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To the Graduate Council:

I am submitting herewith a thesis written by Charles E. Freeman entitled "The Effect of Potassium Fertility Levels on the Uptake and Utilization of Potassium, Calcium, and Magnesium by Corn Inbreds and Hybrids." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agronomy.

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THE EFFECT OF POTASSIUM FERTILITY LEVELS ON THE
UPTAKE AND UTILIZATION OF POTASSIUM, CALCIUM,
AND MAGNESIUM BY CORN INBREDS AND HYBRIDS

A Thesis
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Master of Science

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Charles E. Freeman

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CHAPTER I

INTRODUCTION

The purpose of this investigation was to determine some of the effects different rates of potassium fertilization have on the uptake and utilization of potassium, calcium, and magnesium by corn inbreds and hybrids. The relationships between the uptake of these chemical elements and yield, lodging, premature senescence, and stalk strength were also studied.

CHAPTER II

REVIEW OF LITERATURE

Corn is the marvel plant of present-day commercial agriculture in the United States. As the leading grain crop, it occupies more choice land than any other plant (14).¹ In Tennessee one-third of all commercial fertilizer used on the farm was used for production of corn in 1959 (15). With high fertilization and the use of hybrids, yields have increased tremendously in the last twenty years.

Many new hybrids are being released, but often a sufficient quantity of seed is not available for all farmers who want to try the new hybrid. The greatest limitation in the production of hybrid seed corn is the low yielding inbred strains which are the foundation stock of all hybrid corn. Under optimum conditions most inbreds will produce between 25 and 35 bushels per acre,² but under adverse conditions there will probably be no seed produced. Krantz and Harvey (21) found that early stimulation is extremely important in seed stock production. They obtained a significant increase in plant height prior to tasseling by application of 1,000 pounds of 8-8-8 fertilizer, but no significant increase for 2,000 pounds. There was no fertilizer injury on either of the high rates, which indicates a need for a different fertilization program for inbreds and hybrids.

¹Numbers in parentheses refer to references in the literature cited, pages 77-79.

Thomas, Baker, and Gorsline (31) found that the accumulation of calcium, magnesium, and phosphorus by inbred lines 30-35 days after silking gave a reasonable measure of the accumulation by hybrids involving those lines. They believed that potassium would show a better relationship if sampled nearer the date of silking. Hanaway (13) found that there was less variation in the different plant leaves at silking time than any other stage.

Several investigators (8, 9, 10, 20, 23, 24) have found evidence which would suggest a selective breeding program for the genetically controlled variation in chemical element concentration as a physiological mechanism to control such things as uptake of chemical elements, diseases, stalk strength, and resistance to lodging. Gorsline, Ragland, and Thomas (8) found that a differential ear leaf accumulation of calcium, magnesium, and potassium existed for inbreds and single crosses. They stated that "this differential accumulation was highly inherited on essentially an additive basis in respect to calcium and magnesium, but included non-additive elements for potassium."

Diagnosis of the nutrient status of plants has been carried out by sampling different plant parts. Tyner (32) and Nelson (23) gave the following reasons for selecting the sixth leaf during full silk:

- (a) The stage is easily recognized.
- (b) The weight of vegetative parts approaches a maximum at this stage.
- (c) Nutrient demands are at a peak.
- (d) Most varieties mature in about the same number of days after full silk.

Baker et al. (1) carried on an experiment to ascertain whether the sixth leaf needed any cleaning treatment. They concluded that the changes were not great enough to warrant the use of any cleaning procedure. Thomas' et al. (31) work was in agreement with Baker's with two exceptions. They found that if the ear leaves were near the ground or were being analyzed for iron or aluminum they should be cleaned. Hanaway (14) and many others (3, 12, 20, 27) used the entire plant, divided different ways for diagnosis of deficiency symptoms. Magnistiski (22) suggested the use of the leaf midrib instead of the entire blade.

Nelson (23) found a high positive correlation between the amount of N, P and K in corn leaves at silking time and the yield of grain. Yield of grain was a function of total leaf area and leaf area was a function of the amount of nutrients which the plant had taken up and used (11). Since both leaf area and leaf duration were important in producing the potential yield of grain, any factor which reduces either leaf area or duration will have some effect on the yield produced. Hanaway (11) reported that nitrogen and potassium deficiencies resulted in premature dying of several lower leaves. The translocation of nutrients from the leaves to the grain does not seem to reduce the yield unless premature death of the leaves results from the translocation.

Wittels and Seatz (33) established a critical value for potassium in corn leaves at 1.5 per cent 60 days after planting and 1.7 per cent in later stages of growth. Other investigators (20, 28) have reported that the percentage of potassium decreased throughout the growing season. Tyner's (32) critical value for the sixth leaf at full silk was 1.3 per

cent potassium, and yields changed 2.05 ± 0.93 bushels per acre for each 0.1 per cent change from the critical value.

The per cent potassium in corn leaves and leaf sheaths varied more than any other part of the plant (13). This was especially true early in the season, but tended to disappear near maturity, and differences in leaf content of potassium will probably not be reflected in the mature grain (20, 23). The maximum differences in the leaves were found near silking time. Potassium demands by the plant were greatest 10 days before silking and continued for 3 weeks after silking.

Several investigators (3, 12, 23, 28) have reported a loss of potassium from the leaves which began about silking time and continued until maturity. Sayre (28) believed that the potassium was returned to the soil by the root system whereas Nelson (23) attributed the loss to leaching by rain or dew. At all stages of plant growth the potassium content of the plant reflected the amount of available potassium in the soil (30, 33).

Large concentrations of any one ion in the soil solution will cause decreases in the uptake of certain other ions, and actually may have a "toxic effect." This "toxic effect" can sometimes be overcome by increasing the concentration of one or more other ions (26). There have been many reports (2, 25, 26), of potassium deficiency symptoms appearing after heavy applications of lime on soils where the potassium supply was adequate before the lime was added. When the nutrients are out of balance, yields will be reduced, and additional fertilizer beyond that normally needed will have to be applied to restore the

nutrient balance. Stanford, Kelly, and Pierre (30) and York, Bradfield, and Peech (34) and others reported additions of potassium depressed the uptake of calcium and magnesium, but lime tended to increase absorption of magnesium according to York et al. (34). Beasley (2) reported magnesium deficiency symptoms in corn on the Cumberland Plateau and attributed the deficiencies to: (a) low levels of exchangeable magnesium in the soil, and (b) application of calcitic limestone and fertilizers which had no magnesium carriers. Sommer, Wear, and Baxter (29) found that the amount of magnesium in Chilean Nitrate of Soda and in muriate of potash was sufficient to benefit corn and that superphosphate furnished an adequate amount. Key and Kurtz (17) found that the magnesium content of the vegetative parts of corn increased as the amount of magnesium fertilizer increased. Sommer et al. (29) found no correlation whereby crop responses could be predicted from the magnesium content of the soil.

Foy and Barber (6) reported yields were not reduced by plants showing magnesium deficiency symptoms. In this particular study the supply of magnesium in the plants showing deficiency symptoms was adequate for non-chlorophyll functions and full chlorophyll production was not necessary for the yield permitted by other factors.

Several causes of stalk breakage have been reported. Koehler (18) found that thicker planting, and any factor which causes the plant to prematurely die will increase stalk breakage. Josephson (16) found that plots with no applied potassium had significantly more dead stalks and more stalk breakage at harvest 3 years out of 4. Correlations between

per cent dead stalks and stalk breakage was significant at the .01 level of probability. Koehler (18) suggests that after the plant dies, stalk rot is probably the cause of most breakage. He established whether there was premature dying in inbreds and hybrids by removing some of the leaf sheaths about one foot above the ground and observing whether the stalk was bright green or blanched. To be able to compare premature dying in hybrids and inbreds, one should use the same number of days after silking. Wittels and Seatz (33) reported marked reductions in stalk breakage by additions of 20 and 40 pounds of K_2O per acre, but no further decrease with higher rates of potassium. Krantz and Chandler (20) found that on low potassium soils increments above 80 pounds of K_2O per acre had no effect on lodging or yield. Two investigators (5, 33) found that the N:K ratio was very important in reducing stalk breakage. Both stalk breakage and premature dying were greatly increased when 200 pounds of nitrogen and no potassium were applied.

Pierre and Bower (26) found the iron content of corn nodes higher when plants were deficient in potassium. This iron tends to block translocation and diseases may develop which weaken the stalk and cause lodging.

Zuber and Dicke (35) found a high correlation between stalk lodging resistance of corn with a thick rind and a high crushing strength. They used a two-inch section and determined the crushing strength with a hydraulic press. Hybrids differed greatly in amount of pressure necessary to crush the two-inch section.

CHAPTER III

METHODS AND PROCEDURES

The four inbreds, six possible single cross combinations, and three permutations of Dixie 29 and Tennessee 604 hybrids were grown on a Hartsells soil low in "available" potassium at the Plateau Experiment Station, Crossville, Tennessee, in 1961, 1962, and 1963. The four inbreds making up Dixie 22 and the hybrid Dixie 22 were also included in the study.

Hartsells soils are well drained and developed from acid sandstone and sandy shale. The pH and natural fertility are both low and bedrock is usually at a depth of two to four feet. The soil has good physical properties and responds well to fertilization.

The average result of six soil samples taken at random over the experimental area was: pH 5.6, 22 pounds of available phosphorus per acre, and 67 pounds of exchangeable potassium per acre. All potassium values were very low which made this an ideal sight for the experiment.

The amount of potassium applied to the main plots is shown in Table 1. In addition, the entire experimental area received a broadcast application of 80 pounds P_2O_5 and 150 pounds N per acre each year. Twenty pounds of $ZnSO_4$ was added in 1962 and 1963, and two tons of ground limestone were added in 1962.

Before the grain was harvested in 1961, soil tests were made which showed that the hybrids had removed more potassium than the inbreds,

TABLE 1. Potassium soil test results in pounds of K per acre and K₂O added to three potassium levels for three years at Crossville, Tennessee

Soil sampling Date	0 K ₂ O level				40 K ₂ O level				120 K ₂ O level			
	Soil test		Pounds		Soil test		Pounds		Soil test		Pounds	
	Pounds K/acre		K ₂ O added/acre		Pounds K/acre		K ₂ O added/acre		Pounds K/acre		K ₂ O added/acre	
	Inbreds	Hybrids	Inbreds	Hybrids	Inbreds	Hybrids	Inbreds	Hybrids	Inbreds	Hybrids	Inbreds	Hybrids
June 4, 1961			0	0			40	40			120	120
June 30, 1961	77	77			93	93			150	150		
Oct., 1961	79	65			102	81			120	87		
May 4, 1962			0	0			40	60			120	150
Oct., 1962	77	71			104	87			134	125		
May 8, 1963			0	0			40	40			120	120

and the amount of potassium added in 1962 was adjusted to bring the available potassium on the inbred and hybrid main plots to the same level. Soil tests made in the fall of 1962 showed that potassium levels on the hybrid and the inbred plots were almost equal, and the same amount of potassium was added to the hybrids and inbreds in 1963.

The experimental design was a modified split plot with three replications. Potassium levels were the main plots and varieties were the split plots. The main plots were 42 x 119 feet and the split plots were 80 inches x 19 feet. The split plot entries were grown in 2-row plots 19 feet long with 40 inches between rows. This gave 13,068 plants per acre.

The inbred, single-cross, and double-cross varieties planted are shown in Table 2. Two border rows on each side and border plots on each end were planted to Dixie 29.

The date and days after planting for specific field operations are given in Table 3.

Yields were determined by harvesting all plots and recording the weight in the field in 1961 and 1963. All plots did not have a uniform stand in 1962, and a definite number of individual guarded plants were harvested. A sample was taken from each plot and moisture determined on a Steinlite. Field grain weights were adjusted to 15.5 per cent moisture and then converted to bushels of shelled corn per acre.

