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9. ABSTRACT

The maize improvement research conducted at Samaru, Nigeria, includes several programs designed to develop high-yielding varieties or hybrids. One main objective is to develop maize which, when planted early in June, will tassel in early August and remain standing until mid-October, so that the moisture content will be low enough for the maize to be stored. Root lodging is a major problem in maize production because of the severe tropical storms normally occurring in August and September. The brachytic gene is being incorporated into the seed populations to improve resistance to root lodging and stalk breaking. The opaque-2 gene is also being incorporated to improve the protein balance of the grain by increasing the lysine content. The report presents daily rainfall statistics for 1967 in Samaru, and also monthly figures for the maximum and minimum temperatures and relative humidity. Breeding nursery activities are discussed, and the results of the national zonal trial are presented.

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REPORT OF MAIZE INVESTIGATIONS

INSTITUTE FOR AGRICULTURAL RESEARCH

AHMADU BELLO UNIVERSITY

1967

by

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INTRODUCTION

Yields ranging from 3,000 to 6,000 pounds are expected from the maize grown at Samaru. These yields are being maintained each year on land which is continously cropped by the addition of about 3 tons per acre of organic fertilizer in the form of stable manure or night soil plus about 100 pounds of superphosphate and 60 to 90 pounds of nitrogen in the form of ammonium sulphate or nitro-chalk. Based on our present information an increase in the amount of fertilizer applied to the soil will not give economical returns. As the breeding program advances we will expect to get greater returns by an increase of fertilizer when applied to improved varieties and hybrids.

Farmers in northern Nigeria are planting more maize, especially as a "compound" crop. Although the crop performs well on the experiment station cultural practices have not been developed which will assure the local farmer economic returns on depleted soils. This problem is elaborated upon in the brief report of maize grown at Kano this year.

Maize is generally eaten "green" (corn on the cob after grain is quite mature). The local varieties are early maturing and relatively low yielding when compared with the later maturing types. The present breeding program is not specifically beamed at developing improved varieties for eating green. More attention is being given to later maturing, higher yielding varieties to be harvested for dry grain. If maize is to become an important cash crop in the "north" the grain will be handled in bags or in bulk.

The main objectives of the improvement program at Samaru are to develop high yielding varieties or hybrids which when planted early in June will tassel in early August. The husks must tightly enclose the tip of the ears to prevent damage from insects and birds. The ear shanks should be long enough so that the ears will bend over upon maturing so water from the rains in September will not penetrate into the ears through the tip of the husks. If the plants have good enough resistance to root lodging to stand until mid-October the moisture content of the grain will be low enough for storage. Root lodging is a major obstacle in maize production due to the severe tropical storms which frequent the area in August and September. The crop this year stood until a severe storm on September 10.

The tabular yield data given in this report are as follows:

3-4 The Federal Uniform Zonal Trial and summary.
5 Columbian Introductions.
6-7 Varietal hybrids and summary.

8 West African Trial coordinated by Dr. Craig, Moor Plantation, Ibadan, Nigeria.
9 A group of varieties from local sources and from Kenya.
10 Top cross trial of inbred lines pollinated with Bomo Local.
11 Top cross of a few inbred lines from Biu Yellow pollinated with Bomo Local and Samaru Synthetic.
12 Date of harvest to determine the yield and nitrogen content of stalks, leaves and ears.
13 Date of planting.
14 Plant population trial.
15 A trial to determine the effectiveness of Dr. Craig's work in increasing resistance to root lodging.
16 A sequence of application of nitrogen.

The breeding program is centered around the development of adapted but genetically diverse populations. These populations will be improved by mass selection and recurrent selection. Eventually the populations may be released as varieties or will be used as parents in varietal-hybrids. The brachytic gene is being incorporated into the populations to improve resistance to stalk breaking and root lodging. The opaque-2 gene is also being incorporated to improve the protein balance of the grain by increasing the lysine content.

The maize improvement program in Nigeria has been strengthened by the addition of another maize breeder, Franz de Wolff posted at Mokwa. The improvement program for the country is coordinated from the Federal Station at Ibadan. Annual meetings are held by the interested parties to discuss results and plan for future work.

CLIMATIC SUMMARY

The daily rainfall figures for Samaru are given in Table 1 and a summary of the meteorological data are given in Table 2. The seasonal rainfall at Samaru even in the dryest year is more than enough to produce a good crop of maize. Higher yields may be expected in years of "low" rainfall probably due to better soil aeration and a lower water table. The rainfall for 1967 totaled 38.10 inches or about six inches below average. Usually in August when 11 inches are expected, water stands in the low spots in the field. This year the four inches received, was ample for normal growth and ideal for making hand pollinations. The rains stopped abruptly on September 28 which favored harvest. Usually harvest begins in mid-September and is completed by mid-October. If the crop would stand to keep the ears off the ground until mid-October the grain would be dry enough to shell as harvested.

Table 1. Daily rainfall (inches) Samaru, 1967.

	Jan	Feb	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1							0.80	0.34	0.04			
2						0.03			0.65			
3					0.01							
4					0.03			0.06				
5						0.02	0.20		0.79			
6						0.40	0.42		0.95			
7						1.16		0.27	0.59			
8								0.07	0.05			
9							0.82	0.02				
10						0.52		0.02	0.41			
11				0.01		0.75			1.77			
12									0.03			
13									trace			
14							0.08	0.01	0.01	0.06		
15							0.38			0.07		
16					0.16		1.27	0.12				
17						0.54		0.07	0.17			
18				0.29	0.29		0.60	0.01	0.04			
19						0.40	trace	0.01				
20				0.82					1.64			
21					0.93	0.11	0.19	0.19	0.02			
22			0.22			0.60			1.89			
23			0.04	0.02			0.05	0.30	0.45			
24					0.51	0.42	0.22	0.31				
25						1.18	1.63		0.10			
26						0.83	0.36		0.20			
27						0.23		0.79	0.47			
28							0.76	1.18	1.53			
29				0.38			1.83	0.01				
30				0.34	1.36		0.12	0.01				
31							0.24					
Total	nil	nil	0.26	1.86	3.29	7.19	9.78	3.79	11.80	0.13	nil	nil

Total 38.10

Table 2 Meteorological observation, Samaru, 1967 with long time means.

Month	Temperature (F) Mean Max.	Mean Min.	High	Low	Mean 1965	Mean 1938-66	Precipitation (in.) Total	No. days	Mean 1928-66	Relative humidity (%) Mean 10 am	4 pm	Av.	1954-66
Jan.	81.0	55.2	89	48	68.1	72.5	0.00	0	0.01	15.7	10.6	13.2	16.7
Feb.	90.3	61.3	97	55	75.8	75.7	0.00	0	0.05	12.3	8.2	10.3	14.1
Mar.	92.3	67.5	97	62	82.3	81.3	0.26	2	0.33	18.4	12.2	15.3	21.1
April	95.7	70.8	101	59	83.3	83.8	1.86	6	1.34	49.8	28.1	38.5	41.3
May	82.3	70.4	98	64	81.2	81.0	3.29	7	4.85	61.3	40.4	50.9	52.2
June	83.9	67.6	93	65	76.3	77.6	7.19	14	6.60	72.7	57.2	65.0	66.5
July	82.0	66.6	86	63	74.3	75.1	9.78	16	8.64	79.7	65.5	72.6	73.0
Aug.	79.9	66.7	85	64	73.3	74.3	3.79	18	11.41	81.6	73.2	77.4	76.3
Sept.	83.7	66.1	88	64	74.9	75.6	11.80	20	9.22	75.4	61.7	68.6	69.4
Oct.	87.9	64.2	91	56	76.1	76.8	0.13	2	1.49	57.2	36.5	46.9	51.6
Nov.	87.4	58.5	92	53	73.0	75.0	0.00	0	0.06	25.3	17.2	21.3	26.8
Dec.	89.5	58.5	96	52	74.0	72.3	0.00	0	0.00	24.6	15.0	18.0	19.4
Total	1046.9	773.4			912.6	925.0	38.10	85	44.00				
Mean	87.2	64.5			76.1	77.1							

EXPERIMENTAL PROCEDURES

Field locations: The yield trials and breeding nurseries were planted in W fields 2, 3, 4 and 5. Top-cross isolations were in fields X-5 and U-6. Other isolation plots were located on the main farm, T-10A, T-10B, T-19, X-1 and W-7.

Seedbed preparation, planting and thinning: Rains in April and May were ample to permit the fields to be opened by "rippers". Just prior to planting the fields were double disked and ridged. The ridges were harrowed prior to planting to break up clods.

The planting was done by hand between May 31 and June 9. Generally two seeds are planted in hills about an inch apart at one foot intervals on the ridge. After the seedlings are established they are thinned to one plant per foot. If a hill was blank two adjacent seedlings in a hill were left. Emergence was good and most plots had perfect stands. A common practice is to replant (supply) missing hills soon after emergence. Even though the replanting is done immediately after the first planting has emerged the later plants do not develop normally and are usually barren due primarily to the effect of shading.

Mole crickets often cut off young seedlings and it is necessary to patrol the fields following emergence to erradicate these pests. This is done by pouring a weak solution of Aldrin into the holes or the laborers prefer to dig them out of their burrows and dry them for food.

Fertilizing: Most fields received three tons of night soil and 140 pounds of 20:20:0 broadcast prior to disking. Most trials received 30 pounds of nitrogen in form of nitro-chalk two and again at six weeks after planting. The nitro-chalk was applied by placing a measured amount into shallow holes two or three inches from each plant or a measured amount per plot was uniformily scattered on the surface along the side of the ridge.

Plot size: The standard length of row was 20 feet. The number of rows per plot of the yield trials ranged from one to five with the number of replications ranging from two to six. Two-row plots with four replications seemed to give reliable data. The coefficients of variability in this year's trials which ranged between five and fifteen per cent were very acceptable at this location. These low figures were surprising considering the erratic plant development within and between plots early in the season.

Cultivation: Weeds were removed by hand hoeing. No "hilling" up was done and no cross ties were placed between the ridges to hold water on the fields. For maize it is much better to have the excess run-off the field than to impound it and cause water logging.

Note taking and method of harvest: Stands (number of plants per plot) were noted after thinning. This year, in addition to counting the number of plants per plot at harvest, counts were also made in mid-August. This provided a double check on the number of plants which should have been in the plots at harvest. If lodging is severe, counting stands at harvest can be tedious. Stands are reported in per cent of a full stand of one plant per foot.

The dates of tasseling and silking were noted when about 50 per cent of the tassels were shedding pollen and when 50 per cent of the ear shoots were showing silks. These data are reported as number of days from planting to tassel and silking. Ear and plant heights were measured in centimeters.

Lodging notes were taken in late August when the crop was well developed and before any severe storms had caused any root lodging or stalk breaking. Notes were again taken after a severe wind and rain storm on September 10.

The number of ears from each plot were counted and reported as number of ears per plant. Although many varieties have the potential for more than one ear per stalk most stalks developed only one. Since the number of ears per plot was known the grain weight per ear is also reported. Barren stalks were not reported. This will be done in the future in order to better interpret the data.

The ears from each plot were harvested into burlap bags and transported to the seed house for weighing. In the case of the Zonal Trial the first three replications were first weighed and a composite sample of 20 pounds from each entry was weighed and later shelled. The last three replications were handled the same way. For other yield trials with two row plots a 20 pound composite sample was saved for each entry at the time of weighing. In tests with single row plots all the ears were bulked for an entry after weighing and later shelled. When the ears were dry enough to shell the samples were reweighed, shelled and the grain weighed. A 200 gram sample of grain from each sample was dryed at 180°F for 24 hours to determine the moisture content of the grain. All weights were taken on a spring balance which weighs to an accuracy of 1/ 0 of a pound.

Shelling percentages are reported to demonstrate the variations between entries. There seems to be enough variation in shelling percentages to justify this laborious procedure of harvesting.

Disease and insects. The reaction to maize rust Puccinia sorghi was scored on the basis of 0 = 5 completely susceptible. Rust was very severe on susceptible varieties but developed too late to cause any significant loss in yield.

No other diseases were noted.

Stem borers could be found but not in large enough numbers to cause stalk breakage Compared with sorghum the maize crop has been relatively free of these pests.

RESULTS OF YIELD TRIALS

National Zonal Trial

Exp. No. 1

This trial included nine varieties (Table 3) and was planted at several locations throughout Nigeria. The same group of varieties have been grown for the past three years (Table 4). All varieties have tall plants with high ear placement. Lodging was moderate to severe. This year NS-5 and Diaco. V153 gave the highest yields and were also given the best rating Zero and 1 rust readings were reported for all entries August 25.

