DIFFERENTIAL RESPONSE OF GUINEA CORN (*Sorghum bicolor* L. Moench) VARIETIES TO HERBICIDES IN NIGERIA

BY

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THESIS CERTIFICATION

This thesis entitled DIFFERENTIAL RESPONSE OF GUINEA CORN (*Sorghum bicolor* L. Moench) VARIETIES TO HERBICIDES IN NIGERIA by JOSEPH AKIMBO YUSUFU SHEBAYAN meets the regulations governing the degree of Master of Science (Agronomy) of Ahmadu Bello University and is approved for its contribution to scientific knowledge and literary presentation.

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DEDICATION

Dedicated to my father and mother for their tireless efforts to educate me inspite of the odds, and to Almighty God for making their efforts yield fruit.

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CHAPTER 1

INTRODUCTION

Guinea corn (Sorghum bicolor L. Moench) is an important tropical cereal grown the world over, except in the cool areas. It ranks fourth after wheat (Triticum aestivum L.), rice (Oryza sativa L.) and maize (Zea mays L.) in the world's cereal production (Martin et al., 1976).

In Nigeria, guinea corn is the most important cereal, in terms of both volume of production and total land area cultivated. It occupies about 46% of the total land devoted to cereal cultivation and accounts for about 50% of the total cereal production (Egharevba, 1979). Most of the guinea corn comes from the northern States, north of latitude 9^{o} where the environmental conditions are favourable for its growth.

The use of the crop as human food, livestock-feed and industrial raw material for the manufacture of various products such as alcohol and starch has necessitated the intensification of research to increase its yield and improve its quality. In Nigeria, guinea corn varieties

adapted to different ecological zones have been developed for use (Obilana, 1979). Optimum crop yield has however, not been obtained in farmers' fields because of poor seed-bed preparation, untimely planting, insect pest, diseases and weed interference. The latter has been shown to account for yield losses of 40 to 60% (Choudhary et al., 1979).

To avert the yield losses caused by weeds, several control measures have been devised and adopted. Hoe-weeded which is the most common weed control method in Nigeria, has been reported to be expensive, inefficient and highly labour-intensive (Choudhary et al., 1979). In addition, it could result in stand losses if the implement is not used properly. In the Nigerian situation where labour is continuously getting scarce due to the drift of farming populations from rural to urban centres, a less labour-intensive method of weed control is desirable. Chemical weed control is considered to hold more potential for the Nigerian farmer than hoe-weeding. Judicious application of herbicides will not only reduce labour requirement and its attendant cost, but will also facilitate timely weed control.

Results of several screening trials in parts of the savanna ecological zones of Nigeria, show that herbicides, used alone or in combinations, are effective in controlling weeds in guinea corn (Choudhary et al., 1979). Since guinea corn varieties have been observed to respond differentially to herbicides (Cruz, 1969; Spotanski et al., 1971; Burnside and Wicks, 1972; Raghunathan et al., 1974; Obilana and Lagoke, 1979) a blanket recommendation may not be equally tolerated by all varieties. It is therefore desirable to investigate the tolerance of the varieties being suggested for various ecological zones to promising herbicide treatments for use in the crop.

This study was therefore undertaken to determine the response of seven guinea corn varieties to some herbicide treatments in two ecological zones of Nigeria.

CHAPTER 2

REVIEW OF LITERATURE

1. Promising Herbicides for Weed Control in Guinea Corn

Several herbicides have been used, singly or as mixtures to control weeds in guinea corn. Pre-emergence application of chloramben[1], chlorpropham and linuron each at 3.36 kg/ha and propazine at 3.80 kg/ha gave excellent weed control (Smith, 1963), while early post-emergence application of atrazine at 1-3 kg/ha on a 2-leaf stage guinea corn controlled most weeds including Ipomoea spp. and increased grain yield (Rabago and Preston, 1968). Good weed control following a pre-emergence application of atrazine to the crop has been reported by various workers (Anton-Smith, 1968; Francs et al., 1970; Choudhary et al., 1979). Phillips (1960) successfully controlled weeds and obtained good crop selectivity with an amine salt of 2,4-D applied when the crop was more than 75 cm high. Frans et al. (1978) reported that pendimethalin at 0.84 kg/ha was nearly as good as atrazine at

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[1]Chemical names of herbicides mentioned in the text are given in appendix 2.

1.10 kg/ha when both were applied pre-emergence to the crop. Abernathy et al. (1978) tested post-emergence soil-incorporated application of dinitroaniline herbicides, including pendimethalin, for the control of late weed flushes. Applications were made when the crop was at the spike stage and all herbicides gave more than 90% weed control with no crop injury. Rabeya and Isaacs (1974) compared certain triazines for weed control in guinea corn in a light sandy clay soil and reported good weed control and high selectivity from pre-emergence application of atrazine plus terbuthylazine (1:1) and terbutryne plus terbuthylazine (1:1), each mixture at 2-3 kg/ha. It has also been observed in the savanna ecological zones of Nigeria that atrazine at 1.0 kg/ha, terbutryne plus terbuthylazine (1:1) at 1.0 and 2.0 kg/ha and atrazine plus terbuthylazine (1:1) mixture at 2.0 kg/ha applied pre-emergence showed promise and might be recommended for use in guinea corn (Choudhary et al., 1979; Ndahi, 1981).

2. Differential Response of Weeds to Herbicides

Albrecht (1947) reported that some strains of creeping bentgrasses (Agrostis stolonifera L.) were more tolerant to 2,4-D than others. Santelmann and Meade (1961) observed wide variations in nine varieties of yellow foxtail (Setaria lutescens L. Beauv) and sixteen giant foxtail (S. faberii Herm) varieties in their response to dalapon. Sexsmith (1964) did not observe such differences in the susceptibility of twelve strains of lens-podded hoarycress (Cardaria chalepensis Hand - Maz.) to 2,4-D or 2,3,6-TBA. Jacobsohn and Anderson (1968) studied the differential response of wild oat (Ayena fatua L.) lines to di-allate, tri-allate and barban and reported large differences among the lines in response to these herbicides. Some lines were not affected by those rates that were recommended for the control of the weed.

Radosevich and Appleby (1973) observed differential responses in three common groundsel (Senecio vulgaris L.) bio-types to six s-triazine herbicides and attributed their resistance to differences in physiology rather than exposure to the herbicides caused by variations in germination

time, rooting depth or morphology. Similarly, McClelland et al. (1978) detected differential susceptibility in the response of morning-glory (Ipomoea spp.) to bentazone and stressed on the importance of proper varietal identification before bentazone application.

3. Differential Responses of Fibre and Legume Crops to Herbicides

Some fibre crops have also been reported to respond differentially to herbicides. Dunham and Robinson (1948), Friesan (1949) and Tandon (1949) observed that some varieties of flax (Linum usitatissimum L.) were slightly more susceptible to 2,4-D than others. Santelmann et al. (1966) observed considerable variations in the fibre quality of five upland cultivars of cotton as a result of herbicide treatments.

Differential responses to herbicides have been reported among legumes varieties. Walters and Caviness (1968) reported differential susceptibility of soybean (Glycine max L. Merr.) to 2,4-D. Station and Frans (1971) observed a range of sensitivity from marginal susceptibility to complete tolerance in soybean varieties to dinoseb.

In peas (Pisum sativum L.), Harvey et al. (1972) observed more trifluralin injury in one variety than in others. In six cultivars of common beans (Phaseolus vulgaris L.) treated with four herbicides in a loamy sand soil, Himme and Stryckers (1975) observed varietal differences in yield reductions with each herbicide treatment.

4. Differential Response of Graminaceous Crops to Herbicides

Differences in response to herbicides also exist in graminaceous crop varieties. In sugarcane (Saccharum officinarum L.), Nolla (1950) report marked varietal differences in response to 2,4-D treatment, ranging from susceptibility to tolerance. Osgood et al. (1972) reported considerable differences in tolerance of Hawaiian sugarcane cultivars to diuron and attributed this to variations in distribution and degradation of the herbicide. Equally wide differences had been observed in the tolerance of this crop to monuron, simazine, dalapon and terbacil (Rochecouste, 1963; Mongelard, 1967; Millhollon and Matherne, 1968; Peng and Yeh, 1970). Richard and Baker (1979) reported significant variations in the

response of some selected rice lines, to different rates of molinate. Rossman and Staniforth (1949) reported more susceptibility to 2,4-D in some lines of maize than in others when treated post-emergence at the 6-8 leaf stages. Eastin (1971) worked on the growth and response of six selections of maize to atrazine at 5.6 kg/ha applied pre-emergence. Grogan et al. (1963) had earlier observed such differential susceptibility in maize and found it to be controlled by a single recessive gene. Wright and Rieck (1973) reported differential butylate injury in maize hybrids and observed that the tolerant hybrid took in less and metabolized more of the herbicide than the susceptible variety which took in more and metabolized less of the herbicide.

In Bogota (Columbia), Cruz (1969) observed differential tolerance in five guinea corn varieties to atrazine at 3.0, 4.0, and 6.0 kg/ha applied either pre-emergence or post-emergence in 10 l/ha of oil. He also observed that the variety that was least tolerant to a pre-emergence atrazine was most tolerant to the herbicide when it was applied post-emergence. Similarly, Lagos and Cardenas (1970) observed differences in susceptibility to different

rates of atrazine, propazine and monuron among the four varieties of guinea corn used. Scifres and Bovey (1970) used seven guinea corn varieties and reported wide variations in their responses to pre- or post-emergence applications of various concentrations of picloram.

Spotanski et al. (1971) used twice the normal (1.0 kg/ha) rate of atrazine on ten guinea corn varieties but found only three varieties showing significant yield reductions due to herbicide injury. These same susceptible varieties, which were also early-maturing behaved similarly when Burnside and Wicks (1972) tested their competitiveness with giant foxtail (S. faberii Herm) and herbicide tolerance along with seven other guinea corn varieties. In India, Raghunathan et al. (1974) studied the varietal reactions of guinea corn to 2,4-D, dicamba and atrazine, each at two doses of 0.5 and 1.0 kg/ha, 2.2 and 4.4 l/ha, and 1.0 and 2.0 kg/ha, respectively. They observed differential response to the herbicides at the various levels, with the differences becoming more pronounced with increase in herbicide rates. Obilana and Lagoke (1979) observed at Mokwa that after treatment with

atrazine plus pendimethalin (1:1) at 4.0 kg/ha, varieties "L 187" and "SK 5912" exhibited herbicide injury symptoms, although this was more pronounced with "L 187".

CHAPTER 3

MATERIALS AND METHODS

1. Experimental Sites

Field trials were conducted during the 1980/81 wet season at the research farm of the Agricultural Research Station Mokwa ($9^{o}11'N$; $05^{o}04'E$) in the southern Guinea Savanna and the Institute for Agricultural Research Samaru ($11^{o}11'N$; $07^{o}38'E$) in the northern Guinea Savanna.

In general the soil at Mokwa is a sandy-loam, well drained, high in organic matter and cation exchange capacity. At Samaru the soil is a clay-loamy, well drained but is low in organic matter and cation exchange capacity (Table 1).

2. Cultural Practices and Management

a. Field Operation and Fertilization

At both sites, the land was ploughed, and harrowed at two weeks' interval. At Samaru fertilizers at the rate of 23 kg/ha of P_2O_5 (as single super-phosphate) and 30 kg/ha of K_2O (as muriate of potash), were broadcast

Table 1. Physico-chemical properties of the soils at Mokwa and Samaru.

Mechanical composition		Mokwa	Samaru
Clay	(%)	8.0	12.0
Fine silt	"	6.0	6.0
Coarse silt	"	10.0	14.0
Fine sand	"	44.0	53.0
Coarse sand	"	32.0	15.0
Organic carbon	"	1.0	0.6
pH			
H_2O 1:1		6.1	6.3
H_2O 1:2-5		6.2	6.1
Base Exchange			
Exch. Na^+ (meq/100g soil)		0.08	0.03
Exch. K^+ (meq/100g soil)		0.13	0.07
Exch. Ca^{++} + Mg^+ (meq/100g soil)		2.80	2.00
Total (meq/100g soil)		3.01	2.10
CEC/100g soil		5.40	3.50
Calculated Value			
Base sat.	(%)	55.0	60.0

uniformly before the field was ridged 75 cm apart. The same rates of P_2O_5 and K_2O were applied in bands at the time of planting in Mokwa as the field had earlier been ridged.

