0	0
AGRAL	3	0	0
Mean		0	0

TRIAL II:

TREATMENT	REPLICATION	ASSESSMENT AFTER	
		24 weeks	2 months
LINURON 1 lb	1	9	8.5
+	2	7	8
AGRAL 90	3	8	6
Mean		8	7.5
LINURON 1.25 lb	1	9	8.5
+	2	9	7
AGRAL 90	3	9	9
Mean		9.0	7.5
LINURON 1.5 lb	1	9	6
+	2	8	7
AGRAL 90	3	8	7
Mean		8.3	7.2
LINURON 2 lb	1	8	7
+	2	9	6
AGRAL 90	3	8	5.5
Mean		8.3	6.2
UNSPRAYED	1	0	0
+	2	0	0
AGRAL	3	0	0
Mean		0	0

APPENDIX TABLE 54 1ST WEEED COUNT (16 DAYS AFTER SPRAYING)
NUMBER OF PLANTS PER 2 QUADRATS
(2 BR/TEST).

TREATMENT		REPLICATIONS			TOTAL
		1	2	3	
1 lb LINURON	Cyperus	27	48	43	88
	Grasses	4	4	4	12
	Broadl.	0	1	0	1
	Total	31	53	47	131
2 lb LINURON	Cyperus	5	6	21	32
	Grasses	2	4	2	8
	Broadl.	0	0	1	1
	Total	7	10	24	41
UNSPRAYED	Cyperus	177	138	147	462
	Grasses	25	31	42	98
	Broadl.	51	121	88	260
	Total	248	290	277	815

APPENDIX TABLE 56: 2ND WEED COUNT (29 DAYS AFTER SPRAYING)

MEAN NUMBERS AND WEIGHT (OZS) OF PLANTS PER 2'x5' FT.

PLOTS AND TREATMENTS	REPLICATION NO.	NUTCRASS		ANNUAL GRASSES		BROODLEAF WEEDS	
		No.	Wt.	No.	Wt.	No.	Wt.
1. 2 lbs Linuron	1	3	1.0	11	5.4		
	2	10	1.8	2	0.2		
	3	24	5.6	2	0.2	2	0.1
	4	12	3.9	3	0.4	3	0.1
TOTAL		49	10.1	18	4.2	5	0.2
2. 2 lbs Linuron	1	15	3.4	3	1.4		
	2	5	1.2	3	0.8		
	3	10	0.9				
	4	8	0.7	2	0.3		
TOTAL		38	6.2	10	2.5		
3. 2 lbs Linuron	1	6	1.6	8	18.2		
	2	9	1.7			1	0.1
	3	10	2.2				
	4	15	2.4				
TOTAL		40	7.9	8	18.6	1	0.1
1. 1 lb Linuron	1	36	18.4	8	12.2		
	2	37	11.1	4	2.2		
	3	74	25.8	2	4.0		
	4	51	15.5	1	0.3		
TOTAL		198	68.8	15	21.3		
2. 1 lb Linuron	1	38	19.8	13	2.0	3	0.3
	2	55	12.6	8	4.0	10	1.0
	3	19	13.0			6	0.2
	4	42	20.7	5	2.4	3	0.3
TOTAL		154	66.2	26	10.0	22	2.2
3. 1 lb Linuron	1	21	3.5	1	2.3	3	0.3
	2	14	3.0			5	0.5
	3	18	2.0			9	1.5
	4	13	2.1			14	1.5
TOTAL		67	8.5	1	2.3	22	4.3
1. Control	1	102	180.7	19	69.8	46	37.0
	2	69	32.1	14	22.5	20	107.3
	3	59	86.3	1	0.4	23	83.3
	4	38	188.4	27	58.3		
TOTAL		368	528.3	51	151.2	89	402.6
2. Control	1	60	74.0	11	38.1	3	2.7
	2	24	23.1	2	0.6	33	134.2
	3	90	40.7	7	6.6	46	184.9
	4	69	83.3	280	83.9	28	26.3
TOTAL		182	220.9	280	75.4	112	324.1
3. Control	1	22	15.3	14	96.3	30	100.3
	2	37	54.5	13	14.1	35	235.2
	3	35	33.3	11	18.1	40	134.5
	4						
TOTAL		126	135.8	36	128.2	105	569.5

Author Fisher Jonah

Name of thesis An Investigation Into The Life History, Methods Of Control, Competition And Dispersal Of Cyperus Esculentus (yellow Nutgrass) With Special Reference To The Highveld Region Of Sa. 1966

PUBLISHER:

University of the Witwatersrand, Johannesburg

©2013

LEGAL NOTICES:

Copyright Notice: All materials on the University of the Witwatersrand, Johannesburg Library website are protected by South African copyright law and may not be distributed, transmitted, displayed, or otherwise published in any format, without the prior written permission of the copyright owner.

Disclaimer and Terms of Use: Provided that you maintain all copyright and other notices contained therein, you may download material (one machine readable copy and one print copy per page) for your personal and/or educational non-commercial use only.

The University of the Witwatersrand, Johannesburg, is not responsible for any errors or omissions and excludes any and all liability for any errors in or omissions from the information on the Library website.