TABLE 2. Inbred and hybrid varieties of corn and their groupings grown at Crossville, Tennessee, 1961, 1962, and 1963

Inbred	Grouping	Hybrid	Grouping
T101 T105 T111 T115	Inbreds in Dixie 29	T101 x T105 T101 x T111 T101 x T115 ^a T105 x T111 ^a T105 x T115 T111 x T115	Single-cross combinations of Dixie 29
		Dixie 29A Dixie 29B ^a Dixie 29C ^a	Double-cross hybrid (T115 x T111) x (T105 x T101) (T101 x T111) x (T115 x T105) (T115 x T101) x (T105 x T111)
T218 T220 T222 T224	Inbreds in Tenn. 604	T218 x T220 T218 x T222 ^a T218 x T224 ^a T220 x T222 ^a T220 x T224 ^a T222 x T224	Single-cross combinations of Tenn. 604
		Tenn. 604A Tenn. 604B ^a Tenn. 604C ^a	Double-cross hybrid (T222 x T224) x (T218 x T220) (T218 x T222) x (T224 x T220) (T218 x T224) x (T220 x T222)
T202 T204 NC 7 CI.21	Inbreds in Dixie 22	Dixie 22	Double-cross hybrid (T202 x T204) x (NC 7 x CI.21)

^aVarieties not grown in 1961 due to non-availability of seed.

TABLE 3. Date and days after planting for specified field operations for corn inbreds and hybrids grown at Crossville, Tennessee, in 1961, 1962 and 1963

Operation	1961				1962				1963			
	Inbreds	Days after planting	Hybrids	Days after planting	Inbreds	Days after planting	Hybrids	Days after planting	Inbreds	Days after planting	Hybrids	Days after planting
Planting	June 5		June 5		May 5		May 5		May 9		May 9	
Sampling full stalk									June 24	46	June 24	46
Sampling ear leaf	Aug. 21	78	Aug. 21	78	Aug. 2	89	Aug. 13	100	Aug. 5	88	Aug. 14	97
Sampling at maturity	Sept. 25	113	Sept. 25	113	Sept. 11	129	Sept. 11	129	Sept. 11	125	Sept. 11	125
Dead stalk count	Oct. 25	143	Oct. 25	143	Sept. 11 Oct. 2	129 150	Sept. 11 Oct. 2	129 150	Sept. 30 Oct. 15	144 159	Sept. 16 Sept. 30	130 144
Lodged stalk count	Nov. 16	165	Nov. 16	165	Oct. 2	150	Oct. 2	150	Oct. 7	151	Oct. 7	151
Harvest	Nov. 16	165	Nov. 16	165	Oct. 18	166	Oct. 18	166	Oct. 8	152	Oct. 15	159

I. CHEMICAL ANALYSIS

The sampling procedure for the ear leaves consisted of taking the leaf below the lowest ear from three plants selected at random in each plot. All ear leaf samples were dried in a forced air oven at 70 C. The dried samples were ground in a Wiley mill and stored in air-tight bottles until analyzed.

The full stalk samples taken near maturity were cut into four component parts which were as follows:

1. Upper 1/3 of corn plant (included stalk leaves and tassel).
2. Middle 1/3 of corn plant.
3. Lower 1/3 of corn plant.
4. Ear (included grain, cob, shuck, and ear shank).

These component parts were run through a forage chopper which cut the parts into approximately one-half inch pieces. The chopped samples were collected in paper bags and dried in a forced air oven. The dried samples were ground in a Wiley mill and stored in bottles until analyzed.

Two modifications of the wet oxidation procedure of Gieseking, Snider, and Getz (7) were used for ashing all samples. Detailed analytical procedures used in this study are shown in Appendices A and B.

Potassium and calcium content of the samples were determined with a Beckman DU flame spectrophotometer equipped with a photomultiplier. Magnesium was determined by using a Perkin-Elmer atomic absorption spectrophotometer. The two instruments were calibrated with known concentrations of the elements being determined. The sample readings

were compared with the standard solution calibration curves and the composition of the sample calculated.

II. MEASUREMENT OF PHYSICAL AND AGRONOMIC CHARACTERISTICS

Stalk breakage was obtained by counting all stalks which were broken below the highest ear. A stalk was considered root lodged when the stalk was leaning more than forty-five degrees. In this study there was very little root lodging and it was combined with stalk breakage.

Premature senescence was determined by removing some of the leaf sheath from the first internode above the ground and observing whether the stalk was green or blanched.

The two internodes above the brace roots were taken at harvest to determine the stalk crushing strength and rind thickness. The internodes were air dried and sawed into two-inch sections using a saw with dual blades spaced two inches apart. The crushing strength was determined with a hydraulic press and reported in pounds of pressure necessary to crush the two-inch section vertically. A 1/4-inch section of the rind was taken after the section had been crushed to determine the rind thickness. The pith was removed by scraping with a knife and the thickness determined by a micrometer and reported in thousandths of an inch. Five samples per internode were taken on two replications in 1962.

CHAPTER IV

RESULTS

I. YIELDS OF INBREDS

Yield data for inbreds are summarized in Table 4. All data were subjected to analyses by statistical procedures as outlined by Cochran and Cox (4).

The yields of inbreds were generally much lower than single or double cross hybrids. This is due to the genetic makeup and not to environment or fertility.

In 1961 a comparison of the 0 pounds K_2O treated plots with those receiving 40 or 120 pounds K_2O per acre showed a significant¹ yield difference. The least significant difference in yield at the .05 level was 8 bushels.

A larger increase in yield from 40 or 120 pounds of K_2O per acre was obtained in 1962 than in 1961. There was a highly significant difference between the 0 pounds K_2O plot and those receiving K_2O .

The 1963 yield data showed the smallest inbred average of the three years studied. There was a highly significant difference between the means of the 0 pound K_2O level and the 40 and 120 pound K_2O level.

¹"Significant" will refer to differences at the 0.05 level of probability and "highly significant" will refer to differences at the 0.01 level of probability unless otherwise specified.

TABLE 4. Yield of corn in bushels per acre for 12 inbreds grown at 3 levels of potassium fertilization for 3 years

Corn Inbred	0 pounds K ₂ O per acre			40 pounds K ₂ O per acre			120 pounds K ₂ O per acre			Variety average		
	1961	1962	1963	Avg.	1961	1962	1963	Avg.	1961	1962	1963	Avg.
T101	16 ^a	2	5	8	26	26	18	23	27	32	35	31
T105	14	9	1	8	22	34	15	24	29	36	17	27
T111	16	15	5	12	16	19	14	16	32	18	16	22
T115	19	3	2	8	25	28	25	26	37	39	32	36
T218	15	10	5	10	28	46	21	32	33	21	32	32
T220	16	0	6	7	36	44	37	39	47	60	50	52
T222	7	9	8	8	17	46	30	31	24	44	39	36
T224	6	0	1	2	12	15	10	12	29	37	15	27
T202	19	19	9	16	22	21	18	20	27	39	30	32
T204	16	3	4	8	20	6	14	13	21	26	20	22
NC7	15	9	20	15	19	18	30	22	27	25	33	28
CI.21	16	9	7	11	28	35	29	31	30	39	39	36
Average	14	7	6	9	23	28	22	24	30	36	30	32
L. S. D. (.05) for potassium means 8 13 4 4												
(.01) for potassium means N.S. 21 7 7												
for inbred means 7 N.S. 9												
for inbred means 10 N.S. 12												

^aAll figures represent an average of 3 replications.

A highly significant difference between inbreds was found in 1961 and 1963, and a highly significant potassium x inbred interaction was observed for each of the three years.

II. YIELDS OF HYBRIDS

Hybrid yields are summarized in Table 5.

The 1961 yields are reported for only 9 of the 19 hybrids because seed was not available for the others. A comparison of the means of the 0 pound K_2O plots with those receiving 40 and 120 pounds K_2O per acre showed a highly significant difference between the levels of added potassium.

The hybrid averages were lower in 1962 than either of the other years on the plots with applied potassium. A comparison of the potassium levels shows a significant yield increase by the addition of 40 and 120 pounds K_2O per acre.

In 1963, 40 pounds of K_2O applied per acre more than doubled the yield of the 0 pound K_2O treatment. There was a highly significant yield difference between levels of K_2O .

There was a highly significant difference among hybrids for each of the three years, but no significant potassium x hybrid interaction for any year.

TABLE 5. Yield of corn in bushels per acre for 19 hybrids grown at 3 levels of potassium fertilization for 3 years

Corn Hybrid	0 pounds K ₂ O per acre			40 pounds K ₂ O per acre			120 pounds K ₂ O per acre			Variety average						
	1961	1962	1963	Avg.	1961	1962	1963	Avg.	1961	1962	1963	Avg.				
T101 x T105	72 ^a	64	59	65	89	89	109	96	102	101	133	112	88	84	101	91
T101 x T111	77	70	68	72	92	80	126	99	101	100	128	110	90	84	107	94
T101 x T115		56	39	48		82	102	92		90	142	116		76	94	85
T105 x T111		80	66	73		94	100	97		94	107	101		89	91	90
T105 x T115	54	49	24	42	85	82	88	85	104	86	109	100	81	72	74	76
T111 x T115	69	59	39	56	100	91	114	102	117	125	114	119	95	92	89	92
Dixie 29A	80	64	55	66	101	90	102	98	113	103	124	113	98	86	94	93
Dixie 29B		69	39	54		88	106	97		98	122	110		85	90	88
Dixie 29C		63	35	49		88	112	100		89	116	103	100	80	88	84
T218 x T220	81	55	59	65	101	86	130	105	118	96	139	118	100	79	109	96
T218 x T222		59	45	52		84	118	101		111	125	118		85	96	91
T218 x T224		50	30	40		68	73	71		85	87	86		67	63	65
T220 x T222		78	64	71		91	116	104		102	140	121		90	107	99
T220 x T224		58	38	48		88	101	95		103	127	115		83	89	86
T222 x T224	65	65	50	60	98	89	103	97	96	98	129	108	86	84	94	88
Tenn. 604A	75	70	42	62	97	88	103	96	112	95	123	110	95	84	89	89
Tenn. 604B		68	48	58		93	114	104		106	126	116		89	96	93
Tenn. 604C		62	45	54		86	106	96		94	125	110		81	92	87
Dixie 22	83	76	78	79	109	84	126	106	122	86	130	113	105	82	111	99
Average	73	64	49	59	97	86	108	97	109	98	124	110	93	83	93	89
L. S. D. (.05) for potassium means	12	17	9	1961	1962	1963	1961			1962			1963			
(.01) for potassium means	19	N. S.	15	12	17	9	for hybrid means			8			10			
				19	N. S.	15	for hybrid means			11			13			

^aAll figures represent an average of 3 replications.

III. MINERAL COMPOSITION

Full Stalk Composition 46 Days after Planting

The summary of potassium, calcium, and magnesium content of corn inbreds and hybrids 46 days after planting for 1963 are given in Tables 6 and 7. The per cent potassium increased and calcium and magnesium decreased as applied K_2O increased for all varieties. Almost three times as much potassium was found in plants growing where 120 pounds of K_2O per acre had been applied as where no K_2O was applied. Potassium, calcium, and magnesium each gave a highly significant difference between K_2O levels. A highly significant difference between variety means for all three elements for both inbreds and hybrids was found.

IV. COMPOSITION OF CORN EAR LEAF

The summary of potassium, calcium, and magnesium contents of corn ear leaf samples collected at silking time are given in Tables 8 to 13. A large variation in the per cent potassium was found in inbreds for 1961, 1962, and 1963. The year 1962 was uniformly lower for all three K_2O levels. The same was true for hybrids with the exception of the 120 pound K_2O level where the average per cent potassium was greater in 1962 than in 1961. A highly significant difference between potassium levels was found during all three years for inbreds and hybrids. Variety means had a significant or highly significant difference for both inbreds and hybrids with the exception of 1962 where no significant difference was found between hybrids.