Nitrogen (as nitrochalk) at the rate of 33 kg/ha was split-applied at 2 and 7 weeks after sowing. However, at Mokwa a dry spell delayed the application of the second dose of nitrogen by two weeks.

b. Planting and Spacing

The field trials were established on the 10th June, 1980 at Mokwa and on the 23rd June, 1980 at Samaru. About five seeds were sown per hole at 3 cm depth. The intra-row spacing was 20 and 30cm at Mokwa and Samaru, respectively.

At 10 days after sowing (DAS), spaces where seeds failed to emerge were re-sown. Two weeks after the first sowing, when the seeds sown at gap-filling had emerged, the stands of the crop were thinned to one plant per stand at Mokwa to avoid rank growth due to the tall growth of the varieties; and two plants per stand at Samaru. All plots were kept weed-free throughout the period of crop growth to prevent week-crop competition.

3. Treatments

A total of nine herbicide treatments, applied pre-emergence and a hoe-weeded control were investigated (Table 2).

a. Herbicides

The herbicides used in this study include atrazine and a mixture of terbutryne and terbuthylazine, herbicides that have shown good promise for weed control in guinea corn; and pendimethalin which is normally not well tolerated by ginea corn but is known to be effective against Rottboelia exaltata L., a notorious weed common in mechanized guinea corn farms.

b. Guinea Corn Varieties

Guinea corn varieties adapted to each ecological zone were used (Fig. 1). In each ecological zone varieties differing in growth characteristic were selected for this study. In Mokwa, the varieties used were ^{C}74 (M.S.V.2), FD I (M.S.V.3) and ML 4 (M.S.V.2) while at Samaru the varieties FFBL (S.S.V.2), L1499 (S.S.V.7), L187 (S.S.V.6) and SK5912 (S.S.V.3) were used. The agronomic characteristics of these guinea corn varieties are:

Table 2. Herbicides evaluated for guinea corn varietal response at Mokwa and Samaru during 1980/81 wet season.

Herbicides	Formulation	Rate kg a.i./ha
Atrazine	500 fw[1]	1.0
Atrazine	-do-	2.0
Atrazine	"	4.0
Pendimethalin	300 E.C.[2]	1.0
Pendimethalin	-do-	2.0
Pendimethalin	"	4.0
Terbutryne + terbuthylazine (1:1)[3]	500 fw	1.6
Terbutryne + terbuthylazine (1:1)	-do-	3.2
Terbutryne + terbuthylazine (1:1)	"	6.4
Hoe-weeded control	-	-

[1]FW = Flowable formulation

[2]E.C. = Emulsifiable concentrates

3 Formulated mixture introduced by Ciba-Geigy as sorghoprim containing 250gm/l each of terbutryne and terbuthylazine.

i) C74 (M.S.V.1): This is a late season guinea corn selection from a local variety. It is about 400 cm tall, head in 150 days and matures in about 180 days. The had is large and loose with drooping branches. The grains are medium-sized and white in colour.

ii) FD1 (M.S.V.3): This is also a tall (400 cm) late season selection from a local variety that heads and matures at the same time as C74 variety but it has medium-sized loose heads and fairly large yellow grains.

iii) ML4 (M.S.V.2): This is very similar to FD1 variety, but unlike FD1 it has small white grains.

iv) FFBL (S.S.V.2): This is a long season, tall (400 cm), improved local variety with a characteristic slim stem. It heads in 130 days and takes about 165 days to mature. The head is long and very loose with drooping branches. The grains are white, large and flattened with dark red to black conspicuous glumes.

v) L1499 (S.S.V.7): This is also a long season variety resistant to head smut and striga. It is semi-dwarf (200 cm) and has good standability with upright leaves. It heads in 123 days and matures in 155 to 160 days. The head is semi-compact, elliptical and pointed at the top. The grains are medium in size and cream coloured.

vi) L187 (S.S.V.6): This is another striga resistant variety which is also long season with robust plants. It is about 180 cm tall with excellent standability in the field and large drooping leaves. It is a long season variety which heads is about 126 days and matures in 160 days. The semi-compact and large head is bent with the peduncle. The seeds are very bold, yellow and surrounded with straw-coloured glumes.

vii) SK5912 (S.S.V.3): It is a long season semi-dwarf (260 cm) improved local variety selection which heads in about 130 days and matures between 160 and 165 days. The head is compact and elliptical with bold yellow grains surrounded with

brown, small glumes. The high yields and the low shedding of seeds at harvest due to the structure of the head make this a preferred variety.

4. Experimental Design, Replicating and Plot Sizes

A strip plot design comprising three replicates in each site was used. All herbicide rates were randomly allocated and applied pre-emergence across strips of plots after the guinea corn varieties had been randomly allocated and sown along strips of plots. This particular design was chosen in order to give equal importance to all treatments (it has no main - or sub-treatments); and ease the sowing of the crop and applying the herbicides as these come in straight strips of plots.

The gross and net plot sizes at Mokwa were 22.50 m^2 (6.00m long x 3.75m wide) and 10.13 m^2 (4.50m long x 2.25m wide) respectively, while the plots at Samaru were 31.50 m^2 (6.00m long x 5.25m wide) and 15.75 m^2 (4.20m long x 3.75m wide).

5. Herbicide Application

All herbicide treatments were applied pre-emergent, one day after sowing. A CP 3 Knapsack sprayer was used with a deflector nozzle covering a swath of 75cm at a pressure of 2.1 kg/cm^2 to deliver 220 l/ha of spray solution. The application was done late in the evening to avoid strong wind and resultant drift.

6. Observations

The following observations were made from the net plots.

a. Stand Count: This was taken at 7, 35 and 84 days after sowing (DAS) to determine the effect of herbicides on stand count at different stages of crop growth. A stand with one or more seedlings was counted as one and the figure obtained was expressed as a percentage of the expected total number of stands per net plot.

b. Crop Vigour Score: The vigour was assessed at 21, 42, 63 and 84 DAS using a zero-to-ten (0-10) scale, where ten was taken for the plot with the most

healthy plants while zero was for the plots with completely killed plants (Appendix 1).

c. Plant Height and Leaf Number: The average heights (cm) and leaf number per plant of ten plants in each plot were taken at 21, 42, 63 and 84 DAS using ten randomly selected plants on each occasion.

d. Shoot Dry Weight: Two plants were randomly taken per plot and their shoots (stems with leaves) oven-dried at 70°C and weighed (g/plant) to constant dry weight. Samples were taken at 21, 42, 63 and 84 DAS at Mokwa while they were taken at 21, 42 and 63 DAS at Samaru due to problem of management.

e. Head weight: After harvest, the heads were sun-dried, weighed and the data expressed in tonnes per hectare.

f. Grain Yield: The dry heads of each plot were thres-head and the grains weighed and expressed in kilo-grammes per hectare.

g. 1000-Grain weight: From each variety in each treat-ment, a sample was randomly taken for which 1000 dry grains were counted and weighed in grammes.

h. Stover Yield: After cutting the heads, the stover was left in the field, air-dried, weighed and expressed in tonnes per hectare.

7. Statistical Analysis

The data collected were subjected to statistical analysis of variance as described by Little and Hill (1972). Differences between the treatment means were compared using the Least Significance Difference (L.S.D), where the F value was significant.

CHAPTER 4

RESULTS

A. Mokwa Trial

Stand counts were taken at 7, 35 and 84 days after sowing (DAS) and the data analysed, however, only observations at 7 and 84 days were considered. Similarly, observations were made at 21, 42, 63 and 84 DAS on crop vigour score, plant height, leaf number and shoot dry weight, however, only observations at 21 and 63 DAS were considered, although all data collected was analysed as shown in appendix. The observations considered coincided with the critical stages in the growth of the crop, and no added information was obtained from the observations not considered.

1. Stand Count

At 7 and 84 DAS, there were no significant differences in stand count among guinea corn varieties or in their interaction with herbicide treatments, however, significant differences in stands were observed among the herbicide treatments (Table 3).

Table 3. Effect of various rates of herbicides on stand count of guinea corn varieties at 7, and 84 days after sowing at Mokwa, 1980.

Variety	Control	Terbutryne/terbuthylazine			Atrazine			Pendimethalin			Variety mean
		1.6[1]	3.2	6.4	1.0	2.0	4.0	1.0	2.0	4.0	
		Percent Stand Count (%)									
C74											
7 DAS[2]	99.32	100.00	92.56	89.47	100.00	100.00	100.00	97.08	80.12	78.36	93.69
84 DAS	87.78	86.55	81.25	78.92	81.87	76.36	73.10	67.25	61.99	53.21	74.83
FD1											
7 DAS	99.65	98.83	98.83	74.85	100.00	98.25	94.62	90.64	87.72	81.87	92.53
84 DAS	83.69	84.21	76.61	62.57	79.53	79.53	64.91	64.91	57.31	50.29	70.36
ML4											
7 DAS	96.65	95.32	91.81	88.31	95.91	85.96	80.86	76.02	70.17	62.58	84.36
84 DAS	74.85	66.67	60.85	56.72	73.68	55.55	53.8	44.63	42.11	26.76	55.56
Mean of herbicide rate											
7 DAS	98.54	98.05	94.40	84.21	98.64	94.74	91.83	78.91	79.34	74.27	
84 DAS	82.11	79.14	72.91	66.07	78.36	70.48	63.94	58.93	53.88	43.42	

Time	Least significant difference at 5% level		
	Variety	herbicide rate	Variety x herbicide rate
7 DAS	NS[3]	9.90	NS
84 DAS	NS	12.41	NS

1 Rate of herbicide/herbicide mixture (kg/ha)

2 Days after sowing

3 Not significant

At both counts, terbutryne/terbuthylazine mixture at 6.4 and pendimethalin at all rates resulted in significantly lower stand count relative to the control. Atrazine at 4.0 kg/ha also caused lower stand count at 84 DAS in this trial. At 7 and 84 DAS stand counts with terbutryne/terbuthylazine mixture at 6.4 kg/ha were significantly lower than those of the lower rates; all rates of pendimethalin resulted in lower stand count than the corresponding rates of atrazine. Stand count with atrazine and pendimethalin each at 4.0 kg/ha was lower compared to 1.0 kg/ha at 84 DAS. At each count variety ML 4 appeared more susceptible to all rates of pendimethalin than the other two varieties used, although the interactions between the varieties and herbicides were not statistically significant. This variety also appeared most susceptible to atrazine at 2.0 and 4.0 kg/ha at 7 DAS.

2. Crop Vigour Score

Significant differences in crop vigour score were observed only among varieties at 21 DAS (Table 4). Variety ML 4 appeared to grow less vigorously than Variety C 74.

Table 4. Effect of various rates of herbicides on crop vigour score of guinea corn varieties at 21 and 63 days after sowing at Mokwa, 1980.

Variety	Crop vigour score (0 - 10 score)										
	Control	Terbutryne/terbuthylazine			Atrazine			Pendimethalin			Variety mean
		1.6	3.2	6.4	1.0	2.0	4.0	1.0	2.0	4.0	
C74											
21 DAS	9.00	9.33	8.00	7.83	9.16	9.00	7.00	8.33	8.00	6.33	8.20
63 DAS	7.83	8.30	8.30	7.83	9.00	7.67	7.17	8.67	8.17	7.50	8.04
FD1											
21 DAS	8.33	8.16	8.16	6.16	8.67	8.00	6.83	8.16	7.33	6.00	7.58
63 DAS	8.50	8.00	7.67	7.50	8.17	7.83	6.83	8.17	6.17	5.33	7.42
ML4											
21 DAS	8.00	6.00	5.50	5.83	7.67	7.00	5.83	7.33	7.33	8.83	6.58
63 DAS	8.67	8.83	8.17	8.17	8.30	8.17	7.50	6.30	6.00	6.00	7.61
Mean of herbicide rate											
21 DAS	8.44	7.83	7.22	6.61	8.50	8.00	6.55	7.94	7.55	5.89	
63 DAS	8.33	8.38	8.05	7.83	8.49	7.89	7.17	7.70	6.78	6.28	

Least signficant difference at 5% level

Time	Variety	Herbicide rate	Variety x herbicide rate
21 DAS	1.38	NS	NS
63 DAS	NS	0.95	1.29

At 63 DAS, herbicide treatments and their interaction with guinea corn varieties had significant effects on crop vigour although the varieties themselves did not differ in vigour. Lower crop vigour scores were obtained with atrazine at 4.0 kg/ha and pendimethalin at 2.0 and 4.0 kg/ha relative to the control. No significant depression in crop vigour due to herbicide treatment was observed in Variety C 74 although atrazine at 1.0 kg/ha resulted in slight increases in crop vigour as compared to the control. With Variety FD 1, atrazine at 4.0 kg/ha and pendimethalin at 2.0 and 4.0 kg/ha resulted in significantly lower crop vigour, while all rates of pendimethalin caused lower vigour in Variety ML 4 as compared to the appropriate control. In general, Variety ML 4 appeared more susceptible to pendimethalin than the other two varieties used.