Columbian Introductions

Exp. No. 2

Seed of 40 introductions from Columbia, South America was supplied by Dr. M. Lindsey, University of Ibadan in December 1965. The seed was planted in the irrigation site and some seed was increased by sibbing a few poorly developed plants Additional seed was produced by sibbing during the wet season of 1965 and 1966. No doubt some inbreeding has taken place by the method used in maintaining seed. The performance of the lines grown in 1967 is given in Table 5. The entries are given under code as follows:

Code	Pedigrees
C-1	(USA 342 x Diaco. V 206)-5#
C-2	(Eto x USA 342)-5#
C-3	(Cub. 325 x USA 342)-5#

Code	Pedigree
C-4	(Yotoco x Cub. 325 Bl.)-4#
C-5	(Yotoco x Diacol V 351)-3#
C-6	(Yotoco x Eto)-3#
C-7	(Yotoco x USA 342)-3#
C-8	((USA 342 x Diacol V 206)-4# x Diacol V 254)#
C-9	((Eto x USA 342)-4# x Diacol V 254)#
C-10	((Cub. 325 x USA 342)-4# x Diacol V 254)#
C-12	((Yotoco x Diacol V 351)-2# x Diacol V 254)#
C-16	Compuesto Caribe Amarillo (Cuba-Puerto Rico)-2#
C-17	Compuesto Tuxpeno Amarillo Caribe (Tuxpeno-Sanvibag)-2#
C-18	Composite III Amarillo Centro America (Cuba 40-Hawaii 5-San Luis Potosi 104)-2#
C-19	Compuesto Caribe Amarillo (Cuba-Antibersan)-2#
C-21	(Mez. 17 Lineas Amarillas)-4#
C-25	(Mez. 9 Lineas Blancas x Mez. 5 variedades Blancas)-3#
C-30	(D.V. 101 x D.V. 351)-4#
C-31	(Ven. 1-6# x Eto)-4#
C-33	D. V. 351
C-35	Per. 330-8#
C-36	Ven. 305-3#
C-37	Nar. 330a-7Xa
C-38	Nar. 330b-12#b

Two of the entries carry the same code number, 30. The source of these was the same but the two lines were separated on the basis of seed color. The production of each line is quite different.

The average yield of the entries is 4585 pounds per acre. All lines have shorter plants and lower ears than Mexico-5, and most are not more than a day or two earlier in tasseling. Lodging was least in lines C-4, C-5 and C-6 which have Yotoco as a common parent. All entries were resistant to maize rust (P. sorghi). A few have been included in the composites which have been developed and some have been intercrossed and tested as variety-hybrids.

Variety-Hybrids

Exp. No. 3

Seed of 64 variety-hybrids produced in the 1966-67 irrigation nursery was planted in a replicated trial (Table 6). Replications one and two were planted in field W-5 on June 1 and three and four in field W-3 on June 9. There is no significant difference between the mean yields of the two dates of planting. Most entries root

Table 3. Yields and other agronomic data from the National Zonal Trial, Samaru, 1967. Date planted May 31, Date harvested October 3-4, Plot size 20 x 15 feet.

Entry	Average days to tassel	Average days to silk	Average height ear	Average height plant	Stand Thinning	Stand Harvest	Lodging 28/8 1/	Lodging 28/8 2/	Lodging 11/9 1/	Lodging 11/9 2/
	no.	no.	cm	cm	%	%	%	%	%	%
NS-1	65	70	220	340	99	95	1.2	.5	18.4	9.3
NS-4	57	62	170	290	98	92	1.2	1.4	12.6	9.0
NS-5	57	63	180	290	100	97	1.3	1.0	17.6	7.4
H503	64	70	170	290	98	90	2.8	.2	29.2	5.5
H507	66	71	180	300	99	94	3.0	.5	26.3	6.9
EAFRO 231	67	71	210	340	99	91	2.8	1.4	29.0	7.9
Diacol V 153	61	66	170	300	99	96	1.5	0.0	25.9	7.0
Ex. W/Region	59	65	180	290	98	94	2.0	0.0	18.0	5.6
Mexico - 5	63	69	180	300	97	90	4.1	.5	22.1	5.9

Table 3. (cont d.)

Entry	Ears pl	av grain wt	Yield per plot 12% moisture 1	2	3	4	5	6	Yield per acre
	no.	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs 3/
NS-1	1.14	.36	31.6	34.5	35.9	36.7	33.3	34.1	5029
NS-4	.96	.31	38.7	27.1	30.0	26.2	26.4	24.4	4216
NS-5	1.05	.34	33.4	39.3	33.1	38.9	34.1	38.8	5309
H503	1.07	.31	27.3	33.[illegible]	32.8	31.0	34.3	30.1	4602
H507	1.09	.30	33.0	29.5	34.0	36.1	31.6	31.9	4785
EAFRO 231	.99	.36	35.9	36.3	30.2	32.6	31.1	40.1	6031
Diacol V 153	1.00	.35	32.2	36.0	38.4	37.3	36.3	33.0	5202
Ex. W/Region	1.05	.32	34.5	32.3	33.2	33.7	32.0	28.0	4726
Mexico - 5	1.00	.34	32.3	31.6	31.7	33.5	31.9	31.3	4692

1/ Root lodging 2/ Broken stalks

3/ Yield of 6 replication x 24.4 CV = 11%

LSD .05 = 508 pounds.

Table 4. Summary of yields of maize varieties included in the Federal Uniform Trials, 1964, 1965, 1966, 1967, Samaru, Nigeria.

Variety	Yield per acre (lbs. 12% moisture)				
	1964	1965	1966	1967	Average 1965-67
H-503	3071	5653	3920	4602	4725
Diacol V-153	2882	5152	4225	5202	4860
H - 507	2684	5174	3237	4785	4399
NS - 1	2190	4859	3910	5029	4599
NS - 5	2294	5222	3116	5309	4549
NS - 4	1905	4562	3494	4216	4091
Mexico - 5	--	5305	4293	4692	4763
EAFRO - 231	--	4208	4114	5031	4451
Ex/Western Region	--	5014	3296	4726	4345

Table 5. Yields and other agronomic data from Columbian introductions (Exp. 2) grown at Samaru, 1967. Date planted June 2, date harvested Oct. 5-6, plot size 20 x 6 feet.

Entry	Average days to tassel	Average days to silk	Average height ear	Average height plant	Stand Thinning	Stand Harvest	Lodging 11/9 1/	Lodging 11/9 2/
	no.	no.	cm	cm	%	%	%	%
C-1	56	60	120	240	98	98	14	0.8
C-2	58	62	120	250	98	94	37	1.0
C-3	58	63	130	230	100	98	14	1.0
C-4	59	63	130	230	98	98	4	2.0
C-5	63	68	160	260	98	98	7	7.0
C-6	66	71	170	280	100	99	7	2.0
C-7	64	68	170	280	97	96	13	2.0
C-8	58	62	150	240	98	97	22	3.0
C-9	64	67	140	250	99	97	60	4.0
C-10	63	67	130	230	100	97	22	0.0
C-12	64	68	140	260	97	94	11	2.0
C-16	62	66	140	300	99	94	47	2.0
C-17	65	69	160	250	98	95	54	0.8
C-18	59	63	160	250	98	95	13	1.0
C-19	62	66	130	250	96	93	42	1.0
C-21	63	67	150	260	98	97	21	1.0
C-25	63	67	140	240	97	96	36	1.0
C-30	62	67	150	240	99	94	13	1.0
C-30	63	68	160	280	100	91	15	2.0
C-31	64	68	150	230	100	93	33	2.0
C-33	64	69	140	260	96	94	28	6.0
C-35	63	68	160	260	99	98	24	1.0
C-36	63	68	150	250	92	90	38	5.0
C-37	64	69	140	220	98	94	31	1.0
C-38	59	64	150	250	100	98	22	2.0
Mex-5	65	69	180	290	95	90	13	7.0

1/ Root lodging

2/ Broken stalks

Table 5. (cont'd.)

Entry	Ears Av. plant	Ears Grain wt.	Yield per plot 12% moisture 1	2	3	Yield per acre
	no.	lbs.	lbs.	lbs.	lbs.	lbs. 3/
C-1	1.03	.33	13.8	13.9	13.7	5009
C-2	1.06	.33	13.8	12.3	11.9	4598
C-3	1.13	.29	12.7	13.6	13.6	4828
C-4	0.91	.31	12.5	11.1	11.5	4247
C-5	1.14	.28	12.1	15.4	13.1	4913
C-6	1.35	.23	12.6	11.5	14.8	4707
C-7	1.03	.38	15.1	15.8	16.9	5783
C-8	1.02	.35	14.7	15.3	13.6	5276
C-9	.89	.36	15.4	11.4	12.4	4743
C-10	.98	.34	13.2	13.7	14.1	4961
C-12	1.07	.30	11.8	13.2	12.2	4501
C-16	1.11	.29	13.9	11.8	12.3	4598
C-17	1.47	.22	12.3	13.0	13.1	4646
C-18	1.04	.33	13.3	13.4	14.4	4973
C-19	1.00	.32	12.0	13.1	12.6	4562
C-21	1.11	.28	10.9	13.8	12.6	4513
C-25	1.04	.29	12.4	14.1	10.6	4489
C-30	1.04	.23	9.6	9.3	9.8	3473
C-30	1.17	.27	12.1	12.1	12.0	4380
C-31	1.05	.26	10.1	10.6	11.3	3872
C-33	1.28	.29	13.3	17.1	13.7	5336
C-35	1.42	.19	11.3	11.3	11.1	4078
C-36	1.18	.24	10.4	10.3	11.1	3848
C-37	1.08	.24	10.0	10.5	10.6	3763
C-38	1.08	.25	12.2	10.2	10.6	3993
Mex-5	1.24	.30	15.4	12.7	14.5	5155

3/ Yield of 3 replications x 121 CV = 4.8%

LSD .05 = 634

Table 6. Yields and other agronomic data from varietal hybrids (Exp. 3) grown at Samaru, Nigeria. 1967. Date planted; Reps. 1-2, June 1: reps. 3-4, June 9. Plot size; reps. 1-2, 20 x 6; reps. 3-4, 20' x 3'.

Entry	Rep.	Average days to tassel	Average days to silk	Average height ear	Average height plant	Stand Thin-	Stand Harv	Lodging 1/	Lodging 2/	Ears pl	Av grain wt	Shelling	Yield per plot 12% moisture 1	Yield per plot 12% moisture 2	Yield per acre
		no.	no.	cm	cm	%	%	%	%	no.	lbs	%	lbs	lbs	lbs 3/
C-8xC-10	1-2	60	64	150	260	96	93	36	3	1.03	.40	81	16.2	15.8	5808
	3-4	63	67	130	260	83	83	11	0	1.06	.36	81	13.1	13.9	4900
	Av														5354
C-8xA-154	1-2	57	62	130	260	100	98	38	4	1.03	.40	83	17.0	16.6	6098
	3-4	60	63	140	270	100	100	14	0	.93	.37	81	14.1	12.2	4773
	Av														5436
C-10xC-18	1-2	58	62	140	240	96	92	12	1	1.00	.38	83	14.8	14.2	5264
	3-4	63	67	130	240	88	88	14	0	.81	.39	--	11.3	12.0	4229
	Av														4747
C-10xA-154	1-2	59	63	170	270	98	90	39	24	.96	.38	81	14.7	12.6	4955
	3-4	63	66	150	280	100	100	2	2	1.00	.41	81	15.9	18.9	6316
	Av														5636
C-10xC-8	1-2	57	62	130	240	95	93	24	3	1.00	.37	83	12.5	16.0	5173
	3-4	60	64	140	270	98	98	15	0	.98	.40	82	17.8	14.5	5862
	Av														5518
C-12xC-8	1-2	60	66	120	230	98	93	30	6	.97	.35	77	11.6	15.1	4846
	3-4	63	67	140	270	93	93	10	3	.85	.35	77	12.1	10.8	4156
	Av														4501
C-16xC-8	1-2	56	60	160	250	99	93	14	8	1.05	.37	82	15.3	15.1	5518
	3-4	57	61	140	260	98	98	22	5	.98	.39	80	15.7	15.7	5699
	Av														5609
C-16xC-10	1-2	60	64	160	240	98	96	20	3	1.02	.38	79	16.4	15.1	5717
	3-4	65	70	150	290	100	98	42	0	.90	.41	80	16.8	13.2	5445
	Av														5581

Table 6. (cont d.)