TABLE 6. Per cent potassium, calcium, and magnesium in corn tissue 46 days after planting for 12 inbreds grown at 3 levels of potassium fertilization in 1963

Corn Inbred	Potassium				Calcium				Magnesium			
	Pounds K ₂ O applied per acre				Pounds K ₂ O applied per acre				Pounds K ₂ O applied per acre			
	0	40	120	Avg.	0	40	120	Avg.	0	40	120	Avg.
T101	1.28 ^a	2.03	3.45	2.26	.75	.63	.48	.62	.63	.43	.30	.45
T105	1.42	2.97	4.23	2.87	1.40	1.03	.92	1.12	.93	.67	.50	.70
T111	1.05	2.00	2.78	1.94	.53	.37	.28	.39	.68	.38	.28	.45
T115	1.05	2.13	3.23	2.14	.75	.48	.37	.53	.83	.47	.32	.54
T218	1.48	2.40	3.43	2.44	1.20	.75	.65	.87	1.00	.55	.42	.66
T220	1.15	2.35	3.07	2.19	.75	.57	.52	.61	.70	.45	.38	.51
T222	1.23	2.10	3.35	2.23	.65	.53	.30	.49	.65	.50	.30	.48
T224	1.15	1.82	3.33	2.10	.83	.65	.40	.63	.57	.45	.30	.44
T202	1.23	2.28	3.78	2.43	.90	.68	.48	.69	.75	.38	.27	.47
T204	1.08	1.78	3.10	1.99	.45	.35	.30	.37	.53	.37	.25	.38
NC7	1.32	2.63	4.80	2.92	.90	.65	.45	.67	.72	.47	.32	.50
CI. 21	1.18	2.33	3.35	2.29	1.10	.72	.57	.80	.85	.52	.47	.61
Average	1.22	2.24	3.49	2.32	.85	.62	.48	.65	.74	.47	.34	.52
L. S. D. (.05) for K ₂ O levels					Potassium Calcium Magnesium					Potassium Calcium Magnesium		
(.01) for K ₂ O levels					.12	.05	for inbred means		.46	.12	.10	
					.20	.09	for inbred means		.63	.17	.14	

^aAll figures represent an average for 3 replications.

TABLE 7. Per cent potassium, calcium, and magnesium in corn tissue 46 days after planting for 19 hybrids grown at 3 levels of potassium fertilization in 1963

Corn Hybrid	Potassium				Calcium				Magnesium			
	Pounds K ₂ O applied per acre				Pounds K ₂ O applied per acre				Pounds K ₂ O applied per acre			
	0	40	120	Avg.	0	40	120	Avg.	0	40	120	Avg.
T101 x T105	1.50 ^a	2.15	4.57	2.74	.78	.77	.50	.68	.73	.65	.35	.58
T101 x T111	1.20	2.03	3.93	2.39	.58	.47	.37	.47	.70	.47	.28	.48
T101 x T115	1.07	1.78	3.68	2.18	.73	.60	.45	.59	.82	.57	.35	.58
T105 x T111	1.65	1.70	3.85	2.40	.58	.52	.43	.51	.65	.55	.37	.52
T105 x T115	1.05	2.17	3.83	2.35	.83	.67	.53	.68	.92	.57	.40	.63
T111 x T115	1.23	2.07	3.27	2.19	.53	.42	.35	.43	.73	.48	.33	.51
Dixie 29A	1.47	1.65	3.92	2.34	.53	.55	.40	.49	.73	.62	.33	.56
Dixie 29B	1.22	1.45	4.05	2.24	.65	.50	.43	.53	.82	.58	.30	.57
Dixie 29C	.98	1.73	3.63	2.12	.67	.62	.43	.57	.85	.60	.33	.59
T218 x T220	1.18	1.77	3.83	2.26	.80	.65	.50	.65	.87	.63	.37	.62
T218 x T222	.92	1.77	3.62	2.10	.70	.60	.43	.58	.93	.62	.33	.63
T218 x T224	1.18	1.75	3.32	2.08	.90	.82	.63	.78	.82	.62	.40	.61
T220 x T222	1.20	1.57	3.12	1.96	.53	.45	.42	.47	.63	.48	.37	.49
T220 x T224	1.12	1.67	3.65	2.14	.63	.57	.47	.56	.70	.48	.30	.49
T222 x T224	1.18	1.80	3.52	2.17	.62	.57	.40	.53	.70	.52	.28	.50
Tenn. 604A	1.02	1.68	3.18	1.96	.70	.58	.47	.58	.77	.60	.38	.58
Tenn. 604B	1.12	1.98	3.60	2.23	.78	.63	.43	.61	.85	.53	.33	.57
Tenn. 604C	1.00	1.90	3.23	2.04	.70	.60	.45	.58	.85	.58	.35	.59
Dixie 22	1.42	2.10	3.62	2.38	.63	.57	.45	.55	.68	.50	.37	.52
Average	1.20	1.83	3.65	2.23	.68	.59	.45	.57	.78	.56	.34	.56
Potassium Calcium Magnesium												
L. S. D.	(.05) for K ₂ O levels	.37	.04		.11			for hybrid means	.34		.07	.08
	(.01) for K ₂ O levels	.61	.06		.18			for hybrid means	.45		.09	.11

^aAll figures represent an average for 3 replications.

TABLE 8. Per cent potassium in corn ear leaf tissue for 12 inbreds grown at 3 levels of potassium fertilization for 3 years

Corn Inbred	0 pounds K ₂ O per acre			40 pounds K ₂ O per acre			120 pounds K ₂ O per acre			Variety average		
	1961	1962	1963	Avg.	1961	1962	1963	Avg.	1961	1962	1963	Avg.
T101	.80 ^a	.52	.68	.67	1.10	.77	1.22	1.03	1.60	1.33	1.90	1.61
T105	.83	.42	.57	.61	.98	.97	1.52	1.16	1.38	1.45	1.93	1.59
T111	.92	.50	.65	.69	1.48	.92	1.30	1.23	1.75	1.33	1.75	1.61
T115	.80	.20	.52	.51	.85	.52	1.20	.86	1.32	1.08	1.77	1.39
T218	1.02	.42	.73	.72	1.05	.83	1.38	1.09	1.43	1.48	2.27	1.73
T220	.95	.45	.70	.70	1.45	1.10	1.63	1.39	1.68	1.87	2.15	1.90
T222	1.18	.47	.78	.81	1.43	.82	1.43	1.23	1.82	1.33	2.00	1.72
T224	.68	.28	.62	.53	.78	.52	1.15	.82	1.32	1.03	1.88	1.41
T202	1.07	.50	.97	.85	1.47	.97	1.67	1.37	1.88	1.53	2.20	1.87
T204	.82	.45	.53	.60	1.13	.80	1.32	1.08	1.43	1.40	2.03	1.62
NC7	1.58	.57	1.02	.96	1.73	1.08	1.80	1.54	2.05	1.83	2.42	2.10
CI. 21	.87	.45	.60	.64	.93	.80	1.22	.98	1.47	1.17	1.88	1.51
Average	.96	.43	.70	.69	1.20	.84	1.40	1.15	1.59	1.40	2.02	1.67
L. S. D. (.05) for potassium means (.01) for potassium means	1961 .21 .35	1962 .17 .28	1963 .17 .28		1961 .21 .35	1962 .17 .28	1963 .17 .28		1961 for inbred means for inbred means	1962 .14 .19	1963 .12 .16	

^aAll figures represent an average of 3 replications.

TABLE 9. Per cent potassium in corn ear leaf tissue for 19 hybrids grown at 3 levels of potassium fertilization for 3 years

Corn Hybrid	0 pounds K ₂ O per acre			40 pounds K ₂ O per acre			120 pounds K ₂ O per acre			Variety average		
	1961	1962	1963 Avg.	1961	1962	1963 Avg.	1961	1962	1963 Avg.	1961	1962	1963 Avg.
T101 x T105	.62 ^a	.47	.67	.59	.85	.93	.95	.85	.93	1.05	1.00	1.18
T101 x T111	.77	.60	.75	.71	1.08	1.20	1.14	1.15	1.20	1.14	1.10	1.18
T101 x T115		.45	.57	.51	.90	.90	.90		.90		.98	1.03
T105 x T111		.63	.78	.71	.83	1.13	.98		1.13		1.04	1.27
T105 x T115	.68	.43	.57	.56	.95	1.27	1.02		1.27	.99	1.02	1.21
T111 x T115	.65	.55	.50	.57	1.23	1.15	1.10		1.15	1.02	1.07	1.17
Dixie 29A	.67	.62	.65	.65	.92	1.05	.97		1.05	1.04	1.06	1.23
Dixie 29B		.65	.58	.62	.97	1.03	1.00		1.03		1.01	1.19
Dixie 29C		.47	.57	.52	1.05	1.03	1.04		1.03		1.08	1.17
T218 x T220	.77	.50	.58	.62	1.12	1.25	1.22		1.25	1.21	1.24	1.38
T218 x T222		.43	.60	.52	1.10	1.40	1.25	1.75	2.10		1.09	1.37
T218 x T224		.58	.65	.62	1.32	1.18	1.25	1.93	2.15		1.28	1.33
T220 x T222		.60	.77	.69	1.02	1.20	1.11	1.68	1.97		1.10	1.31
T220 x T224		.45	.57	.51	1.25	1.23	1.24	1.72	2.13		1.14	1.31
T222 x T224	.62	.60	.63	.62	1.13	1.07	1.13	1.42	2.10	1.09	1.16	1.27
Tenn. 604A	.73	.60	.58	.64	1.10	1.02	1.05	1.77	1.85	1.18	1.18	1.18
Tenn. 604B		.57	.65	.61	.93	1.23	1.08		1.65		1.05	1.28
Tenn. 604C		.53	.47	.50	.98	1.13	1.06		1.68		1.07	1.17
Dixie 22	.85	.62	.75	.74	1.30	1.52	1.23	1.63	1.53	1.26	1.01	1.41
Average	.71	.54	.63	.61	1.06	1.16	1.09	1.56	1.68	1.11	1.09	1.25
L. S. D. (.05) for potassium means	1961			1962			1963			1961	1962	1963
(.01) for potassium means	.17			.11			.12			.28	N. S.	.18
				.28			.19			.37	N. S.	N. S.
										for hybrid means		
										for hybrid means		

^aAll figures represent an average of 3 replications.

TABLE 10. Per cent calcium in corn ear leaf tissue for 12 inbreds grown at 3 levels of potassium fertilization for 3 years

Corn	0 pounds K ₂ O per acre				40 pounds K ₂ O per acre				120 pounds K ₂ O per acre				Variety average			
	1961	1962	1963	Avg.	1961	1962	1963	Avg.	1961	1962	1963	Avg.	1961	1962	1963	Avg.
Inbred																
T101	.72 ^a	1.02	.75	.83	.83	1.02	.82	.89	.77	.87	.83	.82	.77	.97	.80	.85
T105	1.20	1.07	.93	1.07	1.10	1.22	.83	1.05	1.08	.97	.90	.95	1.13	1.08	.86	1.02
T111	.50	.72	.60	.61	.40	.67	.38	.48	.38	.40	.37	.38	.43	.59	.45	.49
T115	.68	.87	.68	.74	.87	.85	.67	.80	.60	.68	.55	.61	.72	.80	.63	.72
T218	.95	.75	.90	.87	.92	.83	.88	.88	.77	.48	.65	.63	.88	.69	.81	.79
T220	1.27	1.15	1.15	1.19	1.08	1.28	.87	1.08	.82	1.02	.95	.93	1.06	1.15	.99	1.07
T222	.67	.83	.80	.77	.68	.73	.55	.65	.50	.55	.50	.52	.62	.71	.62	.65
T224	.70	.93	.78	.80	1.08	.93	.63	.88	.77	.65	.52	.65	.85	.84	.64	.78
T202	.98	1.20	.98	1.05	.83	1.13	.70	.89	.68	.77	.67	.71	.83	1.03	.78	.88
T204	.40	.43	.42	.42	.33	.45	.27	.35	.33	.35	.30	.33	.36	.41	.33	.37
NC7	.80	.85	.68	.78	.73	.82	.45	.67	.63	.60	.43	.55	.72	.76	.52	.67
CI. 21	1.10	1.10	1.02	1.07	1.08	1.17	.83	1.03	.85	1.02	.78	.88	1.01	1.09	.88	.99
Average	.83	.91	.81	.85	.83	.92	.66	.80	.68	.70	.61	.66	.78	.84	.69	.77
L. S. D. (.05) for potassium means	1961				1962	1963										
(.01) for potassium means	N.S.				N.S.	.18										
	N.S.				N.S.	N.S.										
							</									

TABLE 11. Per cent calcium in corn ear leaf tissue for 19 hybrids grown at 3 levels of potassium fertilization for 3 years