3. Plant Height

There were neither significant varietal differences in the heights of guinea corn varieties nor in their interaction with herbicide treatments. Significant differences in heights due to herbicide treatments were, however, observed at 21 DAS (Table 5).

Table 5. Effect of various rates of herbicides on plant height of guinea corn varieties at 21 and 63 days after sowing at Mokwa, 1980.

Variety	Plant height (cm)										
	Control	Terbutryne/terbuthylazine			Atrazine			Pendimethalin			Variety mean
		1.6	3.2	6.4	1.0	2.0	4.0	1.0	2.0	4.0	
C74											
21 DAS	16.67	19.67	18.25	18.08	21.50	19.83	13.67	21.25	18.67	16.33	18.39
63 DAS	62.80	84.20	68.80	60.30	97.50	61.60	55.20	80.50	77.50	50.80	69.92
FD1											
21 DAS	18.83	20.83	16.50	14.50	17.83	17.50	12.75	18.67	14.67	12.42	16.45
63 DAS	86.70	72.00	61.00	54.00	86.70	73.80	43.80	83.00	81.50	56.20	69.87
ML4											
21 DAS	15.00	16.00	13.67	13.58	16.00	14.00	11.83	15.33	15.17	13.00	14.36
63 DAS	68.20	73.30	62.30	59.00	78.80	64.70	64.30	75.00	69.30	37.80	65.27
Mean of herbicide rate											
21 DAS	16.83	18.83	16.74	15.39	18.44	17.11	12.75	18.42	16.17	13.92	
63 DAS	72.60	76.50	64.00	57.80	87.70	64.70	54.43	75.00	76.10	48.30	

Least Significant Difference at 5% Level

Time	Variety	Herbicide rate	Variety x herbicide rate
21 DAS	NS	1.19	NS
63 DAS	NS	NS	NS

At 21 DAS, terbutryne/terbuthylazine mixture at 6.4 kg/ha and atrazine and pendimethalin, each at 4.0 kg/ha, significantly reduced plant height relative to the control. In each herbicide/herbicide mixture, there was a significant reduction in plant height with increase in rate.

Although the interaction between guinea corn varieties and herbicide treatments was not significant at 63 DAS, variety ML 4 was observed to be more susceptible to pendimethalin at 4.0 kg/ha than any other variety.

4. Leaf Number

There were neither significant differences in leaf number among guinea corn varieties nor in their interaction with herbicide treatments. However, significant differences were observed between herbicide treatments (Table 6).

At 21 DAS, atrazine at 4.0 kg/ha significantly reduced leaf number of guinea corn varieties relative to the control. Terbutryne/terbuthylazine mixture at 3.2 and 6.4 kg/ha resulted in significantly lower leaf number relative to 1.6 kg/ha of the herbicide; leaf number with

Table 6. Effect of various rates of herbicides on leaf number of guinea corn varieties at 21 and 63 days after sowing at Mokwa, 1980.

Variety	Control	Terbutryne/terbuthylazine			Atrazine			Pendimethalin			Variety mean
		1.6	3.2	6.4	1.0	2.0	4.0	1.0	2.0	4.0	
C74											
21 DAS	7.83	7.67	7.17	7.17	8.17	7.67	6.50	10.67	9.00	6.67	7.85
63 DAS	9.53	10.17	10.00	9.00	11.50	10.00	9.67	11.50	10.33	9.50	10.12
FD1											
21 DAS	8.33	8.00	7.33	6.67	8.50	7.33	6.33	7.50	7.50	7.17	7.47
63 DAS	9.83	10.67	8.50	8.50	12.33	10.67	8.00	10.33	10.33	9.67	9.88
ML4											
21 DAS	8.50	12.33	8.17	8.33	8.50	7.83	7.33	8.17	8.00	8.00	8.52
63 DAS	9.00	10.67	10.33	6.83	10.00	9.33	9.00	12.17	9.67	9.50	9.65
Mean of herbicide rate											
21 DAS	8.22	9.33	7.56	7.39	8.39	7.61	6.72	8.78	8.17	7.28	
63 DAS	9.45	10.50	9.61	8.11	11.28	10.00	8.89	11.33	10.11	9.56	

Least significant difference at 5% level

Time	Variety	Herbicide rate	Variety x herbicide rate
21 DAS	NS	1.23	NS
63 DAS	NS	1.47	NS

atrazine and pendimethalin, each at 4.0 kg/ha was significantly lower compared to 1.0 kg/ha of each herbicide.

At 63 DAS, both atrazine and pendimethalin, each at 1.0 kg/ha, resulted in higher leaf number than the control. Terbutryne/terbuthylazine mixture at 1.6 kg/ha had higher leaf number than the high rate of the herbicide mixture. Similarly, atrazine and pendimethalin, each at 1.0 kg/ha, had significantly higher leaf number than 4.0 kg/ha of each herbicide. Leaf number generally reduced with increase in herbicide/herbicide mixture rate.

5. Shoot Dry Weight

There were no significant differences in shoot dry weight among guinea corn varieties in both samplings. Significant differences in shoot dry weights were however observed among herbicide treatments (Table 7).

As observed in the leaf number, only atrazine at 4.0 kg/ha resulted in significantly lower shoot dry weights at 21 DAS, when compared to the control. Although there were no significant differences in the interaction between guinea corn varieties with herbicide treatments, the low

Table 7. Effect of various rates of herbicides on shoot dry weight (g) of guinea corn varieties at 21 and 63 days after sowing at Mokwa, 1980.

Variety	Shoot dry weight (g)										
	Control	Terbutryne/terbuthylazine			Atrazine			Pendimethalin			Variety mean
		1.6	3.2	6.4	1.0	2.0	4.0	1.0	2.0	4.0	
C74											
21 DAS	3.00	6.80	2.92	2.58	5.08	4.50	2.92	5.08	3.67	3.25	3.98
63 DAS	55.18	50.42	46.28	25.47	56.87	42.03	38.58	51.82	42.57	39.50	44.87
FD1											
21 DAS	3.92	3.39	3.28	2.75	3.25	2.67	1.53	4.97	3.25	2.75	1.83
63 DAS	50.13	56.87	33.75	33.73	58.18	45.97	25.40	51.95	43.87	38.95	43.88
ML4											
21 DAS	3.92	3.28	2.92	2.50	3.75	2.42	1.42	4.58	2.50	2.45	2.78
63 DAS	46.55	56.40	48.27	34.02	46.90	41.22	39.17	54.15	42.25	35.93	44.55
Mean herbicide rate											
21 DAS	3.61	4.47	3.04	2.61	4.03	3.20	1.96	4.88	3.14	2.82	
63 DAS	50.62	54.59	42.77	31.07	53.98	43.07	34.56	52.64	42.90	38.13	

Least significant difference at 5% level

Time	Variety	Herbicide rate	Variety x herbicide rate
21 DAS	NS	1.02	NS
63 DAS	NS	NS	NS

rates of herbicides/herbicide mixtures tended to result in higher shoot dry weights than the control. Significantly lower shoot dry weights were obtained with the high rates of herbicides/herbicide mixtures as compared to the appropriate low rates. Although not statistically significant, reduction in shoot dry weight was higher in varieties FD 1 and ML 4 than in variety C 74 when tested with atrazine at all rates.

Significant differences were not observed in the interaction between guinea corn varieties with herbicide treatments at 63 DAS, however, shoot dry weights decreased with increase in herbicide/herbicide mixture rates. Low shoot dry weights were produced by variety C 74 when treated with terbutryne/terbuthylazine mixture at 6.4 kg/ha and variety FD 1 with atrazine at 4.0 kg/ha than in the respective controls.

6. Head Dry Weight

Neither the varieties nor the herbicide rates had significant effects on head weight of guinea corn varieties (Table 8). Although significant reduction in head weight was not observed as a result of the interaction between

Table 8. Effect of various rates of herbicides on head dry weight of guinea corn varieties at Mokwa, 1980.

Variety	Head weight (t/ha)										Variety mean
	Control	Terbutryne/terbuthylazine			Atrazine			Pendimethalin			
		1.6	3.2	6.4	1.0	2.0	4.0	1.0	2.0	4.0	
C74	6.04	6.41	5.92	4.60	6.76	6.02	4.78	7.01	6.82	6.42	6.08
FD1	5.27	5.69	5.57	5.08	7.63	5.56	5.05	6.19	5.49	5.13	5.67
ML4	7.40	7.08	7.04	6.71	6.78	6.20	5.84	5.15	4.88	3.49	5.05
Mean of herbicide rate	6.24	6.39	6.18	5.46	7.04	5.93	5.22	6.12	5.73	5.01	

Least significant difference at 5% level

Variety	Herbicide rate	Variety x herbicide
NS	NS	NS

varieties and herbicide rates, variety C74 had a lower head weight than any other variety when sprayed with either terbutryne/terbuthylazine at 6.4 kg/ha or atrazine or pendimethalin, each at 4.0 kg/ha. Variety ML4 was apparently more susceptible to all rates of pendimethalin than the other two varieties.

7. Grain Yield

There were neither significant differences in grain yield among the guinea corn varieties nor herbicide treatments, however, significant difference in grain yield were observed as a result of their interaction (Table 9).

With variety C74, only atrazine at 4.0 kg/ha resulted in significantly lower grain yield than the control. Grain yield with terbutryne/terbuthylazine mixture at 1.6 kg/ha and pendimethalin at 1.0 and 2.0 kg/ha was significantly higher than that of the untreated control. Yields obtained with atrazine and pendimethalin, each at 4.0 kg/ha, were significantly lower than at 1.0 kg/ha of each herbicide.

Table 9. Effect of various rates of herbicides on grain yield of guinea corn varieties at Mokwa, 1980.

Variety	Grain yield (kg/ha)										Variety mean
	Control	Terbutryne/terbuthylazine			Atrazine			Pendimethalin			
		1.6	3.2	6.4	1.0	2.0	4.0	1.0	2.0	4.0	
C74	1288	1514	1337	1337	1371	1320	1057	1720	1674	1467	1409
FD1	1368	1270	1153	1095	1483	1327	1175	1816	1651	1368	1371
ML4	1554	2074	1485	1349	1639	1394	904	1674	1655	645	1438
Mean of herbicide rate	1403	1621	1325	1260	1498	1347	1046	1737	1660	1160	

Least significant difference at 5% level		
Variety	Herbicide rate	Variety x herbicide rate
NS	NS	213

With FD 1, terbutryne/terbuthylazine at 3.2 and 6.4 kg/ha resulted in lower yield relative to the control. Pendimethalin at 1.0 and 2.0 kg/ha resulted in higher grain yield than the untreated control. At 4.0 kg/ha, each of atrazine and pendimethalin, yields were lower than at 1.0 kg/ha and 1.0 and 2.0 kg/ha, respectively. With ML 4 both atrazine and pendimethalin, each at 4.0 kg/ha, resulted in significantly lower grain yield relative to the control. Terbutryne/terbuthylazine mixture at 1.6 kg/ha, however, resulted in significantly higher grain yield than the control. Grain yield with terbutryne/terbuthylazine at 3.2 and 6.4 kg/ha and atrazine at 2.0 and 4.0 kg/ha were significantly lower than those of their respective low rates. Similarly, 1.0 and 2.0 kg/ha of pendimethalin had significantly higher grain yield than 4.0 kg/ha of the herbicide.

8. 1000-Grain Weight

Grain weight was not significantly affected by either variety, herbicide rate or their interaction in this trial. However, grain weight was lower with variety C74 than with any of the other varieties when treated with atrazine at 4.0 kg/ha (Table 10).

Table 10. Effect of various rates of herbicides on 1000 grain weight of guinea corn varieties at Mokwa, 1980.