Entry	Rep.	Average days to tassel	Average days to silk	Average height ear	Average height plant	Stand Thinning	Stand Harvest	Lodging 1/	Lodging 2/	Ears Av pl	Ears grain wt	Shelling	Yield per plot 12% moisture 1	Yield per plot 12% moisture 2	Yield per acre
		no.	no.	cm	cm	%	%	%	%	no.	lbs.	%	lbs	lbs	lbs 3/
C-16xC-12	1-2	60	67	150	270	94	86	51	20	1.06	.36	79	14.2	12.5	4646
	3-4	61	65	140	260	90	90	21	0	1.03	.43	82	16.8	16.5	6044
	Av														5445
C-18xC-8	1-2	55	60	130	240	100	94	33	1	1.03	.36	83	14.0	14.8	5227
	3-4	58	63	130	250	100	100	19	0	1.00	.31	81	12.3	13.5	4683
	Av														4955
C-18xC-10	1-2	59	65	150	250	100	98	54	0	.98	.33	83	11.9	14.5	4792
	3-4	61	67	130	250	99	95	10	0	.90	.38	82	15.0	12.4	4973
	Av														4883
C-18xC-12	1-2	59	63	160	270	100	99	33	12	.96	.39	77	15.7	15.2	5681
	3-4	58	65	130	240	99	98	10	0	.98	.89	78	18.9	12.4	5608
	Av														5645
C-18xC-16	1-2	61	65	160	270	99	94	66	5	1.00	.36	82	14.7	13.9	5191
	3-4	62	66	150	280	95	90	34	0	1.00	.42	82	14.4	16.4	5771
	Av														5481
C-31xC-8	1-2	57	62	170	260	98	90	65	4	1.00	.33	75	13.3	11.7	4538
	3-4	59	66	140	250	100	100	48	2	.86	.38	79	14.7	12.6	4955
	Av														4747
C-31xC-10	1-2	58	62	140	250	99	95	33	8	1.03	.37	80	13.5	17.2	5572
	3-4	62	66	130	280	95	95	55	3	.83	.36	80	14.2	9.8	4356
	Av														4964
C-31xC-12	1-2	60	64	160	260	99	93	35	9	1.05	.36	78	13.1	16.4	5354
	3-4	61	67	150	300	100	95	55	0	1.00	.36	77	16.7	11.8	5173
	Av														5264
C-31xC-16	1-2	59	62	140	250	99	90	59	5	1.08	.35	82	13.7	14.5	5118
	3-4	61	65	150	290	86	86	36	6	1.06	.39	82	17.0	12.8	5409
	Av														5264
C-31xC-18	1-2	57	61	170	260	100	95	59	5	1.06	.38	82	16.0	16.0	5808
	3-4	58	64	160	280	100	100	19	7	.97	.42	80	17.4	16.7	6189
	Av														5999

Table 6. (cont'd.)

Entry	Rep	Average days to tassel	Average days to silk	Average height ear	Average height plant	Stand Thinning	Stand Harvest	Lodging 1/	Lodging 2/	Ears Av pl	Ears grain wt	Shelling	Yield per plot 12% moisture 1	Yield per plot 12% moisture 2	Yield per acre
		no	no	cm	cm	%	%	%	%	no	lbs	%	lbs	lbs	lbs3/
C-33xC-8	1-2	60	64	160	260	95	92	29	1	1.14	.31	81	13.8	13.9	5028
	3-4	64	68	160	300	100	95	28	5	1.18	.34	80	17.6	13.8	5699
	Av														5364
C-33xC-10	1-2	61	67	150	270	90	89	46	8	.98	.35	81	14.4	11.4	4683
	3-4	67	72	130	240	98	98	15	0	.95	.33	81	14.1	12.0	4737
	Av														4710
C-33xC-12	1-2	60	66	160	270	88	84	59	12	1.29	.29	80	12.4	18.5	4701
	3-4	65	69	160	280	98	88	65	5	.89	.31	79	11.8	8.8	3739
	Av														4220
C-33xC-16	1-2	62	66	170	270	98	98	37	10	.99	.33	81	12.6	14.3	4882
	3-4	66	70	170	280	98	98	49	7	.85	.41	80	14.4	14.4	5227
	Av														5055
C-33xC-18	1-2	58	62	140	260	100	98	41	1	1.00	.38	83	14.5	16.5	5627
	3-4	59	64	140	250	100	95	8	0	1.05	.34	81	14.1	14.5	5191
	Av														5409
ByxC-8	1-2	56	60	120	240	100	95	9	0	.95	.40	84	17.1	15.2	5899
	3-4	56	61	120	250	100	100	14	0	.95	.40	84	16.1	15.6	5754
	Av														5827
ByxC-10	1-2	55	59	130	240	100	94	4	0	1.02	.40	84	15.8	16.7	5899
	3-4	57	62	120	230	98	98	2	0	.85	.47	82	16.3	16.9	6026
	Av														5963
ByxC-12	1-2	57	61	150	270	99	96	41	4	.99	.44	80	19.1	16.4	6443
	3-4	64	68	150	270	98	98	39	0	1.07	.38	78	14.9	18.6	6080
	Av														6262
ByxC-16	1-2	58	63	140	250	94	94	22	2	1.15	.35	83	14.8	17.3	5826
	3-4	61	65	140	260	95	95	10	0	1.03	.39	83	16.7	15.4	5826
	Av														5826
ByxC-18	1-2	55	59	130	240	98	94	43	1	1.06	.38	84	16.8	14.9	5754
	3-4	58	62	130	260	98	98	00	2	1.14	.34	84	18.0	14.5	5899
	Av														5827

Table 6. (cont'd.)

	Rep	Average days to tassel no.	Average days to silk no.	Average height ear cm	Average height plant cm	Stand Thinning %	Stand Harvest %	Lodging 1/ %	Lodging 2/ %	Ears Av pl no	Ears grain wt. lbs	Ears Shelling %	Yield/plot 12 moisture 1 lbs	Yield/plot 12 moisture 2 lbs	Yield per acre lbs 3/
ByxC-31	1-2	57	61	160	280	99	96	53	13	.98	.42	84	15.1	18.3	6062
	3-4	59	63	140	300	100	100	26	0	1.05	.43	83	19.2	18.7	6879
	Av														6471
ByxC-33	1-2	59	63	140	250	98	98	4	7	--	---	83	16.6	17.3	6153
	3-4	63	66	120	260	93	83	6	6	.94	--	82	16.8	13.2	5445
	Av														5799
ByxA-154	1-2	58	62	140	250	98	93	8	0	.99	.43	81	17.4	15.9	6044
	3-4	62	66	140	290	98	90	11	5	.92	.40	83	14.2	13.7	5064
	Av														5554
A154xC-8	1-2	59	63	160	280	99	93	23	4	1.04	.37	79	14.9	15.4	5499
	3-4	63	67	150	290	100	98	12	2	1.03	.35	78	17.8	14.7	5899
	Av														5699
A154xC-10	1-2	60	66	150	280	98	94	24	3	.99	.41	81	15.7	16.3	5808
	3-4	61	66	160	290	100	98	15	0	.95	.41	80	17.2	11.6	5772
	Av														5790
A154xC-12	1-2	63	67	160	280	99	94	19	1	1.12	.34	79	15.5	12.9	5155
	3-4	68	71	150	260	98	93	3	0	.95	.34	80	13.0	11.6	4465
	Av														4810
A154xC-18	1-2	61	66	140	240	95	98	17	1	1.09	.38	79	15.4	18.6	6171
	3-4	62	66	140	270	98	93	21	3	1.10	.42	80	19.3	16.7	6534
	Av														6553
A154xC-31	1-2	60	65	160	270	100	89	73	7	1.10	.34	79	13.9	13.8	5028
	3-4	62	67	150	290	93	93	26	3	.95	.35	79	13.1	12.9	4719
	Av														4874
A154xC-33	1-2	60	66	170	260	100	98	43	1	1.10	.33	81	15.7	13.6	5318
	3-4	66	70	140	280	98	98	39	20	1.07	.29	81	12.9	12.8	4665
	Av														5492
A154xBy	1-2	56	61	140	240	100	95	14	3	.93	.38	79	13.6	14.5	5100
	3-4	60	65	140	270	95	90	0	0	.95	.37	82	15.6	11.1	4846
	Av														4973
A154xA156	1-2	64	68	160	270	100	96	21	1	1.05	.36	83	15.4	14.9	5499
	3-4	66	70	160	290	98	90	37	0	1.00	.37	84	14.6	18.6	5118
	Av														5309

Table 6 (cont'd.)

Entry	Rep.	Average days to tassel	Average days to silk	Average height ear	Average height plant	Stand Thinning	Stand Harvest	Lodging 1/	Lodging 2/	Ears Av pl	Ears grain wt.	Ears Shelling	Yield/plot 12% moist. 1	Yield/plot 12% moist. 2	Yield per acre
		no.	no.	cm	cm	%	%	%	%	no	lbs	%	lbs	lbs	lbs 3/
A156xC-8	1-2	57	62	150	260	100	98	32	2	1.00	.34	80	13.5	14.5	5082
	3-4	59	64	130	240	93	93	21	0	.97	.30	81	11.0	11.7	4120
	Av														4601
A156xC-16	1-2	60	64	170	290	100	92	82	1	1.02	.38	81	14.0	16.4	5445
	3-4	61	65	140	280	100	98	61	2	.80	.43	82	14.8	13.4	5118
	Av														5282
A156xC-18	1-2	59	64	150	260	100	98	29	6	1.06	.34	82	13.1	16.3	5336
	3-4	61	65	140	280	100	100	26	0	.90	.38	83	16.5	12.5	5264
	Av														5300
A156xC-31	1-2	61	67	150	250	96	84	70	7	1.28	.29	77	13.9	11.4	4592
	3-4	63	67	140	250	100	95	60	0	.83	.33	79	12.5	11.9	4429
	Av														4511
A156xA154	1-2	60	65	160	270	98	94	29	1	1.05	.33	81	13.0	14.5	4991
	3-4	66	71	140	260	98	93	33	0	1.00	.03	80	15.2	10.0	4683
	Av														4837
A195xC-8	1-2	59	64	160	260	100	99	36	1	1.12	.36	84	16.9	16.8	6117
	3-4	63	67	140	260	100	100	1	0	.90	.43	85	16.1	15.9	5808
	Av														5963
A195xC-16	1-2	65	68	170	290	98	87	49	8	1.04	.33	81	11.3	13.5	4501
	3-4	71	76	170	280	93	90	47	3	1.00	.30	83	10.5	12.5	4175
	Av														4338
A195xC-18	1-2	60	65	160	280	99	95	49	3	1.16	.34	82	17.2	14.2	5690
	3-4	66	70	140	260	86	86	48	0	1.05	.42	81	21.1	10.9	5808
	Av														5754
A196xC-8	1-2	62	66	150	260	99	93	79	1	1.04	.36	83	12.6	16.5	5282
	3-4	65	69	140	260	98	100	41	0	.93	.36	80	13.3	14.0	5046
	Av														5164
A196xC-16	1-2	62	67	170	270	96	94	48	5	.97	.35	80	12.9	14.0	4882
	3-4	68	72	170	290	95	93	64	0	.95	.32	82	12.4	9.5	3975
	Av														4429

Table 6 (cont'd.)