Corn Hybrid	0 pounds K ₂ O per acre			40 pounds K ₂ O per acre			120 pounds K ₂ O per acre			Variety average			
	1961	1962	1963	Avg.	1961	1962	1963	Avg.	1961	1962	1963	Avg.	
T101 x T105	1.22 ^a	1.07	.98	1.09	1.13	1.17	1.02	1.11	1.02	.83	.93	.93	.93
T101 x T111	.78	.85	.68	.77	.67	.67	.57	.64	.57	.53	.47	.52	.52
T101 x T115		1.12	.97	1.05		1.13	.92	1.03		.80	.97	.89	.89
T105 x T111		.87	.87	.87		.72	.72	.72		.55	.52	.54	.54
T105 x T115	1.18	1.10	.98	1.09	1.20	1.17	.87	1.08	.98	.80	.95	.91	.91
T111 x T115	.85	.77	.75	.79	.78	.65	.67	.70	.53	.47	.45	.48	.48
Dixie 29A	1.02	.87	.85	.91	1.00	.82	.82	.88	.73	.62	.60	.65	.65
Dixie 29B		.98	.88	.93		.85	.88	.87		.63	.53	.58	.58
Dixie 29C		.90	1.07	.99		.80	.83	.82		.55	.63	.59	.59
T218 x T220	1.30	1.08	1.17	1.18	1.10	.93	.95	.99	.82	.68	.82	.77	.77
T218 x T222		1.05	1.12	1.09		1.02	.73	.88		.58	.65	.62	.62
T218 x T224		1.08	1.13	1.11		1.07	.90	.99		.85	.72	.79	.79
T220 x T222		.90	.98	.94		.87	.80	.84		.68	.57	.63	.63
T220 x T224		.98	1.05	1.02		1.03	.83	.93		.60	.58	.59	.59
T222 x T224	1.07	.78	.98	.94	.98	.82	.88	.89	.65	.53	.65	.61	.61
Tenn. 604A	1.08	1.05	1.02	1.05	1.13	.88	.83	.95	.65	.73	.68	.69	.69
Tenn. 604B		1.13	1.02	1.08		1.00	.98	.99		.68	.78	.73	.73
Tenn. 604C		1.07	.90	.99		.87	.90	.89		.73	.72	.73	.73
Dixie 22	.80	1.03	.88	.90	.90	.77	.72	.80	.73	.57	.75	.68	.68
Average	1.03	.98	.96	.99	.99	.91	.83	.89	.74	.65	.68	.68	.68
L. S. D. (.05) for potassium means	1961			1962			1963			1961			1963
(.01) for potassium means	N. S.			.10			N. S.			.10			.14
	N. S.			.17			N. S.			.13			.19
				for hybrid means			for hybrid means						

^aAll figures represent an average of 3 replications.

TABLE 12. Per cent magnesium in corn ear leaf tissue for 12 inbreds grown at 3 levels of potassium fertilization for 3 years

Corn Inbred	0 pounds K ₂ O per acre			40 pounds K ₂ O per acre			120 pounds K ₂ O per acre			Variety average		
	1961	1962	1963	Avg.	1961	1962	1963	Avg.	1961	1962	1963	Avg.
T101	.70 ^a	.77	.85	.77	.48	.57	.50	.52	.37	.35	.56	.55
T105	.85	.75	.78	.79	.67	.58	.47	.57	.62	.43	.59	.61
T111	.47	.70	.68	.62	.35	.35	.27	.32	.23	.17	.41	.38
T115	.50	.68	.77	.65	.52	.45	.43	.47	.32	.23	.46	.46
T218	.58	.77	.83	.73	.52	.58	.53	.54	.43	.27	.54	.52
T220	.83	.95	.98	.92	.50	.60	.47	.52	.37	.28	.61	.59
T222	.62	.90	.85	.79	.38	.45	.42	.42	.28	.27	.54	.50
T224	.68	.55	.63	.62	.52	.50	.42	.48	.28	.22	.42	.44
T202	.60	.87	.75	.74	.40	.57	.38	.45	.32	.32	.58	.49
T204	.45	.60	.48	.51	.30	.40	.28	.33	.27	.17	.39	.35
NC7	.47	.85	.68	.67	.40	.57	.38	.45	.28	.25	.56	.45
CL.21	.95	.88	.88	.90	.65	.65	.53	.61	.53	.45	.71	.65
Average	.64	.77	.77	.73	.47	.52	.42	.47	.36	.28	.49	.50
L. S.D. (.05) for potassium means (.01) for potassium means	1961			1962	1963	for inbred means			1961	1962	1963	
	.07			.07	.07	for inbred means			.11	.09	.10	
	.12			.12	.11				.15	.11	.13	

^aAll figures represent an average of 3 replications.

TABLE 13. Per cent magnesium in corn ear leaf tissue for 19 hybrids grown at 3 levels of potassium fertilization for 3 years

Corn Hybrid	0 pounds K ₂ O per acre			40 pounds K ₂ O per acre			120 pounds K ₂ O per acre			Variety average		
	1961	1962	1963	1961	1962	1963	1961	1962	1963	1961	1962	1963
			Avg.			Avg.			Avg.			Avg.
T101 x T105	1.02 ^a	.93	.96	.60	.63	.70	.64	.35	.33	.69	.64	.66
T101 x T111	.72	.70	.71	.43	.38	.45	.42	.18	.18	.49	.42	.44
T101 x T115		.93	.94		.50	.70	.60	.27	.32		.57	.66
T105 x T111		.63	.77		.37	.47	.42	.22	.23		.41	.45
T105 x T115	.82	.83	.84	.65	.47	.47	.53	.27	.32	.64	.52	.56
T111 x T115	.78	.72	.81	.50	.30	.47	.42	.22	.18	.52	.41	.53
Dixie 29A	.80	.72	.88	.60	.42	.62	.55	.23	.20	.58	.46	.57
Dixie 29B		.83	.90		.40	.65	.53	.23	.18		.49	.54
Dixie 29C		.80	.85		.40	.57	.49	.20	.27	.61	.47	.53
T218 x T220	.83	.95	1.03	.58	.48	.67	.58	.22	.28		.55	.64
T218 x T222		.93	1.03		.48	.52	.50	.22	.23		.54	.59
T218 x T224		.77	.83		.37	.48	.43	.25	.20		.46	.49
T220 x T222		.80	.86		.48	.50	.49	.27	.22		.52	.53
T220 x T224		.78	.85		.42	.45	.44	.25	.23		.48	.51
T222 x T224	.92	.70	.78	.52	.37	.57	.49	.20	.22	.54	.42	.50
Tenn. 60A	.88	.80	.87	.73	.43	.63	.60	.23	.27	.62	.49	.57
Tenn. 60B		.83	.91		.55	.55	.55	.23	.27		.54	.57
Tenn. 60C		.90	1.02		.50	.67	.59	.28	.23		.56	.62
Dixie 22	.62	.75	.75	.50	.50	.45	.48	.38	.27	.50	.51	.51
Average	.81	.81	.93	.57	.44	.56	.51	.36	.24	.58	.50	.55
L. S. D. (.05) for potassium means			1961			1963				1961	1962	1963
(.01) for potassium means			.11		.14	.07				.14	.10	.13
			.19		.23	.12				N. S.	.13	N. S.
								for hybrid means				
								for hybrid means				

^aAll figures represent an average of 3 replications.

Very little difference in the per cent calcium was found in the ear leaf tissue for the 0 and 40 pound K_2O levels in 1961 and 1962, but in 1963 the per cent calcium found in plants from the 40 pound K_2O level decreased in the hybrids and decreased greatly in the inbreds. There was a significant difference between the 0 and 120 pound potassium level for the inbreds in 1962 and 1963, but no significant difference was found in 1961. No significant difference occurred between K_2O levels in the hybrids in 1961 or 1963, but in 1962 a highly significant difference was found between the 0 and 120 pound level. Variety means were highly significant for all three years. In the inbreds, T220 contained almost three times as much calcium as T204.

Potassium fertilization greatly decreased magnesium content in both inbreds and hybrids for all three years. A significant or highly significant difference was found between both K_2O levels and variety means for inbreds and hybrids and for all three years. The three-year average of the hybrids shows less than one-third as much magnesium in the plants from the 120-pound K_2O plots as from the plots receiving no potassium fertilization.

V. COMPOSITION OF THE MATURE CORN PLANT

The per cent potassium, calcium, and magnesium in a mature corn plant with and without the ear are found in Tables 14 through 25 for both inbreds and hybrids. The per cent potassium found in the plant increased with each increment increase of K_2O applied. There was a highly significant difference between the 0 and 120 pound K_2O level for

TABLE 14. Per cent potassium in a mature corn plant (omitting ear) for 12 inbreds grown at 3 levels of potassium fertilization for 3 years

Corn Inbred	0 pounds K ₂ O per acre			40 pounds K ₂ O per acre			120 pounds K ₂ O per acre			Variety average		
	1961	1962	1963	Avg.	1961	1962	1963	Avg.	1961	1962	1963	Avg.
T101	.74 ^a	.35	.64	.58	1.00	.70	.92	.87	1.19	.90	1.43	1.17
T105	.49	.35	.47	.44	.64	.37	.63	.55	.98	.75	1.30	1.01
T111	.71	.31	.47	.50	.72	.39	.67	.59	1.07	.86	.87	.93
T115	.56	.36	.35	.42	.55	.41	.65	.54	.82	.67	.85	.78
T218	.91	.33	.59	.61	.84	.57	.83	.75	1.15	1.30	1.94	1.46
T220	.64	.35	.55	.51	.89	.63	1.11	.88	1.46	1.37	1.53	1.45
T222	.79	.35	.49	.54	.74	.50	.67	.64	1.40	.92	1.23	1.18
T224	.60	.38	.48	.49	.52	.30	.62	.48	1.10	.59	.92	.87
T202	.71	.39	.62	.57	.95	.65	.84	.81	1.39	.86	1.39	1.21
T204	.61	.32	.45	.46	.69	.39	.62	.57	1.01	.72	1.17	.97
NC7	.70	.40	.53	.54	.82	.46	.83	.70	.98	.82	1.47	1.09
CI. 21	.55	.37	.48	.47	.71	.40	.78	.63	.87	.94	1.10	.97
Average	.67	.36	.51	.51	.76	.48	.76	.67	1.12	.89	1.27	1.09
L. S. D. (.05) for potassium means	1961			1963	1961			1963	1961			1963
(.01) for potassium means	.13			.09	.19			.26	.19			.26
	.22			.15	.26			.36	.26			.36
					for inbred means				for inbred means			
					.19				.26			
					N.S.				N.S.			

^aAll figures represent an average of 3 replications.

TABLE 15. Per cent potassium in a mature corn plant (including ear) for 12 inbreds grown at 3 levels of potassium fertilization for 3 years

Corn Inbred	0 pounds K ₂ O per acre				40 pounds K ₂ O per acre				120 pounds K ₂ O per acre				Variety average			
	1961	1962	1963	Avg.	1961	1962	1963	Avg.	1961	1962	1963	Avg.	1961	1962	1963	Avg.
T101	.77 ^a	.42	.66	.62	.97	.70	.88	.85	1.15	.84	1.29	1.09	.96	.65	.94	.85
T105	.55	.41	.54	.50	.69	.40	.68	.59	.91	.69	1.16	.92	.72	.50	.80	.67
T111	.67	.40	.50	.52	.68	.41	.65	.58	.97	.81	.81	.86	.77	.54	.65	.65
T115	.59	.43	.46	.49	.61	.43	.64	.56	.82	.65	.85	.77	.67	.50	.65	.61
T218	.85	.34	.62	.60	.80	.53	.79	.71	1.02	1.10	1.64	1.25	.89	.66	1.01	.85
T220	.74	.45	.62	.60	.83	.61	1.03	.82	1.31	1.19	1.36	1.29	.96	.75	1.01	.91
T222	.75	.39	.49	.54	.71	.47	.68	.62	1.23	.84	1.12	1.06	.89	.57	.77	.74
T224	.65	.45	.57	.56	.57	.37	.65	.53	1.05	.62	.86	.84	.76	.48	.69	.64
T202	.80	.46	.71	.66	.99	.66	.90	.85	1.33	.85	1.30	1.16	1.04	.66	.97	.89
T204	.62	.37	.52	.50	.72	.43	.64	.60	.97	.68	1.07	.91	.77	.49	.74	.67
NC7	.70	.38	.53	.54	.80	.46	.75	.67	.97	.73	1.26	.99	.82	.52	.85	.73
CI.21	.62	.42	.50	.51	.74	.41	.76	.64	.87	.90	1.07	.95	.74	.58	.78	.70
Average	.69	.41	.56	.55	.76	.49	.75	.67	1.05	.83	1.15	1.01	.83	.58	.82	.74
L. S.D. (.05) for potassium means	1961				1963				1961				1963			
(.01) for potassium means	.08				.08				for inbred means				.12 N. S.			
	.13				.14				for inbred means				.15 N. S.			