Variety	1000 grains weight (g)										
	Control	Terbutryne/terbuthylazine			Atrazine			Pendimethalin			Variety Mean
		1.6	3.2	6.4	1.0	2.0	4.0	1.0	2.0	4.0	
C74	30.83	29.84	29.70	28.00	31.90	29.60	26.27	32.37	31.13	28.50	29.81
FD1	30.77	34.60	30.10	28.83	31.47	31.13	29.93	33.27	30.40	30.27	31.03
ML4	30.73	30.9	30.67	30.67	31.13	30.03	30.00	30.70	30.00	29.47	30.43
Mean of herbicide rate	30.78	30.78	30.16	29.00	31.50	30.23	28.73	32.11	30.51	29.11	

Least significant difference at 5% level

Variety	Herbicide rate	Variety x herbicide rate
NS	NS	NS

9. Stover Yield

There were significant differences in stover yield due to the interaction between varieties of guinea corn with the herbicide treatments, (Table 11). With variety C74, only terbutryne/terbuthylazine mixture at 6.4 kg/ha resulted in significant stover yield reduction relative to its control. Terbutryne/terbuthylazine mixture at 1.6 and pendimethalin at 1.0 kg/ha resulted in higher stover yields than the controls. Yields obtained with the low rates of all herbicides/herbicide mixtures were significantly higher than those of their corresponding high rates. Pendimethalin at 1.0 kg/ha also caused higher stover yield as compared to 2.0 and 4.0 kg/ha of the herbicide.

As observed with variety C74, significantly lower stover yield than the appropriate control was obtained with variety FD1 when terbutryne/terbuthylazine mixture at 6.4 kg/ha was applied. Pendimethalin at 1.0 and 2.0 kg/ha resulted in higher stover yields than the appropriate control and 4.0 kg/ha of the herbicide. Similarly, stover yield at 1.0 kg/ha of atrazine was significantly higher than at 2.0 and 4.0 kg/ha of the herbicide.

Table 11. Effect of various rates of herbicides on stover yield of guinea corn varieties at Mokwa, 1980.

Variety	Stover yield (t/ha)										
	Control	Terbutryne/terbuthylazine			Atrazine			Pendimethalin			₸Variety mean
		1.6	3.2	6.4	1.0	2.0	4.0	1.0	2.0	4.0	
C74	9.09	10.54	9.35	6.72	9.94	8.46	8.07	11.72	9.68	9.42	8.30
FD1	9.19	9.02	8.89	7.77	10.21	8.56	8.16	11.98	10.67	8.33	9.20
ML4	11.42	11.59	11.00	10.13	11.59	8.69	7.90	9.15	7.08	6.78	9.53
Mean of herbicide rate	9.90	10.38	9.75	8.21	10.58	8.57	8.04	10.95	9.14	8.18	

Least significant difference at 5% level

Variety	Herbicide rate	Variety x herbicide rate
NS	NS	1.32

With ML4, significantly lower stover yields were obtained with atrazine at 2.0 and 4.0 kg/ha and pendimethalin at all rates. Stover yield at 6.4 kg/ha of terbutryne/terbuthylazine was also lower than that at 1.6 kg/ha. Both atrazine and pendimethalin, resulted in lower stover yield compared with 1.0 kg/ha of each herbicide.

B. Samaru Trial

Stand counts were taken at 7, 35 and 84 days after sowing (DAS) and analysed, however, only observations at 7 and 84 days were considered. Similarly, observations were made at 21, 42, 63 and 84 DAS on crop vigour score, plant height, leaf number and shoot dry weight, however, only observations at 21 and 63 DAS were considered, although all data was analysed as shown in appendix. The observations considered coincided with the critical stages in the growth of the crop, and no added information was obtained from the observations not considered.

1. Stand Count

At 7 and 84 DAS, there were no significant differences in stand count observed between herbicide treatments (Table 12).

At 7 DAS, atrazine at 4.0 kg/ha and all rates of pendimethalin significantly reduced stand count of guinea corn varieties when compared with the control. This response to pendimethalin, especially at 2.0 and 4.0 kg/ha, was reflected in all varieties.

At 84 DAS, significantly lower stand counts were obtained with all rates of pendimethalin relative to the control. Lower stand count was obtained with variety L187, than with any other variety, sprayed with terbutryne/terbuthylazine mixture at 6.4 kg/ha and atrazine at 4.0 kg/ha. Stand count with SK5912 was also lower with pendimethalin at 4.0 kg/ha. Variety L187 appeared to tolerate pendimethalin at 2.0 kg/ha better than any other variety.

2. Crop Vigour Score

There were significant varietal differences in crop vigour at 63 DAS, with variety FFBL and L1499 being more

Table 12. Effect of various rates of herbicides on stand count (%) of guinea corn varieties 7, and 84 DAS at Samaru, 1980.

Variety	Percent stand count (%)										
	Control	Terbutryne/terbuthylazine			Atrazine			Pendimethalin			Variety mean
		1.6	3.2	6.4	1.0	2.0	4.0	1.0	2.0	4.0	
FFBL											
7 DAS	98.78	98.41	96.37	82.99	96.83	94.11	76.42	83.90	29.25	28.80	78.59
84 DAS	87.89	85.34	80.44	77.44	80.44	80.00	79.11	77.33	40.89	33.67	72.26
L1499											
7 DAS	98.87	99.32	98.87	95.24	99.09	98.42	89.58	82.09	36.28	28.57	82.63
84 DAS	88.00	87.11	81.78	79.56	88.44	84.45	83.11	66.22	32.44	30.67	72.18
L187											
7 DAS	98.97	95.47	93.88	95.88	95.92	93.20	80.73	71.20	37.19	25.62	68.61
84 DAS	89.45	89.78	78.66	58.67	84.89	84.00	68.00	63.11	62.22	20.44	69.92
SK5912											
7 DAS	98.49	98.19	95.63	96.65	96.60	92.52	88.66	78.46	38.32	17.69	80.12
84 DAS	89.44	88.89	81.78	80.00	87.11	77.78	73.33	62.56	38.66	18.67	69.02
Mean of herbicide rate											
7 DAS	98.78	97.85	96.19	87.19	97.11	94.56	83.85	78.91	35.16	25.17	
84 DAS	88.60	87.78	80.67	73.92	85.22	81.56	75.89	67.31	43.55	23.86	

Time	Least significant difference at 5% level		
	Variety	Herbicide rate	Variety x herbicide rate
7 DAS	NS	14.61	NS
84 DAS	NS	14.71	NS

Table 13. Effect of various rates of herbicides on crop vigour score of guinea corn varieties 21 and 63 days after sowing at Samaru, 1980.

Variety	Corn Vigour Score (0 - 10 scale)										
	Control	Terbutryne/terbuthylazine			Atrazine			Pendimethalin			Variety mean
		1.6	3.2	6.4	1.0	2.0	4.0	1.0	2.0	4.0	
FFBL											
21 DAS	7.00	7.00	6.00	4.67	7.17	5.00	4.17	6.67	4.67	2.00	5.41
63 DAS	8.17	7.97	7.67	7.57	9.17	6.27	5.83	8.83	5.03	3.67	7.02
L1499											
21 DAS	6.33	6.00	5.00	4.83	6.17	4.67	4.50	5.33	4.17	3.50	5.05
63 DAS	8.67	8.63	8.60	7.60	9. 3	9.00	7.20	6.93	4.80	3.93	7.45
L187											
21 DAS	5.67	4.83	4.03	3.50	4.83	3.83	2.83	3.83	3.83	2.33	3.95
63 DAS	4.93	5.93	5.83	5.67	6.27	5.83	5.40	4.67	3.37	2.50	5.04
SK5912											
21 DAS	6.67	5.17	4.00	4.33	5.33	5.33	4.00	4.17	3.83	3.83	4.48
63 DAS	7.50	8.10	7.83	7.00	7.17	6.10	5.83	6.00	4.83	2.57	6.29
Mean of herbicide rate											
21 DAS	6.42	5.62	4.92	4.38	5.19	4.71	3.88	5.00	4.13	2.46	
63 DAS	7.57	7.66	7.48	6.96	7.94	6.80	6.07	6.61	4.51	3.17	

Time	Least significant difference at 5% level		
	Variety	Herbicide rate	Variety x herbicide rate
21 DAS	NS	0.87	NS
63 DAS	0.97	2.05	NS

vigorous than variety L187 and SK5912. The effects of the herbicide treatments were significant although interaction between the guinea corn varieties with the herbicide treatments on crop vigour was not significant (Table 13).

At 21 DAS, except terbutryne/terbuthylazine mixture at 1.6 kg/ha, all herbicide treatments resulted in significantly lower crop vigour score as compared to the control. Variety L187 was more susceptible to 2.0 and 4.0 kg/ha, each of atrazine and pendimethalin while variety SK5912 was most affected by terbutryne/terbuthylazine mixture at 3.2 and 6.4 kg/ha, atrazine at 4.0 kg/ha and pendimethalin at 2.0 and 4.0 kg/ha.

At 63 DAS, only pendimethalin at 2.0 and 4.0 kg/ha resulted in significantly lower crop vigour than the control.

3. Plant Height

There were significant differences in height among varieties and herbicide treatments at 21 and 63 DAS (Table 14).

Table 14. Effect of various rates of herbicides on plant height (cm) of guinea corn varieties 21 and 63 days after sowing at Samaru, 1980

Variety	Plant height (cm)										
	Control	Terbutryne/terbuthylazine			Atrazine			Pendimethalin			Variety mean
		1.6	3.2	6.4	1.0	2.0	4.0	1.0	2.0	4.0	
FFBL											
21 DAS	10.42	9.95	9.22	6.58	9.52	5.85	4.95	9.30	9.12	7.93	8.28
63 DAS	82.47	108.15	65.83	63.50	91.70	43.38	40.98	91.18	77.77	37.78	70.27
L1499											
21 DAS	9.17	10.68	10.63	6.80	10.48	10.20	7.13	9.63	7.65	6.28	8.87
63 DAS	53.18	62.83	57.93	57.63	66.52	57.30	56.47	54.50	32.95	32.68	53.20
L187											
21 DAS	7.62	7.57	6.18	5.78	7.27	6.32	5.48	7.67	7.17	5.47	6.65
63 DAS	31.00	32.87	25.12	24.25	49.68	38.73	28.95	35.65	38.55	34.50	34.33
SK5912											
21 DAS	7.63	7.48	6.55	5.98	6.87	5.90	5.02	6.92	4.48	4.15	6.10
63 DAS	40.13	51.97	46.70	28.40	42.27	38.57	32.43	44.32	26.43	24.25	38.45
Mean of herbicide rate											
21 DAS	8.71	8.92	8.15	6.29	8.54	7.07	5.65	8.38	7.11	5.96	
63 DAS	51.70	64.00	48.89	45.95	62.54	44.50	39.71	57.41	43.93	32.05	

Least significant different at 5% level

Time	Variety	Herbicide rate	Variety x herbicide rate
21 DAS	1.19	1.60	NS
63 DAS	9.43	10.93	NS

At 21 DAS, variety FFBL and variety L1499 were significantly taller than variety L187 and SK5912. Terbutryne/terbuthylazine mixture at 6.4 kg/ha and atrazine and pendimethalin, each at 2.0 and 4.0 kg/ha resulted in significantly lower plant height relative to the control. Significantly lower heights were obtained with the high rate of each herbicide/herbicide mixture relative to its low rate. Although the interaction between the varieties and herbicide treatments did not significantly affect plant height, variety SK5912 and L187 were apparently affected by pendimethalin at 2.0 and 4.0 kg/ha; while FFBL was only affected by 4.0 kg/ha of the herbicide.

At 63 DAS, variety FFBL grew significantly taller than all other varieties while variety L1499 inturn grew significantly taller than variety L187 and SK5912. Atrazine and pendimethalin, each at 4.0 kg/ha, significantly reduced plant height relative to the control. Plants treated with terbutryne/terbuthylazine mixture at 1.6 kg/ha were significantly taller than in the control. The interaction of the guinea corn varieties with herbicide treatments did not significantly affect plant height, however, variety FFBL was most affected at 3.2 and 6.4 kg/ha of terbutryne/

terbuthylazine mixture, atrazine at 2.0 and 4.0 kg/ha and pendimethalin at 4.0 kg/ha, while variety L1499 was apparently affected by pendimethalin at 2.0 and 4.0 kg/ha.

4. Leaf Number

Herbicide treatment significantly affected leaf number at 21 and 63 DAS while varieties significantly differed only at 63 DAS (Table 15).

At 21 DAS, all high rates of each herbicide/herbicide mixture significantly reduced leaf number when compared with the control and their respective low rates. Leaf number at 1.0 kg/ha of pendimethalin was significantly higher than in the control.

At 63 DAS, variety L1499 had significantly more leaves than variety L187 and SK5912. Terbutryne/terbuthylazine mixture at 6.4 kg/ha and pendimethalin at 4.0 kg/ha resulted in lower leaf number relative to the control. The low rates of herbicides/herbicide mixtures as well as the medium rate of atrazine had higher leaf number than their corresponding high rates. The interaction between the guinea corn varieties with herbicide treatments was not significant, however, variety SK5912 appeared most susceptible to 2.0 and 4.0 kg/ha

Table 15. Effect of various rates of herbicides on leaf number of guinea corn varieties 21 and 63 days after sowing at Samaru, 1980.