Entry	Rep.	Average days to tassel	Average days to silk	Average height ear	Average height plant	Stand Thinning	Stand Harvest	Lodging 1/	Lodging 2/	Ears Av. pl	Ears grain wt.	Shelling	Yield/plot 12% moist. 1	Yield/plot 12% moist. 2	Yield per acre
		no.	no.	cm	cm	%	%	%	%	no.	lbs.	%	lbs	lbs	lbs 3/
A196xC-31	1-2	62	67	170	270	98	93	49	10	1.04	.35	85	14.6	13.4	5082
	3-4	68	72	150	280	95	88	73	3	1.03	.36	80	10.7	16.6	4955
	Av														5019
A196xA154	1-2	65	69	170	290	96	93	15	4	.99	.33	85	15.0	10.2	4574
	3-4	71	74	160	290	90	80	26	3	1.00	.29	82	10.6	9.1	3576
	Av														4075
A196xA195	1-2	63	66	170	280	96	92	61	1	1.09	.30	83	11.7	13.9	4646
	3-4	69	72	150	290	100	98	51	2	.71	.32	82	10.6	8.0	3376
	Av														4011
TsoloxC-8	1-2	57	61	150	250	100	94	37	0	1.18	.38	82	16.8	16.8	6098
	3-4	58	64	140	270	100	100	21	0	.90	.41	80	16.6	14.5	5645
	Av														5867
TsoloxC-10	1-2	59	62	130	230	100	96	9	6	1.01	.36	81	14.2	15.3	5354
	3-4	60	65	140	270	100	100	5	2	.98	.40	81	17.1	15.1	5899
	Av														5627
TsoloxC-18	1-2	59	63	150	260	99	96	22	0	.97	.40	82	17.9	13.7	5755
	3-4	67	64	150	260	100	98	10	5	1.00	.34	80	14.4	13.7	5100
	Av														5418
TsoloxC-31	1-2	59	62	150	250	95	91	41	8	1.09	.37	83	15.9	15.0	5608
	3-4	62	67	150	270	100	98	37	0	.90	.39	82	15.2	13.6	5227
	Av														5418
TsoloxC-33	1-2	60	65	160	280	98	96	33	10	1.07	.43	80	19.4	18.0	6788
	3-4	63	67	150	280	93	90	21	8	.95	.48	81	18.4	15.8	6207
	Av														6490
TsoloxA154	1-2	60	65	160	250	99	98	23	7	.97	.37	78	14.4	15.2	5372
	3-4	65	69	150	290	100	98	12	7	.90	.38	81	13.9	13.5	4973
	Av														5173
TsoloxA156	1-2	60	65	150	270	100	95	15	1	1.01	.37	81	15.7	14.4	5463
	3-4	63	66	150	290	95	93	13	2	.94	.43	80	17.4	13.2	5554
	Av														5509

Table 6 (cont'd)

Entry	Rep.	Average days to tassel	Average days to silk	Average height ear	Average height plant	Stand Thinning	Stand Harvest	Lodging 1/	Lodging 2/	Ears Av pl	Ears grain wt	Shelling	Yield/plot 12% moist. 1	Yield/plot 12% moist. 2	Yield per acre
		no.	no.	cm	cm	%	%	%	%	no.	lbs.	%	lbs	lbs	lbs 3/
Tsolo x A195	1-2	60	65	170	270	100	95	40	1[illegible]	1.02	.36	83	14.5	14.7	5300
	3-4	65	69	160	300	100	100	26	2	.83	.38	81	14.5	12.4	4882
	Av														5091
ES1 x A154	1-2	67	71	190	300	98	88	79	10	1.38	.27	79	13.8	13.0	4864
	3-4	68	72	200	320	98	95	35	25[illegible]	.97	.25	75	8.0	11.4	3521
	Av														4193
ES 1 x A195	1-2	68	68	190	310	100	96	44	12	1.10	.35	78	14.8	16.2	5627
	3-4	69	72	190	320	95	95	40	0	.93	.37	78	13.6	14.1	5028
	Av														5328
ES x A196	1-2	61	66	170	270	99	93	42	0	1.14	.35	82	16.7	14.5	5663
	3-4	68	71	160	300	100	100	14	0	.95	.39	83	15.8	15.0	5590
	Av														5627
ES x Tsolo	1-2	61	66	160	270	98	93	24	4	1.05	.35	78	14.1	14.8	5215
	3-4	64	69	140	280	95	98	7	0	.83	.39	79	15.8	11.0	4864
	Av														5065
C-8	1-2	57	62	130	230	100	94	46	7	1.11	.28	81	11.7	12.9	4465
	3-4	60	57	140	260	95	95	40	3	.83	.33	81	9.4	12.5	3975
	Av														4220
C-10	1-2	59	62	120	220	95	82	55	6	1.17	.33	83	13.3	13.1	4792
	3-4	61	64	120	230	100	100	5	0	.98	.35	81	16.9	11.7	5191
	Av														4992
C-12	1-2	64	68	130	260	100	93	23	3	.99	.36	79	15.4	12.4	5046
	3-4	68	71	130	250	90	85	28	3	.83	.31	74	7.9	10.4	3321
	Av														4184
C-16	1-2	60	68	160	260	100	96	60	5	1.01	.24	84	10.3	9.5	3594
	3-4	65	69	170	280	100	98	54	7	.98	.30	82	12.5	11.2	4302
	Av														3948
C-18	1-2	57	61	140	240	100	96	16	4	.99	.29	83	10.1	12.9	4174
	3-4	60	64	140	260	98	100	14	5	.88	.34	84	12.6	12.6	4574
	Av														4372

Table 6 (cont'd.)

Entry	Rep.	Average days to tassel	Average days to silk	Average height ear	Average height plant	Stand Thin-ing	Stand Harv-vest	Lodging 1/	Lodging 2/	Ears Av. pl	Ears grain wt	Ears Shell-ing	Yield/plot 12% moist. 1	Yield/plot 12% moist. 2	Yield per acre
		no.	no.	cm	cm	%	%	%	%	no.	lbs	%	lbs	lbs	lbs 3/
C-31	1-2	59	63	140	240	99	91	89	1	.84	.30	79	11.2	8.1	3503
	3-4	65	68	160	270	98	90	37	0	.84	.25	--	7.2	9.1	2953
	Av														3231
C-33	1-2	64	69	140	260	88	90	63	1	.95	.26	77	8.2	10.2	3340
	3-4	67	72	130	250	90	90	74	3	.66	.23	76	7.1	4.3	2069
	Av														2705
Biu	1-2	54	59	110	220	99	91	7	5	1.01	.31	81	11.1	12.6	4302
	3-4	57	62	110	240	100	98	0	0	1.00	.30	80	12.4	12.1	4447
	Av														4375
A-154	1-2	63	67	190	290	100	96	14	0	1.00	.36	84	14.0	15.3	5318
	3-4	67	71	180	300	98	98	5	0	.90	.35	79	12.9	13.3	4755
	Av														5037
A-156	1-2	61	67	150	260	99	92	35	9	1.15	.27	81	13.3	10.5	4320
	3-4	68	72	150	280	100	95	23	3	.80	.33	81	12.6	8.7	3866
	Av														4093
A-195	1-2	64	68	140	250	87	87	18	3	1.01	.38	81	12.3	15.5	5046
	3-4	70	74	150	270	100	98	13	0	.97	.32	81	13.7	11.7	4610
	Av														4328
A-196	1-2	64	68	170	270	92	93	26	1	.94	.39	84	13.1	15.5	5191
	3-4	67	72	150	250	90	78	6	0	.97	.36	83	14.3	8.6	4156
	Av														4674
Tsolo	1-2	58	63	170	250	99	95	28	3	1.02	.33	80	13.4	14.8	5118
	3-4	59	64	150	260	100	95	8	5	1.13	.35	82	12.8	19.0	5772
	Av														5425
NS-1	1-2	66	71	210	320	100	98	60	7	1.17	.30	79	14.4	14.1	5173
	3-4	69	73	200	300	100	100	19	10	1.19	.26	78	12.5	13.7	4755
	Av														4964

Lodging 1/ Root, 2/ Broken stalks. 3/ Yield of two replications x 18/.5
Yields shown for reps 3-4 are double actual harvested to be comparable with those from reps 1-2.
LSD .05 877 lbs. CV = 12.1%

Table 7. Average yields of hybrids with common parents and yields of parents, Samaru, 1967.

Hybrids with line	No. of Hybrids	Average yield lbs.
C-8	14	5329
C-10	11	5343
C-12	7	5164
C-16	10	5231
C-18	11	5487
C-31	10	5253
C-33	8	5256
A-154	15	5180
A-156	7	5050
A-195	6	5081
A-196	6	4721
Tsolo (A 49)	9	5517
Biu yellow	9	5833
NS-1	4	5050
Parents		
C-8		4220
C-10		4992
C-12		4184
C-16		3948
C-18		4372
C-31		3231
C-33		2705
A-154		5037
A-156		4093
A-195		4828
A-196		4674
Tsolo (A 49)		5425
Biu Yellow		4302
NS-1		4964

lodged less in the second planting. The highest yield was made by Biu Yellow x C-31 with 6471 pounds. The hybrid, Biu Yellow x C-10 gave a yield of 5963 pounds and root lodged 4 per cent in the first two replications and 2 per cent in the last two. This hybrid, by chance, was selected to be compared with NS-1 in the nitrogen trial (Table 15).

Several of the variety-hybrids show promise. The average performances of the hybrids with common parents are given in Table 7. The hybrids with Biu Yellow gave the highest average yield of 5833 pounds. This not surprising since this parent is a U.S. Corn Belt dent and the other parents and particularly the Columbian varieties are "tropical" flints. The Biu yellow hybrids were also the best for resistance to root lodging. The mean yield of the hybrids with the South African variety, Tsolo was nearly equal that from Biu Yellow. Biu Yellow was completely susceptible to rust this year but all hybrid combinations with the Columbia lines were resistant.

West African Trial

Exp. No. 8

Dr. Craig, Federal Agricultural Research Station, Ibadan supplied seed which he had collected for the regional West African Maize Trial. The entries are listed in Table 8 but not the source. The following list gives the seed source:

Name	Origin
NS-1	Nigeria
NS-4	Nigeria
NS-5	Nigeria
ZM-10	Senegal
Aldiobla Mais Blanc	Upper Volta
Massayomba	Upper Volta
Darsalam	Upper Volta
Jaune flint de Saria	Upper Volta
Composite Jaune D'Ina	Dahomey
X 302	F_1 hybrid from Jamaica
X 304	F_1 hybrid from Jamaica
X 306	F_1 hybrid from Jamaica
MTS H59	Ivory Coast
H. J.	Ivory Coast

MTS H59 is a synthetic of three varieties from the Ivory Coast while H.J. is a mixture of Cuban and Mexican varieties cross with MTS H 59 - first cycle selection for yellow grain.

The two F_1 hybrids, X 302 and X 306 gave the highest yields. Of the later maturing entries, X 302 had the fewest root lodged plants. Jaune flint de Saria was the first variety to tassel of all varieties tested in the project but by the time it was harvested many of the stalks had broken.

Collection of Kenya and Local Varieties
Exp. 7

Since it was necessary to abreviate the names of the entries from Kenya in Table 9 the complete description is as follows:

Amarillo Syn. x Stiff Stalk Syn.
Cuba 40 - Hawaii S SLP
USA 342 x Guadaloupe Merzda
USA 342 x Dentada Commercial
USA 342 x Deep Kernel Syn.
USA 342 x Cometia
(V520C x Var. Amar) sel Amarillo
Ver. 168 x (Indian Chief x Jarvis)
Ver. 212 x (Indian Chief x Jarvis)
Amar. Syn, x Cometia.
Usatigua
P. Rio GPO 1 Y2
Kitale III
Amagaceno (Kitale selection)
Kitale Composite E
Kitale Composite A

The above varieties were sent to Kenya by Dr. Wellhausen from the Rockefeller Foundation maize program in Mexico. Seed of each of the entries tested has been increased at least once by mass pollination at Samaru. Entries to be noted for resistance to lodging include A-154, V-56, EAFRO 272 and EAFRO 269. The best yields were made by varieties with the largest ears.

Table 8. Yields and other agronomic data from the West African Trial (Exp. 8) grown at Samaru, Nigeria. 1967. Date planted May 31, date harvested October 3. Plot size, 6 feet x 20 feet.

Entry	Days to tassel	Days to silk	Height ear	Height plant	Stand Thinning	Stand Harvest	Lodging 11/9 1/	Lodging 11/9 2/	Ears Av/pl	Ears grain wt	Shelling	Yield per plot 12% moisture 1	2	3	4	Yield per acre
	no.	no.	cm	cm	%	%	%	%		lbs	%	lbs	lbs	lbs	lbs	lbs 3/
X 302	58	63	140	240	99	99	8	2	1.00	.35	82	15.6	14.8	13.6	14.8	5336
X 306	62	66	140	250	100	99	34	3	.98	.34	84	12.6	14.2	15.4	12.2	4937
MTS H59	58	62	150	250	100	98	10	6	1.11	.29	82	14.0	17.6	10.4	11.6	4864
Comp. Jaune D'Ina	59	63	150	240	95	94	12	5	1.03	.33	81	13.2	13.0	13.7	13.6	4855
NS -5	60	64	170	290	99	98	26	8	.99	.33	82	12.7	14.5	13.9	12.4	4855
Aldiobla Mais Blanc	59	64	170	280	97	96	15	9	1.05	.31	78	12.3	13.5	13.1	13.5	4755
NS1- (Mokwa)	65	70	190	320	96	96	12	12	1.05	.27	78	13.2	11.7	12.3	13.2	4574
Massayomba	58	62	160	280	98	96	20	18	1.01	.30	79	12.0	11.3	12.0	13.4	4420
X 304	58	62	140	240	100	100	15	12	.87	.31	81	14.2	--	12.0	8.0	4138
H. J.	59	64	140	260	100	99	22	13	.99	.28	82	10.4	13.0	12.0	10.2	4138
NS-1	65	70	180	290	96	95	24	12	1.06	.25	76	9.6	10.9	10.2	10.6	3748
Darsalam	55	59	130	240	94	95	9	13	.97	.24	82	10.3	9.9	8.4	12.3	3712
ZM -10	57	61	140	250	99	96	12	30	.91	.32	79	9.1	9.2	11.2	10.2	3628
NS -4	59	66	170	270	95	94	27	10	.96	.26	83	10.5	9.7	9.4	10.0	3594
June flint from Saria	46	50	100	200	99	94	1	34	.98	.21	87	8.4	8.0	8.7	--	3037

Lodging 1/ Root 2/ Broken stalks. 3/ Yield of 4 plots x 90.75

LDS .05 = 717 lbs. C.V. 11.8%

Table 9. Yields and other agronomic data from a collection of East African and Local Varieties (Exp. 7) grown at Samaru, Nigeria, 1967. Date planted June 9. Date harvested October 16. Plot size 6 feet x 20 feet.