^aAll figures represent an average of 3 replications.

TABLE 16. Per cent potassium in a mature corn plant (omitting ear) for 19 hybrids grown at 3 levels of potassium fertilization for 3 years

Corn Hybrid	0 pounds K ₂ O per acre			40 pounds K ₂ O per acre			120 pounds K ₂ O per acre			Variety average		
	1961	1962	1963	Avg.	1961	1962	1963	Avg.	1961	1962	1963	Avg.
T101 x T105	.58 ^a	.27	.45	.43	.94	.44	.59	.66	1.16	.78	1.44	1.13
T101 x T111	.59	.30	.42	.44	.97	.53	.77	.76	1.50	1.01	1.59	1.37
T101 x T115		.35	.40	.38		.43	.53	.48		1.18	1.29	1.24
T105 x T111		.28	.38	.33		.43	.65	.54		1.02	1.44	1.23
T105 x T115	.54	.28	.38	.40	.69	.36	.92	.66	1.09	.94	1.27	1.10
T111 x T115	.49	.29	.30	.36	.67	.49	.76	.64	1.18	.85	1.11	1.05
Dixie 29A	.55	.30	.49	.45	.96	.33	.66	.65	1.32	1.24	1.61	1.39
Dixie 29B		.27	.39	.33		.50	.63	.57		1.15	1.58	1.37
Dixie 29C		.29	.43	.36		.51	.71	.61		1.07	1.27	1.17
T218 x T220	.61	.32	.32	.42	.94	.58	.77	.76	1.54	1.44	1.71	1.56
T218 x T222		.28	.34	.31		.47	.82	.65		1.14	1.32	1.23
T218 x T224		.41	.54	.48		.51	.76	.64		.88	1.11	1.00
T220 x T222		.34	.40	.37		.39	1.00	.70		.82	1.56	1.19
T220 x T224		.23	.30	.27		.39	.81	.60		.87	1.16	1.02
T222 x T224	.50	.40	.41	.44	.94	.43	.66	.68	1.29	1.08	1.31	1.23
Tenn. 604A	.56	.29	.32	.39	.97	.33	.79	.70	1.40	.93	1.36	1.23
Tenn. 604B		.34	.46	.40		.50	.99	.75		1.02	1.16	1.09
Tenn. 604C		.32	.36	.34		.48	.82	.65		.92	1.27	1.10
Dixie 22	.55	.45	.53	.51	.93	.37	.97	.76	1.39	1.13	1.29	1.27
Average	.55	.32	.40	.39	.89	.45	.77	.66	1.32	1.03	1.36	1.21
L. S.D. (.05) for potassium means	1961			1963	1961			1963	1961			1963
(.01) for potassium means	.19			.13	.19			.13	.17			N.S.
	.32			.22	.32			.22	N.S.			N.S.
					for hybrid means				for hybrid means			

^aAll figures represent an average of 3 replications.

TABLE 17. Per cent potassium in a mature corn plant (including ear) for 19 hybrids grown at 3 levels of potassium fertilization for 3 years

Corn Hybrid	0 pounds K ₂ O per acre			40 pounds K ₂ O per acre			120 pounds K ₂ O per acre			Variety average		
	1961	1962	1963 Avg.	1961	1962	1963 Avg.	1961	1962	1963 Avg.	1961	1962	1963 Avg.
T101 x T105	.59 ^a	.30	.49	.84	.42	.58	1.04	.70	1.23	.82	.47	.76
T101 x T111	.58	.31	.46	.86	.51	.71	1.29	.88	1.33	.91	.56	.83
T101 x T115		.35	.44		.43	.54		.98	1.12		.59	.70
T105 x T111		.28	.40		.41	.62		.87	1.22		.52	.75
T105 x T115	.54	.30	.43	.64	.35	.82	.96	.80	1.07	.71	.48	.77
T111 x T115	.51	.32	.38	.64	.44	.72	1.06	.74	.94	.74	.50	.68
Dixie 29A	.56	.32	.51	.86	.34	.62	1.12	1.05	1.34	.85	.57	.82
Dixie 29B		.29	.44		.48	.61		.97	1.33		.58	.79
Dixie 29C		.33	.45		.48	.67		.92	1.09		.58	.74
T218 x T220	.59	.31	.37	.84	.52	.70	1.30	1.21	1.43	.91	.68	.83
T218 x T222		.29	.39		.44	.73		.97	1.12		.57	.75
T218 x T224		.40	.53		.50	.68		.76	.98		.55	.73
T220 x T222		.34	.42		.37	.87		.72	1.27		.48	.86
T220 x T224		.26	.37		.39	.72		.77	1.02		.48	.70
T222 x T224	.53	.40	.43	.84	.41	.61	1.13	.93	1.11	.83	.58	.72
Tenn. 604A	.58	.31	.37	.87	.34	.71	1.22	.80	1.14	.89	.49	.74
Tenn. 604B		.34	.47		.47	.86		.86	.99		.56	.78
Tenn. 604C		.33	.41		.44	.71		.79	1.08		.52	.73
Dixie 22	.57	.41	.54	.84	.37	.86	1.23	.96	1.12	.88	.58	.84
Average	.56	.33	.44	.80	.43	.70	1.15	.88	1.15	.84	.54	.76
L. S. D. (.05) for potassium means	1961 1962 1963			1961 1962 1963			1961 1962 1963			1961 1962 1963		
(.01) for potassium means	.13 .13 .11			.13 .13 .11			.13 .13 .11			.13 .13 .11		
	for hybrid means			for hybrid means			for hybrid means			for hybrid means		
	N.S. N.S. N.S.			N.S. N.S. N.S.			N.S. N.S. N.S.			N.S. N.S. N.S.		

^aAll figures represent an average of 3 replications.

TABLE 18. Per cent calcium in a mature corn plant (omitting ear) for 12 inbreds grown at 2 levels of potassium fertilization for 2 years

Corn Inbred	0 pounds K ₂ O per acre			40 pounds K ₂ O per acre			120 pounds K ₂ O per acre			Variety average		
	1961	1962	1963	Avg.	1961	1962	1963	Avg.	1961	1962	1963	Avg.
T101	.57 ^a	.45	.48	.50	.56	.65	.56	.59	.68	.49	.51	.56
T105	.58	.41	.43	.47	.60	.61	.39	.53	.74	.48	.45	.56
T111	.45	.41	.35	.40	.32	.46	.29	.36	.44	.33	.29	.35
T115	.52	.28	.29	.36	.50	.42	.35	.42	.60	.39	.38	.46
T218	.83	.29	.63	.58	.83	.47	.61	.64	.79	.34	.62	.58
T220	1.04	.37	.50	.64	.66	.69	.54	.63	.66	.59	.49	.58
T222	.48	.36	.34	.39	.39	.42	.30	.37	.36	.36	.32	.35
T224	.51	.35	.32	.39	.53	.34	.38	.42	.61	.39	.42	.47
T202	.67	.57	.50	.58	.71	.67	.46	.61	.67	.51	.46	.55
T204	.40	.26	.27	.31	.31	.33	.29	.31	.38	.30	.26	.31
NC7	.58	.41	.45	.48	.51	.39	.41	.44	.56	.38	.42	.45
CI. 21	.64	.35	.47	.49	.62	.56	.46	.55	.51	.51	.48	.50
Average	.61	.38	.42	.47	.54	.50	.42	.49	.58	.42	.42	.48
L. S. D. (.05) for potassium means	1961	1962	1963									
(.01) for potassium means	N. S.	N. S.	N. S.									
	1961	1962	1963									
	N. S.	N. S.	N. S.									
	N. S.	N. S.	N. S.									
	1961	1962	1963									
	.14	.10	.06									
	.19	.14	.08									

^aAll figures represent an average of 3 replications.

TABLE 19. Per cent calcium in a mature corn plant (including ear) for 12 inbreds grown at 3 levels of potassium fertilization for 3 years

Corn Inbred	0 pounds K ₂ O per acre			40 pounds K ₂ O per acre			120 pounds K ₂ O per acre			Variety average		
	1961	1962	1963	Avg.	1961	1962	1963	Avg.	1961	1962	1963	Avg.
T101	.43 ^a	.35	.38	.39	.44	.50	.43	.46	.53	.38	.39	.43
T105	.45	.32	.34	.37	.46	.47	.31	.41	.58	.37	.34	.43
T111	.35	.32	.27	.31	.26	.36	.24	.29	.34	.26	.23	.28
T115	.41	.22	.23	.29	.40	.33	.27	.33	.47	.30	.29	.35
T218	.64	.23	.49	.45	.64	.37	.47	.49	.61	.27	.48	.45
T220	.79	.29	.39	.49	.51	.53	.42	.49	.50	.45	.38	.44
T222	.37	.29	.27	.31	.31	.33	.24	.29	.30	.28	.26	.28
T224	.40	.28	.24	.31	.42	.27	.31	.33	.48	.31	.32	.37
T202	.52	.44	.39	.45	.57	.52	.35	.48	.52	.40	.36	.43
T204	.31	.21	.21	.24	.25	.26	.23	.25	.31	.25	.20	.25
NC7	.45	.31	.35	.37	.40	.31	.31	.34	.44	.30	.32	.35
CI. 21	.49	.28	.36	.38	.47	.43	.36	.42	.40	.40	.37	.39
Average	.47	.30	.33	.36	.43	.39	.33	.38	.46	.33	.33	.37
L.S.D. (.05) for potassium means	1961			1962	1963	1961			1962	1963	1961	
(.01) for potassium means	N.S.			N.S.	N.S.	N.S.			N.S.	N.S.	.10	
	N.S.			N.S.	N.S.	N.S.			for inbred means	for inbred means	.14	
											.08	
											.10	
											.05	
											.06	

^aAll figures represent an average of 3 replications.

TABLE 20. Per cent calcium in a mature corn plant (omitting ear) for 19 hybrids grown at 3 levels of potassium fertilization for 3 years

Corn Hybrid	0 pounds K ₂ O per acre			40 pounds K ₂ O per acre			120 pounds K ₂ O per acre			Variety average					
	1961	1962	1963	Avg.	1961	1962	1963	Avg.	1961	1962	1963	Avg.			
T101 x T105	.79 ^a	.67	.68	.71	.80	.80	.74	.78	.75	.60	.66	.67	.78	.69	.72
T101 x T111	.64	.54	.56	.58	.55	.54	.59	.56	.58	.54	.48	.53	.59	.54	.56
T101 x T115		.55	.70	.63		.57	.80	.69		.58	.64	.61		.57	.64
T105 x T111		.68	.53	.61		.60	.54	.57		.52	.50	.51		.60	.57
T105 x T115	.65	.44	.57	.55	.70	.52	.64	.62	.72	.52	.61	.62	.69	.61	.60
T111 x T115	.62	.39	.46	.49	.59	.53	.51	.54	.51	.44	.39	.45	.57	.45	.49
Dixie 29A	.77	.62	.58	.66	.61	.59	.60	.60	.70	.52	.45	.56	.69	.58	.60
Dixie 29B		.44	.53	.49		.55	.66	.61		.66	.54	.60		.54	.57
Dixie 29C		.58	.54	.56		.51	.63	.57	.81	.57	.55	.56		.55	.57
T218 x T220	.89	.64	.68	.74	.90	.71	.72	.78		.64	.55	.67	.87	.66	.73
T218 x T222		.68	.70	.69		.65	.76	.71		.68	.54	.61		.67	.67
T218 x T224		.60	.65	.63		.58	.62	.60		.55	.48	.52		.58	.58
T220 x T222		.56	.71	.64		.60	.59	.60		.53	.52	.53		.56	.59
T220 x T224		.51	.56	.54		.54	.58	.56		.53	.51	.52		.52	.54
T222 x T224	.66	.54	.55	.58	.68	.51	.66	.62	.60	.46	.42	.49		.52	.57
Tenn. 604A	.71	.56	.62	.63	.74	.58	.68	.67	.60	.53	.59	.57	.65	.50	.62
Tenn. 604B		.60	.72	.66		.61	.60	.61		.64	.53	.59	.68	.56	.62
Tenn. 604C		.60	.64	.62		.51	.63	.57		.73	.53	.63		.62	.62
Dixie 22	.72	.69	.74	.72	.65	.62	.54	.60	.65	.61	.48	.58	.67	.61	.61
Average	.72	.57	.62	.62	.69	.58	.64	.62	.66	.57	.52	.57	.69	.58	.61
L. S. D. (.05)	for potassium means			1961	1962	1963	for hybrid means			1961	1962	1963	1963		
(.01)	for potassium means			N.S.	N.S.	N.S.	for hybrid means			.10	.08	.08	.08		
				N.S.	N.S.	N.S.				.13	.11	.11	.11		

^aAll figures represent an average of 3 replications.