Variety	Control	Terbutryne/terbuthylazine			Atrazine			Pendimethalin			Variety mean
		1.6	3.2	6.4	1.0	2.0	4.0	1.0	2.0	4.0	
FFBL											
21 DAS	6.17	6.17	5.83	5.17	6.00	5.67	6.17	7.50	5.83	5.83	5.93
63 DAS	12.33	12.33	12.00	11.17	12.50	10.57	9.67	12.17	10.83	9.63	11.32
L1499											
21 DAS	6.00	6.17	5.00	5.00	6.00	5.33	4.67	6.17	5.33	5.00	5.47
63 DAS	13.17	13.50	11.85	11.17	15.50	12.00	11.67	13.00	10.50	9.33	12.17
L187											
21 DAS	5.33	5.83	4.83	4.33	5.83	4.83	4.83	6.00	5.83	4.50	5.21
63 DAS	10.83	11.17	8.80	7.00	13.17	10.83	9.83	13.00	11.50	10.50	10.63
SK5912											
21 DAS	5.50	5.67	5.17	5.00	5.67	5.17	4.83	6.50	4.17	3.83	5.15
63 DAS	12.00	11.57	11.33	10.50	12.83	10.17	10.00	13.33	7.57	6.00	10.53
Mean of herbicide rate											
21 DAS	5.75	5.96	5.21	4.87	5.88	5.25	4.90	6.54	5.09	4.79	
63 DAS	12.08	12.11	10.92	9.96	13.84	10.89	10.29	12.88	10.10	8.87	

Least significant difference at 5% level

Time	Variety	Herbicide rate	Variety x herbicide rate
21 DAS	NS	0.77	NS
63 DAS	1.07	2.08	NS

of pendimethalin with consequent low leaf number production.

5. Shoot Dry Weight

There were significant differences in shoot dry weights among varieties and herbicide treatments, although their interaction effect was not significant (Table 16).

At 21 and 63 DAS, variety FFBL and L1499 had significantly higher shoot dry weights than variety SK5912; also variety FFBL had significantly higher shoot dry weights than variety L187.

At 21 DAS, significantly lower shoot dry weights were observed with terbutryne/terbuthylazine mixture at 6.4 kg/ha and atrazine and pendimethalin, each at 2.0 and 4.0 kg/ha, relative to the control. Shoot dry weight at 1.6 and 3.2 kg/ha of terbutryne/terbuthylazine mixture was significantly higher than at 6.4 kg/ha of the herbicide mixture. Similarly, shoot dry weights with 1.0 kg/ha of atrazine and pendimethalin were significantly higher than at 4.0 kg/ha of the corresponding herbicides. Although the interaction between the varieties with the herbicide treatments was not significant, variety FFBL and L187

Table 16. Effect of various rates of herbicides on shoot dry weight (g) of guinea corn varieties 21, and 63 days after sowing at Samaru, 1980.

Variety	Shoot dry weight (g)										
	Control	Terbutryne/terbuthylazine			Atrazine			Pendimethalin			Variety mean
		1.6	3.2	6.4	1.0	2.0	4.0	1.0	2.0	4.0	
FFBL											
21 DAS	1.40	1.40	1.33	0 35	1.17	1.07	0.40	1.90	1.67	1.13	1.18
63 DAS	178.30	177.50	170.20	162.60	176.60	166.90	150.50	174.70	169.90	166.53	169.40
L1499											
21 DAS	1.50	1.50	1.30	0.80	1.00	1.00	0.73	1.47	0.63	0.77	1.07
63 DAS	179.80	173.40	169.10	165.80	180.00	178.40	157.00	182.40	165.70	157.90	170.94
L187											
21 DAS	1.28	1.28	1.03	0.63	1.27	0.61	0.53	1.20	0.93	0.43	0.92
63 DAS	167.80	167.60	165.10	162.50	171.50	166.20	155.50	170.90	169.30	167.10	166.35
SK5912											
21 DAS	1.40	1.40	1.23	0.50	0.60	0.50	0.30	0.60	0.57	0.38	0.75
63 DAS	171.60	165.80	165.00	160.70	168.40	159.00	159.00	163.70	162.30	150.40	162.57
Mean of herbicide rate											
21 DAS	1.40	1.40	1.22	0.57	1.01	0.80	0.54	1.29	0.95	0.63	
63 DAS	174.38	171.07	167.35	162.91	174.12	167.60	155.48	172.93	166.79	160.53	

Least significant difference at 5% level

Time	Varieties	Herbicide rate	Variety x herbicide rate
21 DAS	0.28	0.40	NS
63 DAS	4.53	6.32	NS

appeared most susceptible to 4.0 kg/ha of atrazine while variety L187 and SK5912 were most affected at 4.0 kg/ha of pendimethalin.

At 63 DAS, the two high rates of herbicides/herbicide mixtures resulted in significantly lower shoot dry weights than the control. The low rate of each herbicide/herbicide mixture as well as 2.0 kg/ha of atrazine had significantly higher shoot dry weights than their respective high rates. Although the interaction between the crop varieties with herbicide treatments was not significant, variety FFBL appeared sensitive to 4.0 kg/ha of atrazine.

6. Head Dry Weight

Significant differences in head dry weights were only observed among herbicide treatments (Table 17).

Terbutryne/terbuthylazine mixture at 3.2 and 6.4 kg/ha, atrazine at 4.0 kg/ha and all rates of pendimethalin caused significantly lower head dry weights relative to the control. The low rate of each herbicide/herbicide mixture had significantly heavier heads relative to the two higher rates, just as the medium rate when compared with the high rate. Head weights with terbutryne/terbuthylazine mixture

Table 17. Effect of various rates of herbicides on head dry weight of guinea corn varieties at Samaru, 1980.

Variety	Head weight (t/ha)										
	Control	Terbutryne-terbuthylazine			Atrazine			Pendimethalin			Variety mean
		1.6	3.2	6.4	1.0	2.0	4.0	1.0	2.0	4.0	
FFBL	2.41	2.71	2.16	1.84	2.95	2.31	1.51	1.85	1.78	1.74	2.13
L1499	2.50	2.58	2.24	2.22	2.71	2.48	2.34	2.77	1.57	1.44	2.29
L187	2.10	2.20	2.07	1.19	2.88	2.25	2.01	1.72	1.57	1.08	2.06
SK5912	2.48	2.54	2.39	1.39	2.46	2.38	1.65	1.85	1.82	1.59	2.06
Mean of herbicide rate	2.37	2.51	2.22	1.66	2.75	2.36	1.88	2.05	1.69	1.46	

Least significant difference at 5% level

Variety	Herbicide rate	Variety x herbicide rate
NS	0.50	NS

at 1.6 kg/ha and atrazine at 1.0 kg/ha were higher than with the control. Although the interaction between crop varieties with herbicide treatments had no significant effect on head weight, variety FFBL had a lower head weight as compared to other varieties when treated with atrazine at 4.0 kg/ha. Variety L1499 proved most tolerant to 6.4 kg/ha of terbutryne/terbuthylazine and 1.0 kg/ha of pendimethalin.

7. Grain Yield

Significant effect on grain yield was only observed among herbicide treatments (Table 18).

Grain yield obtained with terbutryne/terbuthylazine mixture at 6.4 kg/ha, atrazine at 4.0 kg/ha and pendimethalin at 2.0 and 4.0 kg/ha were significantly lower relative to the control. Significantly higher grain yields were observed at 1.6 and 3.2 kg/ha of terbutryne/terbuthylazine mixture and 1.0 and 2.0 kg/ha of atrazine when compared with their appropriate low rates. Similarly, grain yield at 1.0 kg/ha of atrazine was significantly higher than at 4.0 kg/ha of the herbicide. Although not significant, grain yield at the low rates of terbutryne/terbuthylazine mixture and atrazine was higher than in the

Table 18. Effect of various rates of herbicides on grain yield of guinea corn varieties at Samaru, 1980.

Variety	Grain yield (kg/ha)										Variety mean
	Control	Terbutryne/terbuthylazine			Atrazine			Pendimethalin			
		1.6	3.2	6.4	1.0	2.0	4.0	1.0	2.0	4.0	
FFBL	1118	1534	1282	935	1442	1334	890	1175	1103	835	1165
L1499	1694	1576	1430	1185	2125	1654	1566	1789	1090	938	1505
L187	1467	1756	1443	857	2054	1565	1338	1300	1120	782	1369
SK5912	2033	2057	1554	1148	1689	1639	1055	1287	1195	1088	1474
Mean of herbicide rate	1578	1731	1427	1031	1828	1548	1212	1388	1129	910	

Least significant difference at 5% level

Variety	Herbicide rate	Variety x herbicide rate
NS	328.96	NS

control. In the interaction between the crop varieties with the herbicide treatments, all varieties produced very low grain yields with terbutryne/terbuthylazine at 6.4 kg/ha. In general, grain yield with pendimethalin was lower than in atrazine especially at 2.0 kg/ha of the herbicide.

8. 1000-Grain Weight

Significant differences in grain weight were observed among varieties and herbicide treatments, but their interaction did not affect grain weight (Table 19).

Variety FFBL and L187 produced significantly heavier grains than variety L1499. Significantly lower grain weight was obtained with terbutryne/terbuthylazine mixture at 6.4 kg/ha as compared with the control. Terbutryne/terbuthylazine mixture at 1.6 kg/ha had significantly heavier grains than at 3.2 and 6.4 kg/ha of the herbicide mixture. Similarly, atrazine at 1.0 and 2.0 kg/ha resulted in heavier grains than 4.0 kg/ha of the herbicide. Heavier grains were observed with pendimethalin at 1.0 and 2.0 kg/ha.

Table 19. Effect of various rates of herbicides on 1000-grain weight of guinea corn varieties at Samaru, 1980.

Variety	1000- grain weight (g)									
	Control	Terbutryne/terbuthylazine			Atrazine			Pendimethalin			Variety mean
		1.6	3.2	6.4	1.0	2.0	4.0	1.0	2.0	4.0	
FFBL	29.33	37.33	34.00	27.33	32.67	32.67	32.00	37.33	36.67	29.33	32.87
L1499	20.00	26.00	22.00	21.33	28.00	24.67	23.33	33.33	32.00	24.67	26.33
L187	30.67	35.33	28.00	22.00	35.33	34.67	28.67	39.67	38.67	32.00	32.00
SK5912	30.67	32.00	26.67	25.33	32.00	28.67	28.67	32.67	30.67	30.67	29.80
Mean of herbicide rate	29.67	32.67	27.67	24.00	32.00	30.17	28.17	35.75	34.50	29.17	

Least significant difference at 5% level

Variety	Herbicide rate	Variety x herbicide rate
3.73	4.30	NS

9. Stover Yield

There were significant differences in stover yield among guinea corn varieties and herbicide treatments at this location (Table 20).

Varieties FFBL and L1499 produced significantly higher stover yield than varieties L187 and SK5912; also variety SK5912 had higher stover yield than variety L187. Terbutryne/terbuthylazine mixture at 6.4 kg/ha, atrazine at 4.0 kg/ha and pendimethalin at 2.0 and 4.0 kg/ha caused significantly lower stover yield relative to the control. Significantly higher stover yields were observed with terbutryne/terbuthylazine mixture at 1.6 and 3.2 kg/ha relative to 6.4 kg/ha of the herbicide mixture. Similarly, stover yield decreased as the rate of atrazine and pendimethalin increased in this trial.

Table 20. Effect of various rates of herbicides on stover yield of guinea corn varieties at Samaru, 1980.

Variety	Stover yield (t/ha)										
	Control	Terbutryne/terbuthylazine			Atrazine			Pendimethalin			Variety mean
		1.6	3.2	6.4	1.0	2.0	4.0	1.0	2.0	4.0	
FFBL	5.95	5.97	5.68	5.04	6.69	5.09	4.51	6.57	2.85	2.64	5.10
L1499	5.78	6.04	5.95	4.96	6.69	6.04	5.08	5.31	2.03	1.46	4.93
L187	3.97	4.05	3.97	3.45	4.43	3.68	2.81	2.57	2.53	0.33	3.18
SK5912	4.19	4.82	4.75	3.84	4.18	4.19	4.19	3.53	2.01	1.26	3.70
Mean of herbicide rate	4.97	5.22	5.09	4.32	5.50	4.75	4.15	4.49	2.35	1.42	

Least significant difference at 5% level

Variety	Herbicide rate	Variety x herbicide rate
0.49	0.53	NS

CHAPTER 5

DISCUSSION

The field experiments were conducted at Mokwa and Samaru in the Southern and Northern Guinea Savanna, respectively, to study the response of promising guinea corn varieties to various herbicide treatments. Three of the herbicides viz atrazine, terbutryne and terbuthylazine are known to be tolerated while pendimethalin is not well tolerated.