Entry	Days to tassel	Days to silk	Height ear	Height plant	Stand Thinning	Stand Harvest	Lodging 1/	Lodging 2/	Shelling	Ears no./pl	Grain wt	Yield per plot 12% moisture 1	2	3	Yield per acre
	no.	no.	cm	cm	%	%	%	%	%	no.	lbs	lbs	lbs	lbs	lbs 3/
A - 195	67	71	190	340	100	98	17	2	85	.94	.42	16.6	15.3	17.8	6014
V - 58	65	71	200	270	100	99	28	2	83	1.02	.39	17.5	13.8	17.7	5929
V - 56	62	65	190	340	99	99	6	0	83	.89	.42	16.3	14.3	15.6	5590
A - 154	65	70	180	330	98	96	1	1	83	1.01	.38	16.9	14.1	14.7	5530
V520C x Var.Amar	66	70	190	320	94	94	11	2	84	.96	.40	15.8	14.8	14.2	5431
Ver.212 x Ind. Jarvis	63	67	180	320	97	94	20	2	83	1.01	.37	15.5	13.9	15.1	5385
V -10	67	71	200	370	99	97	31	5	83	.90	.39	12.4	17.0	14.0	5251
Cuba 40-Hawaii X SLP	60	63	170	310	97	93	5	16	84	1.00	.31	13.7	15.7	13.7	5191
P. Rio GPO 6	55	63	170	290	98	97	8	6	84	1.07	.32	15.8	14.5	11.6	5070
Amar.Syn. x Stiff Stalk	59	65	170	320	100	98	9	2	84	1.04	.33	13.1	15.0	13.6	5046
Usatigua	56	60	160	280	94	92	20	5	84	1.01	.35	15.2	14.3	11.6	4997
Amar.Syn x Cometia	57	62	190	330	100	98	10	2	83	.93	.35	13.2	14.9	12.7	4937
Bida Local Yel.	64	68	170	300	97	95	23	3	83	.98	.34	14.9	13.7	11.7	4876
EAAFRO 272	62	65	180	320	98	96	2	1	86	1.03	.32	13.2	12.2	14.9	4876
P.Rio GPO 1Y2	58	62	180	290	95	92	10	0	83	.94	.35	14.2	13.3	11.0	4679
NS - 1	67	71	220	330	100	95	23	7	81	1.08	.29	11.3	12.9	13.9	4610
Mass Sel.(FDA)	59	63	150	310	98	98	14	0	84	1.02	.29	14.9	10.1	12.1	4489
EAFRO 269	57	61	160	320	96	95	5	1	85	.97	.32	14.0	12.1	10.8	4465
Amagaceno (Kitale sel.)	69	74	210	370	100	95	25	2	82	.89	.33	11.4	12.8	11.1	4271
USA 342 x Guadaloupe Mey.	58	63	160	310	97	97	39	1	83	.88	.33	11.9	12.8	10.4	4247

Table 9. Concluded

Entry	Days to tassel	Days to silk	Height ear	Height plant	Stand Thinning	Stand Harvest	Lodging 23/9 1/	Lodging 23/9 2/	Shelling	Ears no./plant	Ears grain wt	Yield per plot 12% moisture 1	Yield per plot 12% moisture 2	Yield per plot 12% moisture 3	Yield per acre
	no	no	cm	cm	%	%	%	%	%	no	lbs	lbs	lbs	lbs	lbs 3/
H 622	65	70	210	340	98	97	38	4	82	.87	.32	7.1	12.9	14.1	4126
Ver.1[illegible] x Ind[illegible] x Jarvis	66	70	180	320	99	95	15	3	84	.88	.32	12.1	9.9	11.7	4078
Biu Yellow	55	60	120	290	97	94	9	2	81	.96	.30	11.4	11.3	10.1	3969
Tsolo	56	61	140	300	97	97	18	2	79	1.16	.23	10.9	11.2	8.6	3715
USA 342 x Deep Ker. Syn.	55	59	140	300	98	91	60	0	85	.86	.30	12.2	8.0	9.4	3582
Kit.V x Kit.VI	49	54	130	290	98	94	21	1	85	.80	.29	8.4	9.8	11.3	3570
USA 342 x Dentada Com.	56	60	160	280	98	96	37	2	82	.84	.29	10.8	11.0	7.4	3533
USA 342 xCometia	53	59	170	280	99	94	13	4	81	.84	.29	10.8	8.2	9.9	3497
Mokwa Local	52	61	170	310	98	96	7	2	82	.95	.25	8.6	11.5	8.8	3497
Kitale III	71	76	180	380	100	100	44	4	78	.75	.30	9.3	10.7	8.4	3436
Lagos white	63	67	190	320	94	90	45	1	87	.78	.24	9.7	10.3	7.4	3315
Kitale Comp.A	69	76	240	400	99	97	39	1	81	.69	.33	8.6	9.6	9.2	3315
Kitale Comp.E	68	72	230	390	100	94	55	4	82	.71	.32	7.1	6.3	13.3	3231
EAFRO 250	63	67	180	350	99	98	54	7	82	1.07	.25	8.0	8.8	7.0	2880
Bida local white	60	65	170	300	98	94	30	8	80	.87	.22	9.3	7.0	7.7	2904
Kitale Dwarf	66	70	130	260	99	96	21	4	78	.59	.25	7.1	6.0	4.9	2178

Lodging 1/ Root 2/ Broken stalks 3/ Yield of 3 plots x 121

LSD .05 = 997 lbs. CV = 14.2%

Top Cross Trial
with lines from V-56, V-58 and V-10

Exp. No. 6

Seed of 14 varieties was supplied from Ibadan in 1964 for 2-row observation plots. Enough additional seed was supplied of V-56, V-58 and V-10 to plant plots to begin a mass selection program. Some selfing was also carried out in these plots. Sufficient seed was produced from 61 of the inbred lines in a top crossing plot with Bomo Local in the irrigated nursery (1966/67) for a replicated yield trial (Table 10). Forty-two of the 61 topcrosses gave yields of over 5000 pounds per acre and five of this group averaged over 6000 pounds. These are remarkably good yields when compared with 4400 pounds for NS-1. Thirteen of the topcrosses lodged 10% or less.

Top Cross Trial
with lines from Biu Yellow

Exp. No. 5

In 1966 23 S_1 lines from Biu Yellow were planted in isolated plots of Bomo Local and Samaru Synthetic and the plants detasseled. A few of S_2 lines were topcrossed in the irrigated nursery 1966/67 to Bomo local. Topcross seed from 26 of these lines was planted in four replication, single row plots in 1967 (Table 11). Two replications were planted in field W-4 on June 2 and the other two in W-3 on June 9. The sums of the yields in replications one and two were 304.7 and 304.4 pounds and those in replications four and five were 289.9 and 297.8 pounds.

Since these lines and the pollinator parents were susceptible to rust the leaves on the plants were killed by the disease by mid-September. Yields were probably only slightly reduced since these top-cross hybrids nearly all tasseled in less than 60 days after planting and the grain had reached physiological maturity before the rust injured the plants.

NS-1 check, omitted from the table, tasseled in 71 days, silked in 77 days, had a plant height 300 cm, ear height 180 cm, and averaged 5028 pounds of grain.

Lines 1, 4, 11, 14 appear to be the best "Combiners". These top crosses as a group were superior to all other groups tested for resistance to root lodging.

Table 10. Yields and other agronomic data of topcrosses (Exp 6) of inbred lines from V-56, V-58, and V-10 with Bomo local. Samaru, Nigeria. 1967. Date planted; Reps. 1 & 2, June 2, Reps 3 & 4, June 1. Plot size 3 feet x 20 feet.

Line	Variety	Days to tassel	Days to silk	Height ear	Height plant	Stand Thinning	Stand Harvest	Lodging 1/	Lodging 2/	Ears Av/pl	Ears grain wt	Shelling	Yield per plot 12% moisture 1	2	3	4	Yield per acre
		no.	%	cm	cm	%	%	%	%	no.	lbs	%	lbs	lbs	lbs	lbs	lbs 3/
3	V-56	57	61	110	240	99	94	1	1	.99	.32	80	6.3	5.7	6.4	7.2	4646
18	V-58	62	66	130	250	90	82	8	0	1.12	.31	82	7.6	6.1	5.0	5.5	4392
45	V-10	70	75	160	270	90	72	28	9	.94	.21	76	3.6	2.8	2.5	3.7	2287
46	V-10	65	69	180	310	100	93	58	6	1.18	.34	81	8.5	7.8	7.4	8.5	5844
52	V-10	63	67	150	280	100	98	18	0	1.21	.34	78	9.8	8.9	7.8	7.3	6135
54	V-10	62	67	140	260	93	87	20	4	1.12	.27	79	5.5	6.0	5.3	5.1	3975
56	V-10	63	68	160	290	98	93	57	12	1.03	.28	81	7.4	4.8	5.4	5.0	4102
63	V-10	60	64	160	290	99	92	59	2	1.17	.33	82	8.3	7.7	6.2	7.9	5463
64	V-10	60	66	150	280	100	92	24	6	1.06	.33	81	8.5	6.2	6.0	6.4	4919
69	V-10	62	66	150	300	96	93	10	3	1.24	.36	80	8.6	8.4	9.5	8.4	6334
78	V-10	60	63	130	260	98	94	8	1	1.08	.36	82	7.6	5.6	6.4	8.7	5136
80	V-10	61	66	160	290	100	89	22	12	.97	.35	81	8.0	7.3	6.4	5.4	4919
83	V-10	59	64	170	280	100	94	21	8	1.01	.39	82	8.3	6.5	8.7	7.5	5627
91	V-10	61	66	150	270	98	88	8	8	1.16	.34	83	7.9	6.5	7.3	7.4	5282
103	V-10	64	68	150	290	98	88	24	3	1.00	.35	79	7.9	5.3	6.0	6.6	4683
104	V-10	62	67	170	290	98	96	10	2	1.10	.33	81	6.8	7.4	7.8	7.1	5282
107	V-10	62	67	150	280	86	77	4	0	.94	.34	80	6.4	5.3	4.0	5.3	3812
110	V-10	61	66	150	280	99	90	30	6	1.07	.36	80	9.0	8.1	6.0	6.2	5318
112	V-10	60	65	160	280	98	93	11	0	1.17	.35	82	9.7	7.4	7.8	7.4	5862
118	V-10	66	71	150	270	86	78	10	4	1.20	.19	78	3.2	4.1	4.6	4.6	2759
120	V-10	61	65	170	300	99	98	16	3	1.04	.38	79	8.6	8.5	6.7	8.2	5808
122	V-10	61	65	160	280	98	96	36	6	.96	.40	79	8.5	8.5	7.2	6.8	5627
123	V-10	61	66	150	290	96	92	23	3	1.26	.29	81	9.3	7.8	5.5	5.8	5155
126	V-10	56	62	170	280	98	98	16	9	1.25	.33	80	10.3	8.8	7.7	7.2	6171
132	V-10	60	65	150	280	98	96	21	8	1.27	.31	85	8.4	8.7	7.3	7.8	5844

Table 10. (cont'd.)