TABLE 21. Per cent calcium in a mature corn plant (including ear) for 12 hybrids grown at 3 levels of potassium fertilization for 3 years

Corn Hybrid	0 pounds K ₂ O per acre			40 pounds K ₂ O per acre			120 pounds K ₂ O per acre			Variety average		
	1961	1962	1963	1961	1962	1963	1961	1962	1963	1961	1962	1963
	Avg.			Avg.			Avg.			Avg.		
T101 x T105	.62 ^a	.51	.52	.55	.61	.57	.60	.57	.46	.51	.60	.53
T101 x T111	.49	.43	.44	.45	.43	.46	.44	.45	.42	.37	.46	.42
T101 x T115		.42	.53	.48	.44	.61	.53		.44	.49	.44	.55
T105 x T111		.52	.41	.47	.46	.42	.44		.40	.39	.46	.41
T105 x T115	.50	.34	.44	.43	.40	.49	.48	.56	.40	.47	.54	.47
T111 x T115	.48	.30	.36	.38	.41	.40	.42	.40	.35	.30	.44	.35
Dixie 29A	.59	.37	.45	.50	.45	.45	.46	.54	.40	.35	.54	.42
Dixie 29B		.34	.41	.38	.43	.51	.47		.50	.42		.43
Dixie 29C		.45	.42	.44	.39	.49	.44		.44	.42	.43	.45
T218 x T220	.68	.49	.52	.56	.68	.55	.59	.63	.49	.43	.66	.50
T218 x T222		.52	.54	.53	.50	.58	.54		.52	.42		.51
T218 x T224		.46	.50	.48	.44	.48	.46		.43	.37		.45
T220 x T222		.43	.54	.49	.46	.45	.46		.41	.40		.45
T220 x T224		.39	.43	.41	.42	.45	.44		.41	.39		.41
T222 x T224	.51	.42	.42	.45	.53	.51	.48	.49	.36	.33	.51	.42
Tenn. 604A	.54	.43	.48	.48	.57	.52	.51	.47	.41	.45	.53	.48
Tenn. 604B		.47	.55	.51		.46	.47		.49	.41		.47
Tenn. 604C		.47	.49	.48		.48	.44		.56	.41		.46
Dixie 22	.55	.53	.57	.55	.50	.42	.47	.51	.47	.37	.52	.45
Average	.55	.44	.47	.47	.53	.49	.48	.51	.44	.40	.53	.46
												.47
L. S. D. (.05) for potassium means	1961	1962	1963	1961	1962	1963	1961	1962	1963	1961	1962	1963
(.01) for potassium means	N. S.	N. S.	N. S.	N. S.	N. S.	N. S.	N. S.	N. S.	N. S.	.07	.09	.07
										.10	.12	.09
										for hybrid means		
										for hybrid means		

^aAll figures represent an average of 3 replications.

TABLE 22. Per cent magnesium in a mature corn plant (omitting ear) for 12 inbreds grown at 2 levels of potassium fertilization for 3 years

Corn Inbred	0 pounds K ₂ O per acre			40 pounds K ₂ O per acre			120 pounds K ₂ O per acre			Variety average		
	1961	1962	1963	Avg.	1961	1962	1963	Avg.	1961	1962	1963	Avg.
T101	.58 ^a	.45	.45	.49	.45	.41	.42	.42	.41	.28	.28	.32
T105	.64	.45	.39	.49	.49	.31	.36	.36	.57	.31	.28	.39
T111	.57	.36	.37	.43	.33	.32	.30	.30	.34	.16	.21	.24
T115	.52	.35	.41	.43	.44	.32	.36	.36	.42	.25	.23	.30
T218	.60	.34	.47	.47	.56	.32	.41	.41	.47	.18	.21	.29
T220	.74	.41	.39	.51	.42	.32	.36	.36	.33	.24	.23	.27
T222	.50	.44	.42	.45	.40	.33	.28	.34	.37	.23	.27	.29
T224	.52	.36	.27	.38	.38	.22	.25	.28	.36	.21	.23	.27
T202	.61	.48	.39	.49	.47	.34	.28	.36	.35	.28	.21	.28
T204	.55	.41	.37	.44	.37	.29	.30	.30	.35	.17	.19	.24
NC7	.65	.43	.45	.51	.46	.30	.35	.37	.43	.18	.23	.28
CL 21	.62	.42	.46	.50	.48	.38	.41	.41	.43	.26	.27	.32
Average	.59	.41	.40	.47	.44	.32	.31	.36	.40	.23	.24	.29
L. S. D. (.05) for potassium means	1961			1962	1963	1961			1962	1963		
(.01) for potassium means	.08			.05	.03	.10			.05	.05		
	.14			.09	.04	N.S.			.07	.07		

^aAll figures represent an average of 3 replications.

TABLE 23. Per cent magnesium in a mature corn plant (including ear) for 12 inbreds grown at 3 levels of potassium fertilization for 3 years

Corn Inbred	0 pounds K ₂ O per acre			40 pounds K ₂ O per acre			120 pounds K ₂ O per acre			Variety average		
	1961	1962	1963	Avg.	1961	1962	1963	Avg.	1961	1962	1963	Avg.
T101	.48 ^a	.37	.38	.41	.38	.33	.33	.35	.35	.23	.24	.27
T105	.54	.37	.33	.41	.42	.26	.24	.31	.47	.25	.24	.32
T111	.48	.30	.32	.37	.30	.28	.22	.27	.30	.15	.19	.21
T115	.44	.30	.33	.36	.37	.27	.26	.30	.35	.21	.22	.26
T218	.49	.28	.38	.38	.46	.26	.31	.34	.38	.15	.19	.24
T220	.59	.34	.33	.42	.35	.26	.28	.30	.29	.20	.20	.23
T222	.42	.37	.36	.38	.35	.27	.25	.29	.31	.20	.25	.25
T224	.44	.30	.24	.33	.34	.19	.22	.25	.31	.19	.20	.23
T202	.49	.40	.32	.40	.39	.29	.25	.31	.30	.24	.19	.24
T204	.46	.34	.31	.37	.32	.25	.21	.26	.29	.15	.17	.20
NC7	.54	.36	.38	.43	.38	.26	.30	.31	.36	.16	.20	.24
CI. 21	.50	.35	.38	.41	.40	.32	.31	.34	.36	.23	.24	.28
Average	.49	.34	.34	.39	.37	.27	.27	.30	.34	.20	.21	.25
L. S. D. (.05) for potassium means	1961			1962	1963	for inbred means for inbred means						
(.01) for potassium means	.07			.05	.02							
	.11			.09	.04	1961 1962 1963						
						N.S. N.S. N.S.						
						.04 .05 .06						

^aAll figures represent an average of 3 replications.

TABLE 24. Per cent magnesium in a mature corn plant (omitting ear) for 19 hybrids grown at 3 levels of potassium fertilization for 3 years

Corn Hybrid	0 pounds K ₂ O per acre			40 pounds K ₂ O per acre			120 pounds K ₂ O per acre			Variety average		
	1961	1962	1963	Avg.	1961	1962	1963	Avg.	1961	1962	1963	Avg.
T101 x T105	.66 ^a	.52	.64	.61	.57	.46	.54	.52	.48	.30	.23	.34
T101 x T111	.68	.50	.68	.62	.52	.36	.47	.45	.35	.22	.20	.26
T101 x T115		.51	.66	.59		.34	.56	.45		.22	.27	.25
T105 x T111		.41	.46	.44		.31	.33	.32		.20	.21	.21
T105 x T115	.65	.45	.50	.53	.57	.37	.27	.40	.43	.26	.25	.31
T111 x T115	.65	.39	.51	.52	.62	.27	.36	.42	.39	.22	.17	.26
Dixie 29A	.73	.44	.51	.56	.58	.47	.44	.50	.42	.21	.21	.28
Dixie 29B		.46	.60	.53		.30	.35	.33		.22	.23	.23
Dixie 29C		.48	.59	.54		.31	.36	.34		.25	.24	.25
T218 x T220	.76	.54	.75	.68	.69	.43	.56	.56	.46	.21	.21	.29
T218 x T222		.68	.73	.71		.37	.50	.44		.25	.24	.25
T218 x T224		.49	.49	.49		.40	.38	.39		.27	.19	.23
T220 x T222		.45	.66	.56		.44	.32	.38		.27	.19	.23
T220 x T224		.35	.54	.45		.36	.31	.34		.23	.22	.23
T222 x T224	.62	.38	.49	.50	.50	.38	.39	.42	.36	.22	.20	.26
Tenn. 604A	.64	.42	.56	.54	.65	.39	.34	.46	.39	.25	.23	.29
Tenn. 604B		.50	.69	.60		.28	.48	.38		.20	.28	.24
Tenn. 604C		.54	.72	.63		.39	.44	.42		.32	.19	.26
Dixie 22	.67	.54	.66	.62	.55	.29	.39	.41	.48	.23	.27	.33
Average	.67	.48	.60	.56	.58	.36	.41	.42	.42	.24	.22	.26
L.S.D. (.05) for potassium means	1961			1963	1961			1963	1961			1963
(.01) for potassium means	.14			.06	.08			.10	N.S.			.10
	N.S.			.12	.12			.10	for hybrid means			N.S.
									for hybrid means			N.S.

^aAll figures represent an average of 3 replications.

TABLE 25. Per cent magnesium in a mature corn plant (including ear) for 19 hybrids grown at 3 levels of potassium fertilization for 3 years

Corn Hybrid	0 pounds K ₂ O per acre			40 pounds K ₂ O per acre			120 pounds K ₂ O per acre			Variety average		
	1961	1962	1963	Avg.	1961	1962	1963	Avg.	1961	1962	1963	Avg.
T101 x T105	.53 ^a	.42	.52	.49	.47	.37	.44	.43	.40	.26	.21	.29
T101 x T111	.54	.41	.54	.50	.43	.30	.38	.37	.30	.20	.18	.23
T101 x T115		.40	.52	.46		.29	.46	.38		.19	.23	.21
T105 x T111		.33	.38	.36		.27	.29	.28		.18	.18	.18
T105 x T115	.52	.37	.40	.43	.47	.31	.23	.34	.36	.22	.22	.27
T111 x T115	.53	.32	.41	.42	.51	.23	.31	.35	.33	.19	.15	.22
Dixie 29A	.59	.36	.41	.45	.47	.39	.36	.41	.36	.19	.18	.24
Dixie 29B		.37	.48	.43		.27	.29	.28		.20	.20	.20
Dixie 29C		.39	.48	.44		.27	.29	.28		.22	.21	.22
T218 x T220	.60	.42	.60	.54	.55	.36	.45	.45	.39	.18	.18	.25
T218 x T222		.54	.58	.56		.31	.41	.36		.22	.22	.22
T218 x T224		.40	.40	.40		.33	.32	.33		.24	.17	.21
T220 x T222		.36	.53	.45		.37	.27	.32		.24	.17	.21
T220 x T224		.30	.45	.38		.30	.26	.28		.20	.19	.20
T222 x T224	.50	.31	.39	.40	.41	.32	.32	.35	.30	.20	.17	.22
Tenn. 604A	.52	.34	.45	.44	.53	.32	.29	.38	.32	.22	.20	.25
Tenn. 604B		.41	.56	.49		.24	.39	.32		.18	.24	.20
Tenn. 604C		.43	.57	.50		.32	.36	.34		.27	.17	.22
Dixie 22	.55	.43	.53	.50	.44	.24	.31	.33	.40	.20	.22	.27
Average	.54	.38	.48	.45	.48	.31	.34	.35	.35	.21	.19	.23
L. S. D. (.05)	for potassium means			1961	1962	1963	for hybrid means			1961	1962	1963
	for potassium means			.11	.08	.04	for hybrid means			N. S.	.08	.08
	for potassium means			N. S.	.13	.07	for hybrid means			N. S.	N. S.	.10

^aAll figures represent an average of 3 replications.

both inbreds and hybrids (with and without the ear) for all three years. A highly significant difference between variety means was found for the inbreds in 1961 and 1963. A significant difference was found between variety means of the hybrids in 1961 and 1962, and no significant difference occurred in 1963.