The results obtained showed that the guinea corn varieties responded differentially to these herbicide treatments although in most cases the interaction between the varieties with herbicide treatments was not significant.

1. Stand Count

At both Mokwa and Samaru, significant differences were observed only among herbicide treatments.

At Mokwa, terbutryne/terbuthylazine at 6.4 kg/ha and all rates of pendimethalin were the treatments that significantly reduced stand count in each sampling.

At Mokwa, terbutryne/terbuthylazine mixture at 6.4 kg/ha and all rates of pendimethalin were the treatments that significantly reduced stand count in each sampling. At 84 DAS, atrazine at 4.0 kg/ha also reduced stand count. Variety ML4 appeared more susceptible to atrazine especially at 2.0 and 4.0 kg/ha and all rates of pendimethalin than other varieties.

At Samaru, all rates of pendimethalin significantly reduced stand count at 7 and 84 DAS; atrazine at 4.0 kg/ha reduced stand count at 7 DAS. Varietal differences in tolerance were also observed, although not significant. Variety L187 was less tolerant to high rates of triazine herbicides than the other three varieties.

The observed differences in stand count may be due to differences in absorption of the applied herbicide by the germinating seeds as earlier reported by Klingman (1961). Incfease in the rate of herbicide treatments caused further reduction in stand count thus corroborating the findings of Raghunathan et al. (1974) when they tested the responses of guinea corn varieties grown in India to different rates of atrazine, dicamba and 2,4-D.

2. Crop Vigour Score

At Mokwa, significant differences in crop vigour score were observed among herbicide treatments and in their interaction with the guinea corn varieties at 63 DAS, which was the critical period of crop growth. The effect of herbicide treatments on crop vigour score was similar as in stand count. Variety ML4 appeared most susceptible to herbicides especially to pendimethalin at all rates while variety C74 was apparently most tolerant to all herbicide treatments.

At Samaru, all varieties proved susceptible to pendimethalin at 2.0 and 4.0 kg/ha. This low tolerance is due to stunting of the guinea corn roots as earlier reported by Obilana and Lagoke (1979). Variety L187 and SK5912 were more susceptible than the other varieties probably due to differential absorption and degradation of the herbicide as observed by Wright and Rieck (1973) when they investigated the basis of differential butylate injury in maize hybrids.

3. Plant Height

At Mokwa, significant differences in plant height were observed among herbicide treatment at 21 DAS. This response of the guinea corn varieties to the high rates of the herbicide treatments did not last to 63 DAS, although variety ML4 was observed to be most susceptible to 4.0 kg/ha of pendimethalin. This is in line with the observations of Klingman (1961) who reported that plants were more susceptible to herbicides at the early stages of growth.

At Samaru, the varieties used, in addition to being susceptible to high rates of herbicides/herbicide mixtures, were also found to be susceptible to 2.0 kg/ha each of atrazine and pendimethalin. At 63 DAS, only the high rates of atrazine and pendimethalin persisted in reducing crop heights. The initial adverse effects of lower rates on this crop, as observed at 21 DAS, were overcome by the crop as observed at Mokwa.

The general reduction in plant height as a result of herbicide treatment had been reported by Obilana and Lagoke (1979) who observed that a mixture of atrazine and pendimethalin at 4.0 kg/ha caused stunting of the shoot and roots of varieties L187 and SK5912.

4. Leaf Number

At both Mokwa and Samaru, significant differences in leaf number were observed among herbicide treatments in each sampling.

The Mokwa results show that at 21 DAS, only atrazine at 4.0 kg/ha significantly reduced leaf number but did not persist to 63 DAS probably due to improved tolerance with time. At 63 DAS, the low rates of atrazine and pendimethalin increased the leaf number of guinea corn varieties. This is probably due to stimulatory effects of the herbicides at low rates as earlier reported by Wiedman and Appleby (1972).

At Samaru, only terbutryne/terbuthylazine mixture at 6.4 kg/ha and pendimethalin at 4.0 kg/ha significantly reduced leaf number at 63 DAS. Variety SK5912 proved most susceptible to pendimethalin at 2.0 and 4.0 kg/ha. Variety FFBL was apparently most susceptible to 4.0 kg/ha of atrazine.

Since thd leaves are the photosynthetic sites, differences in leaf number would affect the shoot dry matter production and other parameters that depend on it.

5. Shoot Dry Weight

At both Mokwa and Samaru, there were significant differences in shoot dry matter as influenced by herbicide treatments in each sampling.

At Mokwa, as observed with leaf number, the result at 21 DAS shows that only atrazine at 4.0 kg/ha significantly reduced shoot dry weight but its effects did not persist to 63 DAS. However, at Samaru, the medium and high rates of herbicides/herbicide mixtures had adverse effects at 21 DAS which persisted to 63 DAS. This is not unexpected since a similar pattern of response was observed in the crop vigour score.

6. Head Dry Weight

At both locations, although the high rates of herbicides/herbicide mixtures resulted in lower head dry weights, the differences in weights were not significant. At Mokwa, variety ML4 proved more susceptible to all rates of pendimethalin while variety C74 was apparently more affected by the high rates of the triazines relative to the other varieties. At Samaru, variety FFBL was more susceptible to the triazines than any other variety.

7. Grain Yield

At Mokwa, significant differences in grain yield were observed as a result of the interaction between guinea corn varieties with herbicide treatments. The guinea corn varieties responded differentially to herbicides as evidenced in the grain yield. Variety FD1 did not tolerate terbutryne/terbuthylazine at 3.2 and 6.4 kg/ha while variety ML4 did not tolerate atrazine and pendimethalin, each at 4.0 kg/ha.

At Samaru, significant difference in grain yield were only observed among herbicide treatments. The high rates of all herbicides/herbicide mixtures including pendimethalin caused significant grain yield reduction. Variety L187 proved more susceptible to terbutryne/terbuthylazine at 6.4 kg/ha while variety SK5912 did not tolerate atrazine at 4.0 kg/ha and pendimethalin at 2.0 and 4.0 kg/ha.

From the results obtained with stand count and other growth parameters one would expect lower grain yield in pendimethalin, but the contrary was the case. This probably arose from the fewer stand which compensated for the stand loss through making use of the available space and soil nutrients.

8. 1000-Grain Weight

At Mokwa no significant differences in grain weight were observed among varieties probably due to the genetic similarity of the varieties (Obilana, 1979).

At Samaru, significant reduction in grain weight was observed at 6.4 kg/ha of terbutryne/terbuthylazine. The heavier weights of the varieties as compared with the control at the low rate of pendimethalin may be due to compensatory growth as indicated in the grain yield.

9. Stover Yield

At Mokwa, significant differences in stover yields were observed only in the interaction between the varieties and herbicide treatments. Both Variety C74 and FD1 had significantly lower stover yields were observed when treated with terbutryne/terbuthylazine at 6.4 kg/ha as compared to variety ML4. Variety ML4 proved susceptible to 2.0 and 4.0 kg/ha of atrazine and all rates of pendimethalin.

At Samaru, the high rates of all herbicides/herbicide mixtures as well as pendimethalin at 2.0 kg/ha significantly reduced stover yield.

CHAPTER 6

SUMMARY AND CONCLUSIONS

Field trials were conducted at the Agricultural Research Station, Mokwa and the Institute for Agricultural Research, Samaru in the 1980 wet season to determine the response of seven recommended guinea corn varieties (three at Mokwa and four at Samaru) to three levels each of a formulated mixture of terbutryne/terbuthylazine, atrazine and pendimethalin at two savanna ecological zones, Northern and Southern Guinea Savanna.

The guinea corn varieties responded differentially to the herbicide treatments, although in most cases the interaction between the varieties with herbicide treatments was not significant.

At Mokwa, variety ML4 was most sensitive to high rates of atrazine and pendimethalin, with significant decrease in grain yield for the latter. At Samaru, varieties L187 and SK5912 were adversely affected by sorghoprim at 6.4 kg/ha. Only two of the varieties, L187 and FFBL, were affected by atrazine at 4.0 kg/ha. Pendimethalin adversely and equally affected all varieties at its highest rate of 4.0 kg/ha.

Comparing the effects of all three herbicides at Samaru, pendimethalin was the most adverse in its effect in all four varieties. Except FFBL, at 1.0 and 2.0 kg/ha, all varieties reacted negatively to this herbicide at all three rates used.

These observations indicate toxicity of the three herbicides at the high rates to guinea corn varieties. The differential reactions of the guinea corn varieties to herbicides at these two sites, as indicated by reduced grain yields are a carry-over of the same reactions at the vegetative growth phases.

The obtained results imply that although increasing herbicide/herbicide mixture rate results in decreasing crop tolerance, at Mokwa varieties C74 and FD1 would tolerate up to 6.4 kg/ha, of terbutryne/terbuthylazine, and 4.0 kg/ha, each of atrazine and pendimethalin. Variety ML4 would tolerate 6.4 kg/ha of terbutryne/terbuthylazine and only 1.0 kg/ha of atrazine and pendimethalin. At Samaru, using terbutryne/terbuthylazine at 6.4 kg/ha atrazine and pendimethalin each at 4.0 kg/ha

would be safe on variety L1499. Varieties FFBL, L187 and SK5912 would tolerate only up to 3.2 kg/ha of terbutryne/terbuthylazine mixture; while varieties L187 and FFB1 would not tolerate atrazine rates higher than 2.0 kg/ha.

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Appendix 1. Crop vigour score scale

10 = Most healthy in the whole experiment.

9 = Slight discoloration or lower vigour.

8 = Slight discoloration and low vigour/discoloration and necrotic spots.

7 = Distinguishable inhibition of growth.

6 = Distinguishable inhibition of growth and slight discoloration/other injury symptoms.

5 = Distinguishable inhibition of growth and other injury symptoms.

4 = Definite growth reduction and severe toxicity symptoms but apparently still making some growth.

3 = Definite growth reduction and severe toxicity symptoms and less likely to survive.

2 = Only few green tissues present.

1 = Moribund.

0 = Completely killed.

Appendix 2. Common and chemical names of herbicides mentioned in the text.

Common name	Chemical name
Atrazine	2-chloro-4-ethylamino-6-isopropylamino-1,3,5-triazine.
Barban	4-chlorobut-2-ynyl N-(3-chlorophenyl) carbamate.
Bentazone	3-isopropyl-2,1,3-benzothiadiazin-4-one 2,2-dioxide.
Butylate	S-ethyl N,N-di-isobutyl (thiocarbamate).
Chloramben	3-amino-2,5-dichlorobenzoic acid.
Chlorpropham	isopropyl N-(3-chlorophenyl) carbamate.
2,4-D	2,4-dichlorophenoxyacetic acid.
Dalapon	2,2-dichloropropionic acid.
Di-allate	S-2,4-dichloroallyl N,N-di-isopropyl (thiocarbamate).
Dicamba	3,6-dichloro-2-methoxybenzoic acid.
Dinoseb	2-(1-methylpropyl)-4,6-dinitrophenol.
Diuron	N'-(3,4-dichlorophenyl)-N,N-dimethylurea.
Linuron	N-(3,4-dichlorophenyl)-N-methoxy-N-methylurea.
Molinate	S-ethyl N,N-hexamethylene (thiocarbamate).
Monuron	N'-4(dichlorophenyl)-N,N-dimethylurea.
Noruron	N'-(hexahydro-4,7-methanoindan-5-yl)-N,N-dimethylurea.
Pendimethalin	N-(1-ethylpropyl)-2,6-dinitro-3,4-xylidine.
Picloram	4-amino-3,5,6-trichloropicolinic acid.
Simazine	2-chloro-4,6-bisethylamino-1,3,5-trazine.
2,3,6-TBA	2,3,6-trichlorobenzoic acid.
Terbacil	5-chloro-6-methyl-3-t-butyuracil
Terbuthylazine	2-chloro-4-ethylamino-6-t-butylamino-1,3,5-triazine.
tri-allate	S-2,3,3-trichloroallyl N,N-di-isopropyl (thiocarbamate).
Trifluralin	2,6-dinitro-N,N-dipropyl-4-trifluoro-methylaniline.

Appendix 3. Analysis of variance table for stand count of guinea corn varieties at 7 days after sowing as affected by different rates of herbicides at Mokwa, 1980.