Line	Variety	Days to tassel	Days to silk	Height ear	Height plant	Stand Thinning	Stand Harvest	Lodging 1/	Lodging 2/	Ears Av/pl	Ears grain wt	Shelling	Yield per plot 15.5% moisture 1	2	3	4	Yield per acre 3/
		no.	%	cm	cm	%	%	%	%	no.	lbs	%	lbs	lbs	lbs	lbs	lbs
133	V-10	61	66	160	290	100	98	9	4	1.04	.37	80	8.1	9.0	6.4	7.7	5663
134	V-10	62	66	140	250	100	96	16	3	1.04	.37	77	6.5	5.1	6.7	8.0	4773
136	V-10	64	68	140	270	100	98	13	6	1.04	.28	80	7.1	4.1	7.3	5.7	4392
137	V-10	61	66	150	280	98	95	16	5	.96	.37	82	7.2	8.0	7.1	6.4	5209
149	V-10	60	64	160	300	99	90	32	6	1.03	.35	79	7.4	7.6	6.4	6.6	5082
150	V-10	65	68	150	280	99	92	27	5	1.07	.38	82	8.2	7.1	9.0	6.5	5590
151	V-10	60	65	150	290	100	100	19	7	1.10	.33	84	7.2	8.4	7.4	7.2	5481
152	V-10	62	66	150	290	96	93	9	0	1.23	.30	83	8.0	7.5	7.9	5.6	5264
164	V-10	65	67	170	300	100	96	30	5	1.05	.34	81	5.7	8.5	7.3	6.9	5155
165	V-10	64	68	170	300	99	95	23	5	1.08	.37	80	10.5	7.0	6.6	7.6	5754
166	V-10	60	64	160	300	100	99	35	3	1.04	.34	81	6.6	8.7	7.1	6.9	5318
172	V-10	60	65	140	250	100	93	17	8	.96	.30	80	6.0	8.0	7.6	5.7	4955
177	V-10	60	64	180	300	99	95	11	12	1.24	.29	80	7.3	7.4	7.1	7.3	5282
184	V-10	55	61	160	280	98	93	12	7	1.07	.37	82	9.4	7.4	7.5	6.3	5554
185	V-10	60	65	150	290	99	98	9	9	1.01	.35	82	7.7	8.6	6.0	6.5	5227
187	V-10	60	65	160	270	100	93	26	6	1.22	.32	80	7.3	6.1	8.8	7.8	5445
188	V-10	59	64	160	280	100	95	13	8	1.13	.28	82	6.5	6.6	6.2	6.2	4628
189	V-10	58	62	160	280	98	93	25	7	1.15	.36	83	9.1	8.7	7.3	7.1	5844
191	V-10	58	63	160	270	100	94	27	5	1.07	.33	80	8.3	7.4	6.4	5.3	4973
192	V-10	59	64	170	280	99	[illegible]	10	7	1.09	.38	83	9.3	9.0	8.2	5.6	5826
199	V-10	59	63	150	280	98	93	36	3	.96	.37	82	7.3	6.3	7.2	6.7	4991
200	V-10	57	62	160	290	99	92	36	2	1.06	.34	84	7.6	7.1	7.8	4.8	4955
201	V-10	59	63	160	280	100	96	12	3	1.04	.30	82	7.6	5.3	7.0	5.3	4574
202	V-10	58	62	160	290	98	94	19	6	.98	.37	78	7.5	7.5	6.9	6.5	5155
203	V-10	60	66	160	290	100	95	25	5	1.09	.34	80	7.8	6.5	7.6	7.5	5336

Table 10. (cont'd.)

Line	Variety	Days to tassel	Days to silk	Height ear	Height plant	Stand Thinning	Stand Harvest	Lodging 1/	Lodging 2/	Ears Av/pl	Ears grain wt	Ears Shelling	Yield per plot 12% moisture 1 lbs	2 lbs	3 lbs	4 lbs	Yield per acre 3/ lbs
207	V-10	59	64	150	280	99	96	25	5	1.01	.36	81	9.3	6.6	6.6	6.5	5264
219	V10	62	66	170	300	99	98	12	10	1.00	.43	79	10.8	8.3	8.3	7.8	6387
220	V10	60	64	160	300	98	93	7	1	1.15	.36	78	8.7	8.1	7.5	8.4	5935
223	V-10	61	65	180	280	95	93	30	4	1.00	.35	83	8.0	6.2	6.0	7.1	4955
233	V-10	59	63	150	280	99	98	3	14	.98	.37	82	9.4	7.8	7.1	5.6	5427
237	V-10	59	63	160	280	99	93	14	6	1.06	.36	80	8.5	9.1	6.6	5.3	5354
246	V-58	75	81	150	260	93	87	23	1	.60	.18	75	1.9	3.7	1.8	1.9	1683
248	V-58	58	62	140	270	100	94	6	1	1.13	.31	81	7.3	7.6	6.7	6.0	5009
252	V-58	61	66	170	290	100	100	7	3	1.05	.34	83	8.2	6.9	8.4	6.4	5427
258	V-58	61	65	170	290	100	95	13	2	1.07	.35	80	7.3	8.7	8.1	6.0	5463
292	V-59	60	64	160	290	100	93	4	3	1.04	.42	83	9.8	8.3	7.7	8.1	6153
NS-1	(Ck)	68	73	180	310	100	90	42	8	1.05	.26	77	3.9	4.8	6.8	5.6	4452

Lodging 1/ Root 2/ Broken stalks 3/ Yield of 4 rep. in lbs x 181.5 -- LSD .05 = 972 lbs, CV = 13.5%.

Table 11. Yields and other agronomic data from topcrosses of inbred lines from Biu Yellow and Bomo Local (BL) and Samaru Synthetic (SS) Samaru, Nigeria, 1967. Part of seed produced under irrigation (66/67) and remainder is isolated plots (1966). Date planted reps. 1-2 June 2 in field W-4, Reps. 3-4 June 9 in field W-3. Plot size 3x20 feet.

Entry	Source	Rep	Days to tassel	Days to silk	Height ear	Height plant	Stand Thinning	Stand Harvest	Lodging 13/9 1/	Lodging 13/9 2/	Ears Av pl	Ears grain wt	Shelling	Yield plot 12% moist. 1	Yield plot 12% moist. 2	Yield per acre	Average
			no.	no.	cm	cm	%	%	%	%	no.	lbs.	%	lbs	lbs	lbs 3/	
1 x BL	66/67	1-2	52	62	160	270	100	99	2	0	1.03	.35	82	7.4	7.4	5372	
		3-4	57	61	140	250	100	100	7	2	.95	.34	82	6.9	6.7	4937	5145
1 x BL	66	1-2	58	63	140	260	100	90	0	0	1.18	.30	84	6.6	6.8	4864	
		3-4	56	61	130	250	100	100	0	0	1.05	.33	79	7.1	7.4	5264	5064
1 x SS	66	1-2	51	62	140	260	93	95	2	0	1.13	.35	83	7.8	7.4	5518	
		3-4	53	57	130	250	95	90	8	0	1.05	.35	83	6.7	7.2	5046	5282
2 x BL	66	1-2	57	61	130	260	100	93	10	2	.95	.37	81	6.5	6.9	4864	
		3-4	61	61	130	240	88	88	0	0	1.00	.33	82	4.4	7.6	4356	4610
3 x BL	66	1-2	57	61	140	260	100	90	9	5	.84	.36	80	6.4	4.8	4066	
		3-4	58	61	130	250	90	90	7	2	.97	.24	80	4.7	4.2	3231	3649
3 x SS	66	1-2	63	68	130	250	82	82	30	0	1.09	.20	82	4.3	4.8	3303	
		3-4	58	63	130	230	98	98	5	0	.95	.29	83	5.9	5.3	4066	3684
4 x BL	66	1-2	58	62	140	280	98	98	12	0	.93	.31	82	5.7	5.9	4211	
		3-4	58	61	130	240	88	86	7	2	.94	.28	81	5.1	4.5	3485	3848
4 x SS	66	1-2	57	61	130	270	100	98	7	2	1.05	.36	84	7.6	7.9	5627	
		3-4	56	60	140	260	98	98	0	2	.90	.38	85	6.2	7.7	5409	5518
5 x SS	66	1-2	57	61	120	250	98	95	5	0	1.05	.34	84	7.1	6.9	5082	
		3-4	56	60	110	230	90	86	2	0	.92	.35	85	5.3	6.3	4211	4647
6 x BL	66	1-2	58	63	150	280	100	100	12	4	1.02	.30	81	6.3	6.4	4610	
		3-4	58	62	140	290	100	100	7	4	.86	.29	81	5.1	5.4	3812	4211
6 x SS	66	1-2	60	63	130	260	100	90	10	0	.95	.31	84	6.2	5.0	4066	
		3-4	57	61	130	250	88	88	2	0	.97	.30	81	5.1	5.3	3775	3921

Table 11. (cont'd.)

Entry	Source	Rep	Days to tassel	Days to silk	Height ear	Height plant	Stand Thinning	Stand Harvest	Lodging 13/9 1/	Lodging 13/9 2/	Ears Av pl	Ears grain wt	Ears Shelling	Yield plot 12% moist. 1	Yield plot 12% moist. 2	Yield per acre	Average
			no.	no.	cm	cm	%	%	%	%	no.	lbs.	%	lbs	lbs	lbs 3/	
8 x SS	66	1-2	59	62	130	260	100	95	2	0	1.03	.27	82	5.6	5.5	4029	
		3-4	53	58	120	250	88	86	0	0	.98	.35	84	6.7	5.6	4465	4047
9 x BL	66	1-2	57	61	140	260	100	98	10	10	1.03	.27	80	4.9	4.6	3485	
		3-4	56	60	140	250	100	100	4	4	.95	.26	81	4.8	5.7	3811	3648
9 x BL	66	1-2	59	62	130	250	100	98	2	5	1.13	.29	81	6.8	6.5	4828	
		3-4	57	60	140	240	88	88	10	2	.97	.29	80	5.5	4.9	3775	4301
9 x SS	66	1-2	58	62	140	260	98	95	10	5	1.08	.35	82	8.3	6.6	5409	
		3-4	57	60	140	280	100	98	11	2	.98	.32	82	6.6	6.0	4574	4991
10 x BL	66	1-2	59	63	140	250	93	88	11	0	1.00	.33	82	6.6	5.6	4428	
		3-4	57	61	140	260	90	90	4	0	.95	.34	84	6.3	5.8	4392	4410
11 x BL	66	1-2	54	59	140	250	95	93	2	15	1.10	.36	84	7.6	7.9	5627	
		3-4	57	62	140	260	98	98	12	0	.95	.33	77	5.9	7.0	4683	5155
11 x BL	66	1-2	57	61	140	280	100	100	15	0	.93	.33	81	7.2	5.5	4610	
		3-4	56	60	140	260	100	98	14	2	.95	.33	81	6.2	6.5	4610	4610
11 x SS	66	1-2	59	64	140	270	95	86	15	2	1.11	.35	83	6.2	7.7	5046	
		3-4	58	62	180	250	90	93	15	0	1.00	.35	83	5.5	8.2	4973	5010
12 x BL	66	1-2	58	62	130	260	98	86	5	2	1.06	.31	80	5.9	6.0	4320	
		3-4	55	62	120	240	93	76	0	0	1.12	.29	83	5.7	5.3	3993	4157
12 x SS	66	1-2	57	61	140	260	86	83	0	0	1.03	.31	82	5.5	5.8	4102	
		3-4	55	59	130	240	93	88	10	2	.92	.30	83	4.1	6.2	3739	3921
13 x BL	66	1-2	56	56	130	260	100	93	5	0	1.03	.26	79	5.6	4.9	3812	
		3-4	54	54	110	240	100	100	0	0	.97	.27	81	5.0	5.8	3920	3866

Table 11 (cont'd.)