Calcium content was very consistent for inbreds and hybrids and for each year. No significant difference was found between K_2O levels for inbreds or hybrids for any of the three years, but a highly significant difference occurred between variety means for both inbreds and hybrids for all three years.

There was a decrease in the magnesium content of the plant with each increase in K_2O added. In the inbreds a highly significant difference was found between the 0 and 40 and between the 0 and 120 pound K_2O levels for all three years. In the hybrids there was a significant difference between the 0 and 120 pound K_2O level in 1961 and a highly significant difference between K_2O levels in 1962 and 1963.

Including or omitting the ear changed the least significant difference between variety means for 1961 inbreds and for 1962 hybrids. In 1961 inbreds, omitting the ear gave a significant difference between variety means, but when the ear was included no significant difference was found. The other two years there was a highly significant difference between inbred means whether the ear was included or omitted. No significant difference between variety means was found for hybrids in 1961, but a significant difference occurred in 1962 when the ear was included. When the ear was omitted there was no significant difference.

The differences in 1963 were highly significant whether the ear was included or omitted.

VI. DEAD STALKS IN INBREDS

The data on dead stalks in inbreds are summarized in Tables 26 and 27.

The percentage of dead stalks was only obtained at one stage in 1961. No significant difference between K_2O levels 143 days after planting was found. The actual percentages was 15 per cent for the 0 K_2O level, but decreased to 31 per cent at the 120 pound K_2O level. A highly significant difference between inbred averages occurred, but no significant potassium x inbred interaction was found. NC 7 had less than 1 per cent dead stalks while T224 had 79 per cent.

In 1962 dead stalks were counted at two different dates. The first count was made 129 days after planting and a significant difference between the 0 and 40 and the 0 and 120 pound K_2O levels was found. There were more dead stalks on the 40 and 120 pound K_2O levels than on the 0 pound K_2O level. A highly significant difference between inbred means was found with five inbreds having no dead stalks at this date, whereas, 50 per cent or more of the stalks of T115 and T224 were dead.

The second date the stalks were counted was 150 days after planting. Still no significant difference between K_2O levels was found, but again a highly significant difference between inbred means occurred with T115 and T224 still having the most dead stalks.

TABLE 26. Per cent dead stalks^a before harvest for 12 corn inbreds grown at 3 levels of potassium fertilization for 3 years

Corn	0 pounds K ₂ O per acre				40 pounds K ₂ O per acre				120 pounds K ₂ O per acre				Variety average			
	1961	1962	1963	Avg.	1961	1962	1963	Avg.	1961	1962	1963	Avg.	1961	1962	1963	Avg.
Inbred																
T101	17.2 ^b	0.0 ^b	1.5 ^c	6.2	0.0 ^b	0.0 ^b	0.0 ^c	0.0	0.0 ^b	0.0 ^b	0.0 ^c	0.0	5.7	0.0	0.5	2.1
T105	42.7	21.4	5.1	23.1	38.8	36.8	3.4	26.3	24.2	38.9	8.0	23.7	35.2	32.3	5.5	24.3
T111	7.7	5.8	0.0	4.5	1.2	0.0	1.6	0.9	4.6	0.0	0.0	1.5	4.5	1.9	0.5	2.3
T115	62.8	40.8	25.8	43.1	57.4	79.7	83.7	73.6	18.7	51.5	67.5	45.9	46.3	57.3	59.0	54.2
T218	35.7	0.0	27.8	21.2	61.9	0.0	57.2	39.7	42.5	0.0	75.5	39.3	46.7	0.0	53.5	33.4
T220	61.8	44.7	60.0	55.5	46.7	35.2	19.1	33.7	5.5	7.3	20.2	11.0	38.0	29.1	33.1	33.4
T222	7.1	0.0	0.0	2.4	8.3	0.0	0.0	2.8	3.3	0.0	14.5	5.9	6.3	0.0	4.8	3.7
T224	88.8	20.2	17.0	42.0	70.9	71.7	55.4	66.0	77.1	89.8	55.8	74.2	78.9	60.6	42.7	60.7
T202	9.4	18.3	2.7	10.1	2.2	2.0	0.0	1.4	0.0	3.4	0.0	1.1	3.9	7.9	0.9	4.2
T204	28.5	0.0	0.0	9.5	8.9	0.0	1.4	3.4	7.3	0.0	2.7	3.3	14.9	0.0	1.4	5.4
NC7	2.1	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.2
CI. 21	9.5	0.0	0.0	3.2	2.1	8.3	0.0	3.5	0.0	4.0	0.0	1.3	3.8	4.1	0.0	2.6
Average	31.1	12.6	11.6	18.5	24.9	19.5	18.5	20.9	15.3	16.3	20.3	17.3	23.8	16.1	16.8	18.9
L. S. D. (.05)	for potassium means				1961	1962	1963		for inbred means				1961	1962	1963	
(.01)	for potassium means				N.S.	4.6	N.S.		for inbred means				15.3	23.6	24.7	
					N.S.	N.S.	N.S.						20.3	32.1	33.6	

TABLE 27. Per cent dead stalks^a at harvest for 12 corn inbreds grown at 3 levels of potassium fertilization for 2 years

Corn Inbred	0 pounds K ₂ O per acre			40 pounds K ₂ O per acre			120 pounds K ₂ O per acre			Variety average		
	1962	1963	Avg.	1962	1963	Avg.	1962	1963	Avg.	1962	1963	Avg.
T101	8.8 ^b	17.8 ^c	13.3	14.1 ^b	6.5 ^c	10.3	6.7 ^b	5.6 ^c	6.2	9.9	10.0	10.0
T105	62.8	40.5	51.7	88.7	42.6	65.7	97.4	51.2	74.3	83.0	44.8	63.9
T111	37.5	9.8	23.7	23.7	7.8	15.8	11.0	11.1	11.1	24.1	9.6	16.9
T115	99.0	71.5	85.3	100.0	100.0	100.0	99.0	90.3	94.7	99.3	87.3	93.3
T218	39.5	66.7	53.1	76.7	83.9	80.3	71.4	86.9	79.2	62.5	79.2	70.9
T220	90.0	80.0	85.0	90.2	54.5	72.4	87.8	65.2	76.5	89.2	66.6	77.9
T222	44.8	6.3	25.6	63.3	31.6	47.5	45.9	49.5	47.7	51.3	29.1	40.2
T224	96.7	54.6	75.7	99.0	78.4	88.7	98.2	71.0	84.6	98.0	68.0	83.0
T202	63.5	15.6	39.6	33.0	8.0	20.5	40.1	0.0	20.1	45.5	7.9	26.7
T204	15.9	10.7	13.3	37.7	12.3	25.0	20.9	10.4	15.7	24.8	11.1	18.0
NC7	15.3	13.4	14.4	51.2	30.2	40.7	16.2	19.8	18.0	27.6	21.1	24.4
CI. 21	26.5	5.0	15.8	72.2	0.0	36.1	68.3	1.9	35.1	55.7	2.3	29.0
Average	50.0	32.6	41.4	62.5	38.0	50.3	55.2	38.6	46.9	55.9	36.4	46.2
L. S. D. (.05) for potassium means	1962			1963			1962			1963		
(.01) for potassium means	N. S.			N. S.			for inbred means			22.8		
	N. S.			N. S.			for inbred means			31.1		

^a150 and 159 days after planting for 1962 and 1963, respectively.

^bAll figures represent an average of 3 replications.

^cAll figures represent an average of 2 replications.

The same general trend occurred in 1963 except that no significant difference between K_2O levels occurred. In 1963, the stalks were counted 144 and 159 days after planting. T115, T218, and T224 had the greatest percentage of dead stalks.

VII. DEAD STALKS IN HYBRIDS

Data for per cent dead stalks are summarized and reported in Tables 28 and 29.

In 1961, data on dead stalks in hybrids was taken only one time: 143 days after planting. A comparison of the K_2O levels gave a highly significant difference. Approximately a 40 per cent decrease in the amount of dead stalks was found for 40 pounds K_2O per acre and a 70 per cent decrease for 120 pounds. A highly significant difference between hybrid means was found for all three years.

Data on dead stalks were taken twice in 1962: 129 and 150 days after planting. A highly significant difference between the 0 and 120 pound K_2O levels for the first date was found, but no significant difference for the second date occurred as most of the stalks were dead at this time.

In 1963, the dead stalks were counted 130 and 144 days after planting. Each date gave a significant difference between the 0 and 40 and between the 0 and 120 pound K_2O levels, and a highly significant potassium x hybrid interaction.

TABLE 28. Per cent dead stalks^a before harvest for 19 corn hybrids grown at 3 levels of potassium fertilization for 3 years

Corn	0 pounds K ₂ O per acre				40 pounds K ₂ O per acre				120 pounds K ₂ O per acre				Variety average			
	1961	1962	1963	Avg.	1961	1962	1963	Avg.	1961	1962	1963	Avg.	1961	1962	1963	Avg.
Hybrid																
T101 x T105	45.2 ^b	3.2 ^b	3.0 ^c	17.1	6.5 ^b	4.3 ^b	0.0 ^c	3.6	3.9 ^b	6.0 ^b	0.0 ^c	3.3	18.5	4.5	1.0	8.0
T101 x T111	34.7	76.2	0.0	37.0	12.5	71.9	0.0	28.1	4.4	64.3	0.0	22.9	17.2	70.8	0.0	29.3
T101 x T115		82.5	18.2	50.4		69.4	3.5	36.5		65.7	0.0	32.9		72.6	7.3	39.9
T105 x T111		57.7	8.6	33.2		52.7	8.6	30.7		22.9	4.6	13.8		44.4	7.3	25.9
T105 x T115	92.6	92.2	37.7	74.2	64.7	85.2	22.1	57.3	33.7	65.9	42.0	47.2	63.7	81.1	33.9	59.6
T111 x T115	98.1	97.8	60.8	85.6	81.1	89.4	73.9	81.5	42.5	91.5	56.8	63.6	73.9	92.9	63.8	76.9
Dixie 29A	78.2	58.2	21.4	52.6	43.1	68.8	9.0	40.3	26.6	50.3	3.0	26.6	49.3	59.1	11.1	39.8
Dixie 29B		53.7	30.5	42.1		74.8	20.0	47.4		62.4	5.7	34.1		63.6	18.7	41.2
Dixie 29C		72.4	50.6	61.5		63.7	10.6	37.2		44.5	18.3	31.4		60.2	26.5	43.4
T218 x T220	87.0	68.4	62.8	72.7	48.4	63.3	29.2	47.0	16.1	21.7	0.0	12.6	50.5	51.1	30.7	44.1
T218 x T222		60.5	70.6	65.6		79.4	14.7	47.1		62.5	0.0	31.3		67.5	28.4	48.0
T218 x T224		83.7	48.4	66.1		89.0	59.5	74.3		86.0	49.1	67.6		86.2	52.3	69.3
T220 x T222		85.3	46.9	66.1		72.3	1.5	36.9		12.3	0.0	6.2		56.6	16.1	36.4
T220 x T224		96.2	85.3	90.8		93.9	38.6	66.3		79.6	29.5	54.6		89.9	51.1	70.5
T222 x T224	89.7	92.8	43.4	75.3	53.4	97.3	34.3	61.7	17.9	75.2	1.5	31.5	53.7	88.4	26.4	56.2
Tenn. 604A	86.4	80.3	69.9	78.9	66.4	88.5	13.6	56.2	32.8	61.9	13.0	35.9	61.9	76.9	32.2	57.0
Tenn. 604B		62.5	53.2	57.9		74.4	42.3	58.4		63.5	15.7	39.6		66.8	37.1	52.0
Tenn. 604C		80.2	67.7	74.0		79.0	37.3	58.2		62.0	13.6	37.8		73.7	39.5	56.6
Dixie 22	52.8	66.2	18.6	45.9	37.4	68.1	13.5	39.7	24.7	42.9	18.4	28.7	38.3	59.1	16.8	38.1
Average	73.9	72.1	42.0	60.4	45.9	72.9	22.7	47.8	22.5	54.8	14.3	32.7	47.4	66.6	26.3	47.0
L. S. D. (.05)			for potassium means		1961	1962	1963						1961	1962	1963	
(.01)			for potassium means		11.2	7.0	15.0						12.5	18.0	24.2	
			for potassium means		18.6	11.5	N.S.						16.6	24.1	32.4	

all 43, 129, and 130 days after planting for 1961, 1962, and 1963, respectively.

ball figures represent an average of 3 replications.