Sources	DF	SS	MS	F
Replication	2	237.7	118.9	
Variety	2	1297.3	648.7	0.81 NS
Error(a)	4	3216.4	804.1	
Herbicide rates	9	5451.2	605.7	6.03*
Error (b)	18	1806.7	100.4	
Variety x herbicide rates	19	1340.5	74.5	0.45 NS
Error (c)	36	6016.0	167.1	
Total	89			

NS = Not significant
* = Significant at 5% level
DF = Degrees of freedom
SS = Sum of squares
MS = Mean squares.

Appendix 4. Analysis of variance table for stand count of guinea corn varieties at 35 days after sowing as affected by different rates of herbicides at Mokwa, 1980.

Sources	DF	SS	MS	F
Replication	2	600.5	300.3	
Variety	2	4951.3	2475.6	1.90 NS
Error (a)	4	5203.0	1300.8	
Herbicide rates	9	10134.0	1126.0	20.54*
Error (b)	18	987.0	54.8	
Variety x herbicide rates	18	2855.9	158.7	0.69 NS
Error (c)	36	8309.3	230.8	
Total	89			

Appendix 5. Analysis of variance table for stand count of guinea corn varieties 84 days after sowing as affected by different rates of herbicides at Mokwa, 1980.

Source	DF	SS	MS	F
Replication	2	262.8	131.4	2.22 NS
Variety	2	4852.0	2426.0	
Error (a)	4	4379.6	1070.9	
Herbicide rates	9	9638.4	1070.9	6.92*
Error (b)	18	2824.9	156.9	
Variety x herbicide rates	18	1018.4	56.6	0.52 NS
Error (c)	36	3690.4	102.5	
Total	89			

Appendix 6. Analysis of variance table for crop vigour score of guinea corn varieties 21 days after sowing as affected by different rates of herbicides at Mokwa, 1980

Sources	DF	SS	MS	F
Replication	2	3.8	1.9	
Variety	2	71.4	35.7	9.63*
Error (a)	4	14.8	3.7	
Herbicide rates	9	30.4	3.4	1.23 NS
Error (b)	18	49.3	2.7	
Variety x herbicide rates	18	13.8	0.8	1.13 NS
Error (c)	36	24.5	0.7	
Total	89			

Appendix 7. Analysis of variance table for crop vigour score of guinea corn varieties at 42 days after sowing as affected by different rates of herbicides at Mokwa, 1980.

Sources	DF	SS	MS	F
Replication	2	2.2	1.1	
Variety	2	7.6	3.8	0.92 *NS*
Error (a)	4	16.6	4.1	
Herbicide rates	9	37.7	3.1	2.49*
Error (b)	18	22.3	1.2	
Variety x herbicide rates	18	43.6	2.4	1.64 NS
Error (c)	36	53.2	1.5	
Total	80			

Appendix 8. Analysis of variance table for crop vigour score of guinea corn varieties at 63 days after sowing as affected by different rates of herbicides at Mokwa, 1980.

Sources	DF	SS	MS	F
Replication	2	139.8	69.9	
Variety	2	7.0	3.5	1.04 NS
Error (a)	4	13.5	3.4	
Herbicide rates	9	40.9	4.6	4.99*
Error (b)	18	16.4	0.9	
Variety x herbicide rates	18	26.6	1.5	2.46*
Error (c)	36	21.6	0.6	
Total	89			

Appendix 9. Analysis of variance table for crop vigour score of guinea corn varieties 84 days after sowing as affected by different rates of herbicides at Mokwa, 1980.

Sources	DF	SS	MS	F
Replication	2	12.5	6.2	
Variety	2	3.4	1.7	0.67 NS
Error (a)	4	10.0	2.5	
Herbicide rates	9	13.4	1.5	0.82 NS
Error (b)	18	32.9	1.8	
Variety x herbicide rates	18	10.6	0.6	1.30 NS
Error (c)	36	16.4	0.5	
Total	89			

Appendix 10. Analysis of variance table for plant height by guinea corn varieties 21 days after sowing as affected by different rates of herbicides at Mokwa, 1980.

Sources	DF	SS	MS	F
Replication	2	29.5	14.3	
Variety	2	244.1	122.1	6.76 NS
Error (a)	4	72.3	18.1	
Herbicide rates	9	319.1	35.5	12.78*
Error (b)	18	50.0	2.8	
Variety x herbicide rates	18	94.5	5.3	0.52 NS
Error (c)	36	361.5	10.0	
Total	89			

Appendix 11. Analysis of variance table for plant height of guinea corn varieties 42 days after sowing as affected by different rates of herbicides at Mokwa, 1980.

Sources	DF	SS	MS	F
Replication	2	174.7	87.3	
Variety	2	3.6	1.8	0.04 NS
Error (a)	4	187.1	46.8	
Herbicide rates	9	490.4	54.5	1.89 NS
Error (b)	18	517.7	28.8	
Variety x herbicide rates	18	282.3	15.7	0.03 NS
Error (c)	36	16507.3	458.5	
Total	89			

Appendix 12. Analysis of variance table for plant height of guinea corn varieties 63 days after sowing as affected by different rates of herbicides at Mokwa, 1980.

Sources	DF	SS	MS	F
Replication	2	25287.1	1264.5	
Variety	2	317.8	158.9	0.30 NS
Error (a)	4	1771.1	442.8	
Herbicide rates	9	4587.3	509.7	1.37 NS
Error (b)	18	6685.0	371.4	
Variety x herbicide rates	18	162912.7	717.4	1.52 NS
Error (c)	36	1694.9	470.6	
Total	89			

Appendix 13. Analysis of variance table for plant height of guinea corn varieties 84 days after sowing as affected by different rates of herbicides at Mokwa, 1980.

Sources	DF	SS	MS	F
Replication	2	50873.4	25436.7	
Variety	2	2702.1	1351.1	0.45 NS
Error (a)	4	12138.8	3034.7	
Herbicide rates	9	47410.5	5267.8	2.22 NS
Error (b)	18	42654.0	2369.7	
Variety x herbicide rates	18	72494.1	4027.5	1.52 NS
Error (c)	36	95608.9	2655.8	
Total	89			

Appendix 14. Analysis of variance table for leaf number of guinea corn varieties 21 days after sowing as affected by different rates of herbicides at Mokwa, 1980.

Sources	DF	SS	MS	F
Replication	2	2.9	1.5	
Variety	2	16.9	8.5	3.51 NS
Error (a)	4	9.6	2.4	
Herbicide rates	9	47.6	5.3	3.45*
Error (b)	18	27.6	1.5	
Variety x herbicide rates	18	57.4	3.2	1.33 NS
Error (c)	36	86.2	2.4	
Tctal	89			

Appendix 15. Analysis of variance table for leaf number of guinea corn varieties 42 days after sowing as affected by different rates of herbicides at Mokwa, 1980.

Sources	DF	SS	MS	F
Replication	2	0.6	0.3	
Variety	2	1.2	0.6	0.13 NS
Error (a)	4	19.2	4.8	
Herbicide rates	9	24.3	2.7	1.69 NS
Error (b)	18	28.8	1.6	
Variety x herbicide rates	18	19.8	1.1	0.52 NS
Error (c)	36	72.0	2.0	
Total	89			

Appendix 16. Analysis of variance table for leaf number of guinea corn varieties 63 days after sowing as affected by different rates of herbicides at Mokwa, 1980.

Sources	DF	SS	MS	F
Replication	2	29.8	14.9	
Variety	2	3.4	1.7	0.29 NS
Error (a)	4	23.5	5.9	
Herbicide rates	9	80.9	9.0	4.09*
Error (b)	18	39.6	2.2	
Variety x herbicide rates	18	33.1	1.8	1.12 NS
Error (c)	36	59.4	1.6	
Total	89			

Appendix 17. Analysis of variance table for leaft number of guinea corn varieties 84 days after sowing as affected by different rates of herbicides at Mokwa, 1980.

Sources	DF	SS	MS	F
Replication	2	9.4	4.7	
Variety	2	7.7	3.9	0.63 NS
Error (a)	4	24.6	6.1	
Herbicide rates	9	32.7	3.6	2.22 NS
Error (b)	18	29.5	1.6	
Variety x herbicide rates	18	56.3	3.1	0.79 NS
Error (c)	36	143.6	4.0	
Total	89			

Appendix 18. Analysis of variance table for shot dry weight of guinea corn varieties 21 days after sowing as affected by different rates of herbicides at Mokwa, 1980.

Sources	DF	SS	MS	F
Replication	2	8.1	4.1	
Variety	2	17.2	8.6	1.33 NS
Error (a)	4	25.8	6.5	
Herbicide rates	9	63.3	7.0	6.63*
Error (b)	18	19.1	1.1	
Variety x herbicide rates	18	30.2	1.6	0.60 NS
Error (c)	36	101.1	2.8	
Total	89			

Appendix 19. Analysis of variance table for shoot dry weight of guinea corn varieties 42 days after sowing as affected by different rates of herbicides at Mokwa, 1980.

Sources	DF	SS	MS	F
Replication	2	193.7	96.8	
Variety	2	4.0	2.0	0.03 NS
Error (a)	4	323.5	80.9	
Herbicide rates	9	450.5	50.1	1.23 NS
Error (b)	18	734.7	40.8	
Variety x herbicide rates	18	574.7	31.9	1.67 NS
Error (c)	36	690.5	19.2	
Total	89			

Appendix 20. Analysis of variance table for shoot dry weight of guinea corn varieties 63 days after sowing as affected by different rates of herbicides at Mokwa, 1980.

Sources	DF	SS	MS	F
Replication	2	34981.2	17490.6	
Variety	2	15.3	7.7	0.01 NS
Error (a)	4	4649.5	1162.4	
Herbicide rates	9	4613.6	512.6	1.00 NS
Error (b)	18	9188.8	510.5	
Variety x herbicide rates	18	2363.6	131.3	0.32 NS
Error (c)	36	14939.0	415.0	
Total	89			

Appendix 21. Analysis of variance table for shoot dry weight of guinea corn varieties 84 days after sowing as affected by different rates of herbicides at Mokwa, 1980.

Sources	DF	SS	MS	F
Replication	2	2972.8	1486.4	
Variety	2	92340.9	46170.4	2.61 NS
Error (a)	4	70879.5	17719.9	
Herbicide rates	9	49543.7	5504.9	2.33 NS
Error (b)	18	42572.0	2365.1	
Variety x herbicide rates	18	111687.2	6304.8	1.44 NS
Error (c)	36	155378.5	4316.1	
Total	89			

Appendix 22. Analysis of variance table for head weight of guinea corn varieties as affected by different rates of herbicides at Mokwa, 1980.

Sources	DF	SS	MS	F
Replication	2	562782.7	28214.4	
Variety	2	352287.5	176143.8	1.11 NS
Error (a)	4	639889.8	159972.5	
Herbicide rates	9	3238900.9	35987.8	1.49 NS
Error (b)	18	4334998.4	240833.2	
Variety x herbicide rates	18	5090853.6	282825.2	0.94 NS
Error (c)	36	10804587.0	300127.4	
Total	89			

Appendix 23. Analysis of variance table for grain yield of guinea corn varieties as affected by different rates of herbicides at Mokwa, 1980.

Sources	DF	SS	MS	F
Replication	2	4998688.6	2499344.3	
Variety	2	74259.8	3712999.0	0.42 NS
Error (a)	4	353081.6	88270.4	
Herbicide rate	9	4222217.8	46935.3	2.16 NS
Error (b)	18	3910486.9	217249.3	
Variety x herbicide rates	18	2835385.7	157521.4	2.72 NS
Error (c)	36	2087560.0	57987.8	
Total	89			

Appendix 24. Analysis of variance table for 1000-grain weight of guinea corn varieties as affected by different rates of herbicides at Mokwa, 1980.

Sources	DF	SS	MS	F
Replication	2	3.5	1.8	
Variety	2	22.9	11.5	0.92 NS
Error (a)	4	49.7	12.4	
Herbicide rates	9	86.1	9.6	0.74 NS
Error (b)	18	232.9	12.9	
Variety x herbicide rates	18	115.8	6.4	1.04 NS
Error (c)	36	223.6	6.2	
Total	89			

Appendix 25. Analysis of variance table for stover yield of guinea corn varieties as affected by different rates of herbicides at Mokwa, 1980.

Sources	DF	SS	MS	F
Replication	2	15621.1	7810.6	
Variety	2	121.7	60.9	0.03 NS
Error (a)	4	7079.9	1770.0	
Herbicide rates	9	9574.7	1063.9	1.05 NS
Error (b)	18	18275.3	1015.3	
Variety x herbicide rates	18	9566.9	531.5	8.43*
Error (c)	36	2269.8	63.1	
Total	89			

Appendix 26. Analysis of variance table for stand count of guinea corn varieties 7 days after sowing as affected by different rates of herbicides at Samaru, 1980.