Entry	Source	Rep	Days to tassel	Days to silk	Height ear	Height plant	Stand Thin-ing	Stand Harv-est	Lodging 13/9 1/	Lodging 13/9 2/	Ears Av pl	Ears grain wt	Shell-ing	Yield plot 12% 1	Yield plot moist. 2	Yield per acre	Aver-age
			no	no.	cm	cm	%	%	%	%	no.	lbs	%	lbs	lbs	lbs 3/	
14 x BL	66	1-2	58	61	150	270	100	98	2	7	1.02	.36	82	7.5	7.7	5518	
		3-4	57	61	140	260	100	100	2	0	1.00	.34	82	7.0	7.3	5191	5355
16 x BL	66	1-2	58	61	120	260	100	95	0	3	.98	.24	78	4.5	4.7	3340	
		3-4	57	62	130	240	100	95	0	0	1.05	.26	79	5.5	5.5	3993	3666
16 x SS	66	1-2	60	64	140	260	100	98	4	2	1.12	.27	81	6.3	6.0	4465	
		3-4	57	62	140	260	98	98	10	5	.98	.30	81	5.5	6.3	4283	4374
17 x BL	66	1-2	56	61	120	240	100	88	10	2	.95	.32	84	5.1	6.6	4247	
		3-4	56	63	130	240	93	93	0	0	1.00	.31	82	6.1	5.9	4356	4302
17 x SS	66	1-2	61	65	140	270	95	95	15	7	1.09	.31	84	4.8	7.6	4501	
		3-4	57	60	130	240	72	72	2	0	1.10	.34	83	5.1	5.6	3957	4229
18 x BL	66	1-2	58	61	130	240	98	98	20	2	1.08	.30	81	4.7	6.7	4138	
		3-4	58	63	130	230	100	93	15	0	1.08	.31	81	6.4	6.5	4683	4411
18 x BL	66	1-2	59	62	140	270	98	98	10	5	1.00	.26	81	5.1	5.6	3884	
		3-4	57	61	130	230	88	88	5	0	1.00	.28	81	5.5	4.6	3666	3775
18 x SS	66	1-2	59	64	130	240	98	90	5	2	1.00	.31	83	5.6	6.4	4356	
		3-4	57	61	130	250	95	76	7	2	.80	.35	84	6.1	5.2	4102	4229
19 x BL	66	1-2	58	62	140	270	98	98	15	6	1.03	.30	82	6.1	6.0	4392	
		3-4	55	60	140	260	93	93	0	0	.97	.29	81	5.6	5.6	4066	4229
19 x BL	66	1-2	56	60	110	240	98	93	3	0	1.03	.29	83	5.0	6.2	4066	
		3-4	54	58	110	240	88	86	0	0	1.00	.28	84	5.4	4.8	3703	3884
19 x SS	66	1-2	62	66	130	260	93	93	12	0	1.08	.26	82	5.6	5.0	3848	
		3-4	57	61	130	250	100	100	2	0	.93	.34	84	6.0	6.7	4610	4229
20 x BL	66	1-2	60	62	120	250	98	90	2	2	1.05	.30	79	5.6	6.2	4283	
		3-4	55	59	120	240	83	83	0	0	1.00	.30	80	5.6	5.5	4029	4229
20 x BL	66	1-2	60	65	110	240	93	80	14	0	1.09	.32	85	7.6	4.3	4320	
		3-4	56	61	140	250	88	88	7	2	1.06	.30	82	5.5	6.2	4247	4283

Table 11 (cont'd.)

Entry	Source	Rep	Days to tassel	Days to silk	Height ear	Height plant	Stand Thinning	Stand Harvest	Lodging 13/9 1/	Lodging 13/9 2/	Ears pl	Av grain wt	Shelling	Yield plot 12% moist. 1	Yield plot 12% moist. 2	Yield per acre	Average
			no.	no.	cm	cm	%	%	%	%	no.	lbs	%	lbs	lbs	lbs 3/	
21 x BL	66	1-2	58	62	130	250	98	93	10	2	1.10	.27	82	5.6	5.8	4138	
		3-4	62	64	120	230	100	98	7	2	1.00	.28	81	5.3	6.2	4175	4157
21 x BL	66	1-2	56	60	110	250	100	95	7	2	..98	.31	84	6.8	5.3	4392	
		3-4	54	57	130	250	98	93	9	0	.97	.32	83	6.1	6.2	4465	4428
21 x SS	66	1-2	54	59	120	240	100	95	7	0	.98	.33	89	6.8	6.0	4646	
		3-4	55	60	120	240	93	93	7	0	.90	.32	83	6.8	4.3	4029	4337
22-1xBL	66	1-2	60	64	150	290	100	95	25	10	1.00	.29	81.1	6.1	5.3	4138	
		3-4	56	61	150	270	98	98	15	0	.93	.35	81	5.7	7.5	4792	4465
22-3xBL	66	1-2	57	61	120	250	100	95	0	0	.98	.28	79	5.0	6.0	3993	
		3-4	55	58	140	260	98	98	2	0	1.07	.25	78	4.7	6.5	4066	4030
22 x BL	66	1-2	58	62	120	240	98	93	15	0	1.03	.30	81	6.4	5.4	4283	
		3-4	58	61	130	250	93	93	0	2	.92	.28	81	5.9	4.3	4703	4493
22 x SS	66	1-2	58	62	150	270	100	98	0	0	.98	.32	89	6.7	6.2	4683	
		3-4	57	61	140	260	95	90	2	0	1.08	.35	83	6.6	7.4	5082	4882
23 x BL	66	1-2	57	62	130	250	100	98	12	7	1.00	.27	81	5.4	5.2	3848	
		3-4	55	59	130	240	80	80	7	2	1.18	.28	80	5.4	5.9	4102	3975
23 x SS	66	1-2	58	62	120	230	100	90	22	7	1.08	.35	81	7.4	6.7	5118	
		3-4	54	58	130	240	100	100	0	4	.98	.33	84	5.9	7.4	4828	4973
105 x BL	66	1-2	58	63	150	240	100	--	15	7	1.14	.28	80	4.9	6.9	4283	
		3-4	56	60	130	230	100	--	7	2	1.00	.26	81	5.1	5.4	3848	4065
101 x BL	66	1-2	57	61	150	270	98	98	2	0	1.05	.32	82	6.3	7.5	5009	
		3-4	57	61	130	240	100	100	0	0	1.00	.32	80	6.5	6.9	4864	4937
108 x BL	66	1-2	56	60	120	260	100	98	7	0	.93	.29	82	5.8	5.2	3993	
		3-4	53	58	140	260	93	88	10	0	1.06	.32	83	7.1	5.3	4501	4247
110 x BL	66	1-2	57	62	130	260	98	93	7	2	.95	.32	82	5.7	6.3	4356	
		3-4	56	60	130	270	93	88	2	0	1.06	.27	83	6.4	4.1	3812	4084
111 x BL	66	1-2	56	60	140	250	93	78	2	0	.94	.29	82	3.3	4.9	2977	
		3-4	56	60	130	240	100	86	2	2	.97	.25	81	4.6	4.2	3194	3086

Lodging 1/ Root 2/ Broken stalks. 3/Yield of 2 plots x 363 LSD .05 = 805 lbs. CV = 13.1%

Date of Harvest

Exp. No. 12

Mexico-5 was used for this trial in 1965 and 1966 but due to a shortage of seed NS-1 was substituted this year (Table 12). This trial is of interest in demonstrating the development of the crop from tasseling to maturing and the nitrogen content in the component parts of the plant. Six weeks after tasseling the grain yield of immature kernels was 1246 pounds per acre while two weeks later the kernels were fully developed and the grain yield was 3750 pounds, a 3-fold increase.

The nitrogen content of the grain at the last harvest was about 50% of the total in the plant. The total nitrogen in the crop at second harvest was 104 pounds per acre and only an additional 7 pounds was present in the crop four weeks later. The total nitrogen applied to this trial during the season was about 90 pounds which suggests that there was residual nitrogen in the soil at planting time.

Date of Planting

Exp. No. 10

A date of planting trial has been conducted each year for the past three with similar results. The first planting has given the highest yields. Yields are reduced as planting is delayed. The reduction in yield is due to reduce ear size and more barren stalks.

The experimental design has been a randomized plot using 4 row plots from which the center rows are harvested for yield. This design no doubt penalizes the later dates because of the effects of shading. The design of the experiment will be modified in 1968 and more entries included.

Spacing Trial

Exp. No. 13

This test (Table 14) has been conducted for three years with similar results each year. It may be concluded that as long as plant population per acre are about the same similar yields can be expected if plantings are one plant spaced each foot of row, or two plants every two feet or three plants each three feet. If this trial is to be continued, the length of rows will be increased and end plants discarded at harvest so that exactly the same number of plants are harvested per plot.

Table 12. Yield and nitrogen content of stalks, leaves, ears and grain of NS-1 harvested at four 2-week intervals beginning at tasseling (Exp. 12) Samaru, Nigeria. 1967. Plot size 5 rows x 20 feet from which 40 competitive plants were harvested. Planted May 31. 1/

Date harvested	Rep	STALKS Green	DM	Dry	Pct. total	Protein	N	LEAVES Green	DM	Dry	Pct. total	Protein	N
		lbs	%	lbs		%DB	%	lbs	%	lbs		%DB	%
8/8	1	81.8	15.6	12.8	72	5.4	0.87	24.7	20.4	5.0	28	13.9	2.23
	2	79.0	14.8	11.7	70	5.4	0.86	23.8	20.4	4.9	30	14.5	2.32
	3	76.0	14.4	10.9	66	6.6	1.05	24.5	22.9	5.6	34	14.6	2.34
	Av	78.9	14.9	11.8	69	5.8	0.93	24.3	21.2	5.2	31	14.4	2.30
8/22	1	65.3	20.0	13.1	52	4.5	0.72	24.7	25.0	6.2	25	12.3	1.97
	2	55.0	19.6	10.8	50	3.5	0.56	23.9	27.0	6.5	30	13.4	2.14
	3	66.3	20.1	13.3	49	3.6	0.57	25.5	25.1	6.4	24	13.4	2.15
	Av	62.2	19.9	12.4	51	3.9	0.62	24.7	25.7	6.3	62	13.1	2.09
9/5	1	54.3	21.6	11.7	43	2.9	0.47	20.7	28.0	5.8	21	10.0	1.60
	2	56.0	20.7	11.6	43	3.7	0.59	24.4	25.4	6.2	23	11.4	1.83
	3	55.8	21.4	11.9	41	2.7	0.43	29.4	29.0	8.5	29	10.0	1.60
	Av	55.4	21.2	11.7	42	3.1	0.50	24.8	27.4	6.8	25	10.5	1.68
9/19	1	41.0	28.2	11.6	38	2.3	0.38	13.3	41.3	5.5	18	7.3	1.16
	2	42.3	27.4	11.6	35	1.8	0.29	15.1	46.5	7.0	21	7.1	1.13
	3	40.0	23.5	9.4	32	3.4	0.54	15.5	37.8	5.9	20	7.9	1.27
	Av	41.1	26.4	10.9	35	2.5	0.40	14.6	41.9	6.1	20	7.4	1.19

1/ DM = Dry matter DB = Dry basis

Table 12. (cont'd.)

Date harvested	Rep	EARS WITH HUSKS Green	DM	Dry	Pct. total	Protein	N	GRAIN Plot 12%DB	Protein DB	N DB	Yield grain 12%DM	acre total DB	Nitrogen/acre grain	DB total
		lbs	%	lbs		%DB	%	lbs	%	%	lbs			
8/8	1													
	2													
	3													
	Av											6171		83
8/22	1	33.5	16.9	5.7	23	7.8	1.25							
	2	30.6	14.8	4.5	21	9.9	1.58							
	3	40.0	18.5	7.4	27	7.3	1.16							
	Av	34.7	16.7	5.8	24	8.3	1.33					8894		104
9/5	1	36.8	25.9	9.5	35	7.8	1.25	4.2	11.1	1.77				
	2	33.1	27.8	9.2	34	7.2	1.15	3.4	12.3	1.96				
	3	26.8	31.6	8.5	29	9.3	1.48	2.7	11.1	1.78				
	Av	32.2	28.4	9.1	33	8.1	1.29	3.4	11.5	1.84	1246	10019	20	105
9/19	1	30.0	45.0	13.5	44	8.4	1.34	9.0	10.4	1.67				
	2	31.6	47.4	15.0	45	7.9	1.27	11.8	10.4	1.67				
	3	27.8	50.2	14.0	48	8.4	1.34	10.2	11.2	1.79				
	Av	29.8	47.5	14.2	46	8.4	1.34	10.3	10.7	1.71	3751	11326	56	111

Table 13. Results from a date of planting trial (Exp 10) using NS-1 maize variety, Samaru, Nigeria, 1967. Plot size 12 feet x 20 feet, center 2 rows harvested.

Date planted	Days to tassel	Days to silk	Height ear	Height plant	Stand Thinning	Stand Harvest	Lodging 9/9 1/	Lodging 9/9 2/	Ear Av/pl	Ear grain wt	Shelling	Yield per plot 1	Yield per plot 2	Yield per plot 3	Yield per acre 3/
	no.	no.	cm	cm	%	%	%	%	no.	lbs	%	lbs	lbs	lbs	lbs
5/31	65	69	350	190	99	94	5	9	1.08	.33	86	14.1	13.6	15.2	5070
6/7	73	76	360	200	99	93	17	2	.90	.25	79	9.1	9.1	8.5	3231
6/14	--	--	340	200	98	91	13	5	1.08	.17	73	6.3	7.2	7.8	2577
6/21	--	--	340	200	98	87	22	9	.78	.13	64	3.6	2.7	5.2	1392

Lodging 1/ Root, 2/ Broken 3/ Yield of 3 plots x 121

Fertilizer - 30 pounds of nitrogen applied:
First planting - June 24, July 11
Second planting - June 24, July 11
Third Planting - July 11, July 21
Fourth Planting - July 21, Aug. 1

The results of this trial are of interest to the extension workers since the labor in hand planting is only about half if two seeds are dropped each two feet as compared with one seed dropped each foot.