Sources	DF	SS	MS	F
Replication	2	270.4	135.1	
Variety	3	437.5	145.8	3.07 NS
Error (a)	6	285.4	47.6	
Herbicide rates	9	77576.4	8619.6	29.69*
Error (b)	18	5225.1	290.3	
Variety x herbicide rates	27	1487.2	55.1	0.90 NS
Error (c)	54	3323.9	61.6	
Total	119			

Appendix 26. Analysis of variance table for stand count of guinea corn varieties 7 days after sowing as affected by different rates of herbicides at Samaru, 1980.

Sources	DF	SS	MS	F
Replication	2	270.4	135.1	
Variety	3	437.5	145.8	3.07 NS
Error (a)	6	285.4	47.6	
Herbicide rates	9	77576.4	8619.6	29.69*
Error (b)	18	5225.1	290.3	
Variety x herbicide rates	27	1487.2	55.1	0.90 NS
Error (c)	54	3323.9	61.6	
Total	119			

Appendix 27. Analysis of variance table for stand count of guinea corn varieties 35 days after sowing as affected by different rates of herbicides at Samaru, 1980.

Sources	DF	SS	MS	F
Replication	2	3082.9	1541.5	
Variety	3	3011.0	1003.7	83.97*
Error (a)	6	71.7	12.0	
Herbicide rates	9	42993.4	4770.4	3.94*
Error (b)	18	21776.4	1209.8	
Variety x herbicide rates	27	2170.7	80.4	0.34 NS
Error (c)	54	12905.1	239.0	
Total	119			

Appendix 28. Analysis of variance table for stand count of guinea corn varieties 84 days after sowing as affected by different rates of herbicides at Samaru, 1980.

Sources	DF	SS	MS	F
Replication	2	5143.1	2571.5	
Variety	3	355.4	118.5	2.02 NS
Error (a)	6	351.5	58.6	
Herbicide rates	9	44184.7	4909.4	16.68*
Error (b)	18	5290.7	294.3	
Variety x herbicide rates	27	4041.2	149.7	1.25 NS
Error (c)	54	6492.2	120.2	
Total	119			

Appendix 29. Analysis of variance table for crop vigour score of guinea corn varieties 21 days after sowing as affected by different rates of herbicides at Samaru, 1980.

Sources	DF	SS	MS	F
Replication	2	16.0	8.0	
Variety	3	36.6	12.2	1.74 NS
Error (a)	6	42.0	7.0	
Herbicide rates	9	137.7	15.3	15.30*
Error (b)	18	18.0	1.0	
Variety x herbicide rates	27	27.0	1.0	1.00 NS
Error (c)	54	54.0	1.0	
Total	119			

Appendix 30. Analysis of variance table for crop vigour score of guinea corn varieties 42 days after sowing as affected by different rates of herbicides at Samaru, 1980.

Sources	DF	SS	MS	F
Replication	2	6.9	3.4	
Variety	3	36.5	12.2	26.82*
Error (a)	6	2.7	0.5	
Herbicide rates	9	202.1	22.5	18.39*
Error (b)	18	22.0	1.2	
Variety x herbicide rates	27	14.9	0.6	1.24 NS
Error (c)	54	23.9	0.4	
Total	119			

Appendix 31. Analysis of variance table for crop vigour score of guinea corn varieties 63 days after sowing as affected by different rates of herbicides at Samaru, 1980.

Sources	DF	SS	MS	F
Replication	2	17.1	8.6	
Variety	3	96.7	32.2	13.58*
Error (a)	6	14.2	2.4	
Herbicide rates	9	240.6	26.7	15.82*
Error (b)	18	30.4	1.7	
Variety x herbicide rates	27	37.9	1.4	1.46 NS
Error (c)	54	51.8	1.0	
Total	119			

Appendix 32. Analysis of variance table for crop vigour score of guinea corn varieties 84 days after sowing as affected by different rates of herbicides at Samaru, 1980.

Sources	DF	SS	MS	F
Replication	2	17.2	8.6	
Variety	3	86.3	18.8	11.15*
Error (a)	6	15.5	2.6	
Herbicide rates	9	267.1	2.6	16.95*
Error (b)	18	31.5	1.8	
Variety x herbicide rates	27	33.7	1.2	1.42 NS
Error (c)	54	47.5	0.9	
Total	119			

Appendix 33. Analysis of variance table for plant height of guinea corn varieties 21 days after sowing as affected by different rates of herbicides at Samaru, 1980.

Sources	DF	SS	MS	F
Replication	2	37.0	18.5	
Variety	3	142.3	47.4	13.3*
Error (a)	6	21.3	3.6	
Herbicide rates	9	182.2	20.2	5.82*
Error (b)	18	62.6	3.5	
Variety x herbicide rates	27	97.5	3.6	1.43 NS
Error (c)	54	136.8	2.5	
Total	119			

Appendix 34. Analysis of variance table for plant height of guinea corn varieties 42 days after sowing as affected by different rates of herbicides at Samaru, 1980.

Sources	DF	SS	MS	F
Replication	2	85.2	42.6	
Variety	3	302.5	100.8	3.26 NS
Error (a)	6	185.4	30.9	
Herbicide rates	9	1587.5	176.4	3.54*
Error (b)	18	896.4	49.8	
Variety x herbicide rates	27	529.4	19.6	0.48 NS
Error (c)	54	2210.4	40.9	
Total	119			

Appendix 35. Analysis of variance table for plant height of guinea corn varieties 63 days after sowing as affected by different rates of herbicides at Samaru, 1980.

Sources	DF	SS	MS	F
Replication	2	1420.5	710.2	
Variety	3	23008.6	7669.5	34.42*
Error (a)	6	1337.0	222.8	
Herbicide rates	9	11676.8	1297.4	7.99*
Error (b)	18	2922.8	162.4	
Variety x herbicide rates	27	11926.6	441.7	2.10*
Error (c)	54	11357.2	210.3	
Total	119			

Appendix 36. Analysis of variance table for plant height of guinea corn varieties 84 days after sowing as affected by different rates of herbicides at Samaru, 1980.

Sources	DF	SS	MS	F
Replication	2	1667.5	833.8	
Variety	3	137424.5	45808.2	87.49*
Error (a)	6	3141.6	523.6	
Herbicide rates	9	16154.9	1806.5	4.41*
Error (b)	18	7378 .8	409.9	
Variety x herbicide rates	27	15766.4	583.9	1.11 NS
Error (c)	54	28325.7	524.6	
Total	119			

Appendix 37. Analysis of variance table for leaf number of guinea corn varieties 21 days after sowing as affected by different rates of herbicides at Samaru, 1980.

Sources	DF	SS	MS	F
Replication	2	2.9	1.5	
Variety	3	11.3	3.8	3.89 NS
Error (a)	6	5.8	1.0	
Herbicide rates	9	35.3	3.9	4.90*
Error (b)	18	14.4	0.8	
Variety x herbicide rates	27	11.3	0.4	0.74 NS
Error (c)	54	30.5	0.6	
Total	119			

Appendix 38. Analysis of variance table for leaf number of guinea corn varieties 42 days after sowing as affected by different rates of herbicide at Samaru, 1980.

Sources	DF	SS	MS	F
Replication	2	0.02	0.01	
Variety	3	103.2	34.4	5.24*
Error (a)	6	39.4	6.6	
Herbicide rates	9	113.4	12.6	1.17 NS
Error (b)	18	194.1	10.8	
Variety x herbicide rates	27	81.0	3.0	0.09 NS
Error (c)	54	1729.9	32.0	
Total	119			

Appendix 39. Analysis of variance table for leaf number of guinea corn varieties 63 days after sowing as affected by different rates of herbicides at Samaru, 1980.

Sources	DF	SS	MS	F
Replication	2	11.8	5.9	
Variety	3	52.1	17.4	6.05*
Error (a)	6	17.2	2.9	
Herbicide rates	9	217.8	24.2	4.12*
Error (b)	18	105.6	5.9	
Variety x herbicide rates	27	128.3	4.8	0.57 NS
Error (c)	54	454.1	8.4	
Total	119			

Appendix 40. Analysis of variance table for leaf number of guinea corn varieties 84 days after sowing as affected by different rates of herbicides at Samaru, 1980.

Sources	DF	SS	MS	F
Replication	2	7.4	3.7	
Variety	3	78.0	26.0	2.05 NS
Error (a)	6	76.1	12.7	
Herbicide rates	9	364.6	40.5	3.35*
Error (b)	18	217.8	12.1	
Variety x herbicide rates	27	210.5	7.8	0.78 NS
Error (c)	54	540.5	10.0	
Total	119			

Appendix 41. Analysis of variance table for shoot dry weight of guinea corn varieties 21 days after sowing as affected by different rates of herbicides at Samaru, 1980.

Sources	DF	SS	MS	F
Replication	2	1.2	0.6	
Variety	3	3.3	1.1	5.86*
Error (a)	6	1.1	0.2	
Herbicide rates	9	11.4	1.3	5.76*
Error (b)	18	4.0	0.2	
Variety x herbicide rates	27	5.9	0.2	0.71 NS
Error (c)	54	16.7	0.3	
Total	119			

Appendix 42. Analysis of variance table for shoot dry weight of guinea corn varieties 42 days after sowing as affected by different rates of herbicides at Samaru, 1980.

Sources	DF	SS	MS	F
Replication	2	460.8	630.4	
Variety	3	1264.7	421.6	9.42*
Error (a)	6	268.5	44.7	
Herbicide rates	9	2424.8	269.4	3.77*
Error (b)	18	1286.8	71.5	
Variety x herbicide rates	27	1288.9	47.7	0.44 NS
Error (c)	54	5808.3	107.6	
Total	119			

Appendix 43. Analysis of variance table for shoot dry weight of guinea corn varieties 63 days after sowing as affected by different rates of herbicides at Samaru, 1980.

Sources	DF	SS	MS	F
Replication	2	412.4	206.2	
Variety	3	1252.1	417.4	8.12*
Error (a)	6	308.4	51.4	
Herbicide rates	9	2557.5	284.2	5.23*
Error (b)	18	978.4	54.4	
Variety x herbicide rates	27	1266.7	46.9	0.40 NS
Error (c)	54	6393.3	118.4	
Total	119			

Appendix 44. Analysis of variance table for head weight of guinea corn varieties as affected by different rates of herbicides at Samaru, 1980.

Sources	DF	SS	MS	F
Replication	2	9.1	4.6	
Variety	3	2.0	0.7	0.98 NS
Error (a)	6	4.1	0.7	
Herbicide rates	9	15.7	1.7	5.19*
Error (b)	18	6.1	0.3	
Variety x herbicide rates	27	5.9	0.2	0.88 NS
Error (c)	54	13.4	0.2	
Total	119			

Appendix 45. Analysis of variance table for grain yield of guinea corn varieties as affected by different rates of herbicides at Samaru, 1980.

Sources	DF	SS	MS	F
Replication	2	1730455.5	865227.8	
Variety	3	2130422.2	710140.7	3.18 NS
Error (a)	6	1342172.3	223695.4	
Herbicide rates	9	9913769.0	1101528.9	7.54*
Error (b)	18	2642162.0	146786.8	
Variety x herbicide rates	27	2840611.1	105207.8	0.72 NS
Error (c)	54	7894326.9	146191.2	
Total	119			

Appendix 46. Analysis of variance table for 1000-grain weight of guinea corn varieties as affected by different rates of herbicides at Samaru, 1980.

Sources	DF	SS	MS	F
Replication	2	12.0	6.0	
Variety	3	806.8	269.0	7.71*
Error (a)	6	209.5	34.9	
Herbicide rates	9	1497.0	166.3	6.61*
Error (b)	18	452.8	25.2	
Variety x herbicide rates	27	498.5	18.5	0.74 NS
Error (c)	54	1345.0	24.9	
Total	119			

Appendix 47. Analysis of variance table for stover yield of guinea corn varieties as affected by different rates of herbicides at Samaru, 1980.

Sources	DF	SS	MS	F
Replication	2	131.7	565.9	
Variety	3	8324.7	2774.9	45.29*
Error (a)	6	367.8	61.3	
Herbicide rates	9	18811.4	2090.2	54.35*
Error (b)	18	692.2	38.5	
Variety x herbicide rates	27	2145.4	79.5	1.29 NS
Error (c)	54	3329.7	61.7	
Total	119			