"Root Strength" Trial

Exp. No. 4

Dr. J. Craig produced a composite, 011 from the varieties EAFRO 231, Es-1, Tsolo, EAFRO 271 Br. 155, EAFRO 237, Diacol V153, Miss. 6002, Miss. 6004 and Metro. Selection has been for yellow grain. He has used this composite to test the potential value of a simple mechanical device which measures the pounds of pull required to up-root maize plants for selecting against root lodging.

The following lots of seed were supplied for trial at Samaru

011 - original pan-mictic bulk
042 - seed of plants selected for root strength, 1st cycle
047 - seed of plants selected for weak roots
048 - seed of plants selected for root strength, 2nd cycle
049 - random sample of progeny of 042

The trial was planted with NS-1 as a check in 4-row plots replicated three times (Table 15). The notes taken following the September 10 wind storm are in line with what we had hoped for. The readings taken on October 5 were 30% root lodging for 011, 19% for the 1st cycle and about the same for the 2nd cycle, and 46% for 047 which was selected for weak roots. NS-1 had a reading of 49% root lodging. Selection for root strength did not improve yield but the composite yielded significantly better than NS-1. The composite was about 6 days earlier in tasseling than NS-1 with ear and plant height about the same. One can conclude from this trial that it should be easy to select a new composite which will be superior to NS-1 for yield and root strength.

Time and Rate of Application of Nitrogen

Exp. No. 11

Relatively few fertilizer trials have been conducted in the "north" with maize. In order to have a better understanding how to manage the research plots, a "time of application of nitrogen" study was started in 1965. In 1965 and 1966 the maize variety, Mexico-5 was used. The site was given a preplant application of 3 tons of farmyard manure and 200 cwt of super phosphate in 1965

Table 14. Yields and other agronomic data from a maize spacing trial (Exp 13) Samaru, Nigeria. 1967. Variety, NS-1. Planted May 31, harvested Oct. 21. Plot size 12 feet x 20 feet. center 2 rows harvested for yield.

Spacing	Stand Thinning	Stand Harvest	Population per acre	Lodging 21/10	Ears Av. pl	Ears grain wt	Yield per plot 12% moisture 1	2	3	4	5	6	Yield per acre
	%	%	M	%	no.	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs 3/
1 plant at 1 foot	99	98	15.2	31	1.02	.29	12.6	13.4	10.3	12.2	11.1	12.9	4386
2 plants at 2 feet	100	99	16.0	23	1.00	.32	13.2	13.7	12.4	16.0	14.0	14.6	5015
3 plants at 3 feet	96	95	17.4	19	.98	.27	13.7	11.0	11.0	11.4	11.7	14.4	4429

1/ Yield of 6 plots x 60.5

LSD .05 = 409 lbs CV = 7.7 %

Table 15. Yields and other agronomic data from "Root strength" Test (Exp. 4) Samaru, Nigeria 1967. Date planted, June 2. Plot size, 12 feet x 20 feet, data from center two rows.

Entry	Days to tassel	Days to silk	Height ear	Height plant	Stand Thinning	Stand Harvest	Lodging (%) Sept. 13 1 1/	1 2/	2 1/	2 2/	3 1/	3 2/	Av 1/	Av 2/	Oct. 5 1 1/	1 2/	2 1/	2 2/	3 1/	3 2/	Av 1/	Av 2/
	no.	no.	cm	cm	%	%																
011	63	69	300	170	94	93	3	0	20	0	2	5	15	2	5	5	45	8	41	13	30	9
042	63	67	300	180	94	89	10	0	9		11	14	10	8	12	0	17	3	28	14	19	6
047	65	70	300	170	97	94	24	3	18	5	21	2	21	3	34	5	39	5	64	5	46	5
048	63	68	300	170	94	92	0	3	3	3	8	0	4	2	8	10	13	11	14	5	20	5
049	63	68	300	170	98	94	3	5	16	5	5	0	8	3	8	20	36	5	18	5	21	10
NS-1	69	73	310	180	98	96	46	3	24	7	15	10	28	7	59	3	50	7	39	10	39	7

Table 15. (cont'd.)

Entry	Shelling	Ears Av plant	Ears grain wt	Yield per plot 12% moisture 1	2	3	Yield per acre
	%		lbs	lbs	lbs	lbs	lbs 3/
011	85	1.15	.33	16.8	13.3	14.0	5336
042	83	1.21	.32	14.6	13.9	15.2	5288
047	82	1.18	.32	16.1	15.9	13.3	5481
048	83	1.16	.31	13.5	15.1	13.4	5082
049	83	1.09	.32	13.5	13.2	14.9	5034
NS-1	78	1.11	.25	11.2	9.0	12.2	3920

Lodging 1/ Root 2/ Broken stalks Yield of three replications x 121
LSD = .05 817 lbs, CV = 10%

and 1966. The treatments included (1) check (no nitrogen), (2) 20 pounds of nitrogen applied at thinning (three weeks after planting), (3) 30 pounds of nitrogen at thinning plus 30 pounds five weeks later and (4) 30 pounds of nitrogen at thinning plus 30 pounds five weeks later plus 30 pounds at the time of silking. In both years the largest increase came from the application of the 30 pounds at time of thinning; the second application gave a significant increase, but the 30 pounds applied at tasseling gave little or no response.

The trial planted in 1967 included the variety NS-1, similar in maturity to Mexico-5 and hybrid (C-10 x Biu Yellow) Table 16. C-10 is a Columbian introduction (Cub. 325 x USA 342)-4 x Discol V 254) and Biu Yellow, a yellow dent selection from a composite of U. S. hybrids. The variety-hybrid had not been previously tested and was used because of an ample seed supply. Prior to planting the field received an application of mixed fertilizer 10:20:0 at a rate of 140 pounds per acre.

The hybrid being earlier in maturity was able to give a greater yield response to the initial fertility in the soil than the variety. The hybrid had a yield advantage over the variety of 38, 21, 17 and 27% for treatments A, B. C, and D respectively. The yield increase over the control for the variety was 17, 44 and 39% for treatments B, C, and D while the increase for the hybrid was 3, 22, and 28%.

The experiment was planted in a latin design using five replications. The plot arrangement was the same in the first and fourth replications. The variety and hybrid were in paired plots for each treatment.

In order to use all of the information in the statistical analysis the trial was analyzed as a split plot, randomized block experiment. The analysis of variance was as follows:

Source of variation	Degrees of freedom	Sum of squares	Mean squares	F
Replications	4	2.57	0.66	NS
Nitrogen	3	97.00	32.33	11.30**
Error (a)	12	34.34	2.86	
Whole plot total	19	133.91		
Varieties	1	86.14	86.14	51.74**
Variety x Nitrogen	1	3.54	1.16	HS
Error (b)	16	26.64	1.67	
Total	39	250.23		

Table 16. Yields and other agronomic data from a date and rate applicating nitrogen (Exp. 11) to a maize variety and a variety hybrid, Samaru, Nigeria 1967. Date planted, June 1, date harvested October 5. Plot size 12 feet x 20 feet.

Treat-ment	Entry	Height ear	Height plant	Stand Thinning	Stand Harvest	Lodging 1/	Lodging 2/	Shelling	Ears Av/pl	Ears grain wt
		cm	cm	%	%	%	%	%		lbs
A	NS-1	190	360	98	95	29	14	77	1.00	.23
	C-10 x Biu Yell.	130	290	98	95	14	3	81	.93	.35
B	NS-1	190	350	100	96	21	5	77	.95	.29
	C-10 x Biu Yell.	140	290	99	95	11	3	83	.98	.34
C	NS-1	210	360	99	98	29	5	79	1.11	.29
	C-10 x Biu Yell.	150	310	98	97	13	10	82	.92	.42
D	NS-1	200	350	99	98	24	11	78	1.04	.30
	C-10 x Biu Yell.	130	320	99	96	11	9	81	1.03	.39

Table 16. (cont'd.)

Treat-ment	Entry	Protein %DB	Yield per plot 12% moisture 1	2	3	4	5	Yield per acre
		%	lbs	lbs	lbs	lbs	lbs	lbs 3/
A	NS-1	9.1	10.0	8.1	9.0	8.8	10.9	3398
	C-10 x Biu Yell.	8.3	12.9	10.2	15.3	10.5	15.6	4683
B	NS-1	9.4	9.7	9.3	12.7	11.4	11.6	3971
	C-10 x Biu Yell.	8.4	13.3	13.5	11.3	14.2	14.1	4821
C C	NS-1	9.3	13.0	14.8	13.5	12.5	13.3	4871
	C-10 x Biu Yell.	9.3	17.2	16.7	15.2	16.7	13.0	5721
D	NS-1	11.4	12.8	13.3	12.0	14.3	12.1	4704
	C-10 x Biu Yell.	10.2	16.9	15.5	16.5	16.8	16.7	5982

Lodging 1/ Leaning 2/ Broken 3/Yield of 5 plot x 72.6
Fertilizers used: All plot received 140 lb/acre of 20:20:0 preplant
A control B 30 pound of N June 15 C 30 pound of N June 15 + 30 pounds of N July 21 D 30 pound of N June 15 + 30 pounds of N July 21 + 30 pounds of N Aug. 1.

BREEDING WORK

The main emphasis is being placed on the development of composites which may be used in recurrent selection programs to develop better adapted varieties for the area.

The first "blend" of three composites was planted in 1966. The second "cycle" was grown this season. Selection was based on plants resistant to rust, good standability, with an ear height less than 5 feet and ears with husks which tightly enclosed the tip of the ears.

The composition of the three composites were given in the 1966 report as follows:

Composite 1. Biu Yellow x Mexico-5
Mexico-5 x C-8
Mexico-5 x C-18
Mexico-5 x C-31

Composite 2. F_1 is involving C-5, C-8, C-10, C-12, C-16, C-18, C-30, C-31, C-33, and Biu Yellow.

Composite 3. Biu Yellow x C-8
Biu Yellow x C-18
Biu Yellow x C-25

A composite of the selections made this year will be intercrossed among themselves and with three varieties in the 1967/68 irrigated nursery. The crosses will be grown with their parents in 1968.

Resistance to root lodging is a major breeding objective and brachytic gene is being added to Composite 1 and 3. Seed of brachytic lines GT 112 D, L 578 D, MP 444 D, and MP 462 D was obtained from Mississippi. Short rows of these lines as well as Kitale Dwarf from Kenya were grown with the two composites and detasseled. We were surprised to observe that the Mississippi lines tasseled later than the composites. The seed from these rows will be planted in the irrigated nursery and the plants will be selfed or sibbed. A blend of the selfed or sibbed seed will again be planted with the two composites in 1968 and the plants detasseled. Plants with the desired agronomic characteristics will be selected and the cycle will be repeated.

Three lines with opaque-2 (high lysine) are being handled the same as the brachytic material. We hope to be able to separate the opaque-2 kernels from the normal in the sibbed and selfed ears harvested from the irrigated nursery. Two of the lines identified as

NS-1 x O_2 sib and V-1 x O_2 Sib were obtained from Dr. Henry Wiggin, Ibadan and the third line came from Dr. Rossman of Michigan State Universith. The later line is reported to have twice the normal lysine and 50% more tryptophan.

In addition to the three composites mentioned above, a plot of Bulk-2 from Dr. Wiggin was planted and ears were selected from agronomically desirable plants.

In 1966 another composite started by blending seed of several introductions from Kenya was discarded because of too few plants in the plot. A similar composite was again made up this year. Seed increase plots of Bomo Local, Mexico-5 and NS-1 were grown.

A limited program of inbreeding is being continued with V-10, V-56, V-58 and Biu Yellow. All of the lines were included in a top cross nursery with Bomo Local as the pollinator.

Nearly 100 introductions are being maintained by mass pollination. These were planted in a top cross nursery with Bomo Local on August 12. If the rains had extended into October as expected, a good crop would have developed from this late planting. Since the last effective rain fell on September 28 some varieties failed to set seed. One variety, EAFRO 269 was outstanding in its ability to grow and produce good ears when other lines of similar maturity were near failures.