All figures represent an average of 2 replications.

TABLE 29. Per cent dead stalks^a at harvest for 19 corn hybrids grown at 3 levels of potassium fertilization for 2 years

Corn Hybrid	0 pounds K ₂ O per acre			40 pounds K ₂ O per acre			120 pounds K ₂ O per acre			Variety average		
	1962	1963	Avg.	1962	1963	Avg.	1962	1963	Avg.	1962	1963	Avg.
T101 x T105	87.2 ^b	46.3 ^c	66.8	64.9 ^b	17.6 ^c	41.3	72.8 ^b	11.2 ^c	42.0	74.9	25.0	50.0
T101 x T111	95.7	51.2	73.4	87.2	17.3	52.3	98.2	7.9	53.1	93.7	25.8	59.8
T101 x T115	91.7	63.5	77.6	94.6	52.9	73.8	94.0	47.4	70.7	93.4	54.6	74.0
T105 x T111	94.8	86.5	90.7	95.2	84.4	89.8	94.7	72.3	83.5	94.9	81.1	88.0
T105 x T115	98.2	92.1	95.2	100.0	90.2	95.1	99.2	96.6	97.9	99.1	93.0	96.1
T111 x T115	98.2	90.9	94.6	83.0	94.0	88.5	98.9	100.0	99.5	93.3	95.0	94.2
Dixie 29A	93.0	73.0	83.0	91.4	60.7	76.1	84.6	57.0	70.9	89.7	63.6	76.7
Dixie 29B	89.6	78.1	83.9	98.2	62.9	80.6	90.5	57.6	74.1	92.8	66.2	79.5
Dixie 29C	92.2	88.5	90.4	94.8	80.9	87.9	87.8	62.9	75.4	91.6	77.4	84.5
T218 x T220	93.7	90.3	92.0	89.7	83.8	86.8	80.8	38.3	59.6	88.1	70.8	79.5
T218 x T222	93.7	88.3	91.0	96.7	49.7	73.2	97.4	8.6	53.0	95.9	48.3	72.1
T218 x T224	90.9	92.0	91.5	100.0	94.4	97.2	91.5	87.0	89.3	94.1	91.1	92.6
T220 x T222	93.1	86.0	89.6	90.0	26.3	58.2	62.7	8.8	35.8	81.9	40.4	61.2
T220 x T224	100.0	98.5	99.3	97.1	88.6	92.9	99.1	66.9	83.0	98.8	84.7	91.8
T222 x T224	97.3	89.8	93.6	96.5	89.6	93.1	95.7	64.6	80.2	96.5	81.3	88.9
Tenn. 604A	93.9	91.9	92.9	99.0	61.2	80.1	92.1	55.4	73.8	95.0	69.5	82.3
Tenn. 604B	98.9	89.1	94.0	94.1	84.9	89.5	90.4	51.5	71.0	94.5	75.2	84.9
Tenn. 604C	91.7	91.2	91.5	99.2	70.2	84.7	88.5	49.6	69.1	93.2	70.3	81.8
Dixie 22	91.0	60.0	75.5	87.7	40.8	64.3	88.3	53.9	71.1	89.0	51.6	70.3
Average	93.9	81.4	87.7	92.6	65.8	79.2	89.8	52.5	71.2	92.1	66.6	79.4
L. S. D. (.05)	for potassium means			1962	1963		for hybrid means			1962	1963	
(.01)	for potassium means			N. S.	15.6		for hybrid means			9.9	22.6	
				N. S.	N. S.					13.2	30.3	

^a150 and 144 days after planting for 1962 and 1963, respectively.

^bAll figures represent an average of 3 replications.

^cAll figures represent an average of 2 replications.

VIII. ROOT LODGING AND STALK BREAKAGE IN INBREDS

Very little root lodging was observed for any inbred during any of the three years, so root lodging and stalk breakage² were combined and are reported in Table 30. A significant difference in lodging between the 0 and 120 pound K_2O level was found in 1961. The actual percentage lodged dropped from 42 per cent for the 0 K_2O level to 30 per cent for the 120 pound K_2O level. A highly significant difference was found between inbred means which ranged from 12 per cent to 80 per cent lodged stalks. No significant potassium x inbred interaction was found.

There was not as much lodging in 1962 as in 1961 and the percentage dropped from 32 per cent for the 0 pound level to 8 per cent for the 120 pound treatment. A highly significant difference between the 0 level and added potash was observed but no difference between levels of added potash. The actual percentage ranged from 0 for NC 7 to 30 for T220 and T224. Interaction between inbreds and potassium was highly significant in 1962.

The amount of lodging decreased in 1963. It was 10 per cent compared to 32 per cent in 1962 and 42 per cent in 1961 for the 0 K_2O level. More lodging occurred at the 120 pound K_2O level than at the 0 K_2O level. In both 1962 and 1963 there was less lodging on the 40 pound K_2O level than on either the 0 or 120 pound K_2O level. No significant difference between added potassium levels was found, but a highly

²The combined lodging and breakage will be referred to as lodged, hereafter.

TABLE 30. Per cent combined root lodging and stalk breakage for 12 corn inbreds grown at 3 levels of potassium fertilization for 3 years

Corn Inbred	0 pounds K ₂ O per acre			40 pounds K ₂ O per acre			120 pounds K ₂ O per acre			Variety average		
	1961	1962	1963	Avg.	1961	1962	1963	Avg.	1961	1962	1963	Avg.
T101	57.4 ^a	10.2 ^a	25.9 ^b	31.2	53.6 ^a	1.3 ^a	13.1 ^b	22.7	42.9 ^a	1.4 ^a	16.7 ^b	20.3
T105	56.9	12.6	5.3	24.9	43.1	3.4	6.6	17.7	39.6	9.1	30.1	26.3
T111	10.4	37.5	3.3	17.1	9.2	2.6	4.7	5.5	17.4	4.6	0.0	7.3
T115	39.8	62.1	13.1	38.3	59.5	7.3	3.3	23.4	29.4	10.9	6.7	15.7
T218	32.5	42.0	5.6	26.7	42.3	9.6	0.0	17.3	29.2	6.7	1.8	12.6
T220	91.2	74.9	10.0	58.7	95.7	3.8	2.4	34.0	53.6	11.2	2.8	22.5
T222	17.9	30.1	10.4	19.5	25.1	4.5	0.0	9.9	31.5	14.8	20.5	22.3
T224	75.7	53.9	19.2	49.6	73.1	14.9	29.2	39.1	64.5	22.4	38.1	41.7
T202	29.5	12.4	0.0	14.0	34.3	1.1	0.0	11.8	8.3	1.2	0.0	3.2
T204	62.7	27.1	12.7	34.2	48.6	5.4	16.0	23.3	17.5	4.1	3.4	8.3
NC7	9.6	0.0	1.9	3.8	16.0	0.0	1.5	5.8	18.1	0.0	1.7	6.6
CI.21	23.2	24.0	8.8	18.7	17.1	0.0	5.5	7.5	11.0	8.2	1.6	6.9
Average	42.2	32.2	9.7	28.1	43.1	4.5	6.8	18.2	30.3	7.9	10.3	16.1
L. S. D. (.05) for potassium means	1961			1962	1963							
(.01) for potassium means	9.9			12.1	N.S.							
	N.S.			20.0	N.S.							
	1961			1962	1963							
	9.9			12.1	N.S.							
	N.S.			20.0	N.S.							
	1961			1962	1963							
	14.2			19.6	8.2							
	18.8			N.S.	11.0							

^aAll figures represent an average of 3 replications.

^bAll figures represent an average of 2 replications.

significant difference among inbreds occurred. Inbred averages ranged from 0 per cent for T202 to 29 per cent for T224. The interaction of potassium and inbreds was not significant.

IX. LODGING IN HYBRIDS

The differences between K_2O levels was not significant in 1961 (Table 31). A comparison of hybrid averages gave a highly significant difference. A highly significant potassium x hybrid interaction also occurred.

Applied potassium decreased lodging in 1962. The percentages being 24, 8, and 5 for the 0, 40, and 120 pound K_2O levels, respectively. A highly significant difference between the 0 and 40 and the 0 and 120 pound K_2O level occurred, but no significant difference was found between hybrid means which ranged from 5 per cent to 21 per cent lodged stalks. The potassium x hybrid interaction was not significant.

No significant difference between K_2O levels was found in 1963, but the actual per cent of lodged stalks did decrease from 35 per cent for the 0 pound K_2O level to 14 per cent for the 120 pound K_2O level. A highly significant difference between hybrids occurred. They ranged from 5 per cent for T101 x T111 to 51 per cent for T220 x T224. A highly significant potassium x hybrid interaction was found.

Of the three years only 1962 had a significant difference between K_2O levels, and only 1962 did not have significant differences between hybrid means.

TABLE 31. Per cent combined root lodging and stalk breakage for 19 corn hybrids grown at 3 levels of potassium fertilization for 3 years

Corn Hybrid	0 pounds K ₂ O per acre			40 pounds K ₂ O per acre			120 pounds K ₂ O per acre			Variety average						
	1961	1962	1963	Avg.	1961	1962	1963	Avg.	1961	1962	1963	Avg.				
T101 x T105	86.7 ^a	12.9 ^a	28.3 ^b	42.6	78.8 ^a	4.4 ^a	5.8 ^b	29.7	64.8 ^a	1.4 ^a	16.9 ^b	27.7	76.8	6.2	17.0	33.3
T101 x T111	36.1	23.2	26.2	28.5	65.9	12.1	9.3	29.1	74.2	9.7	21.9	35.3	58.7	15.0	19.1	30.9
T101 x T115		29.1	41.3	35.2		3.4	17.3	10.4		1.7	3.4	2.6		11.4	20.7	16.1
T105 x T111		16.8	1.6	9.2		3.4	10.6	7.0		6.2	3.1	4.7		8.8	5.1	7.0
T105 x T115	79.8	12.4	26.6	39.6	62.8	1.8	3.1	22.6	60.7	0.9	7.1	22.9	67.8	5.0	12.3	28.4
T111 x T115	96.9	18.8	31.9	49.2	89.0	3.6	1.6	31.4	89.9	4.2	19.9	38.0	91.9	8.9	17.8	39.5
Dixie 29A	78.9	3.5	32.1	38.2	74.5	15.9	17.1	35.8	65.8	5.9	15.1	28.9	73.1	8.4	21.4	34.3
Dixie 29B		25.8	33.4	29.6		4.2	15.7	10.0		2.4	13.3	18.5		10.8	20.8	15.8
Dixie 29C		29.0	21.2	25.1		5.7	11.9	8.8		7.8	11.4	9.6		14.2	14.8	14.5
T218 x T220	96.7	31.4	34.2	54.1	82.0	3.1	7.2	30.8	47.3	3.7	13.3	21.4	75.3	12.7	18.2	35.4
T218 x T222		26.4	11.8	19.1		6.0	1.5	3.8		1.7	11.4	6.6		11.3	8.2	9.8
T218 x T224		22.5	22.6	22.6		7.1	5.6	6.4		7.7	17.4	12.6		12.4	15.2	13.8
T220 x T222		38.5	81.3	59.9		19.8	12.7	16.3		3.2	5.9	4.6		20.5	33.3	26.9
T220 x T224		43.3	89.6	66.5		5.3	41.4	23.4		5.3	21.7	13.5		17.9	50.9	34.4
T222 x T224	51.2	23.3	23.1	32.5	79.4	9.2	30.0	39.5	67.7	4.9	20.1	30.9	66.1	12.5	24.4	34.3
Tenn. 604A	62.0	23.3	43.4	42.9	87.3	10.2	22.7	40.1	70.0	3.6	17.5	30.4	73.1	12.4	27.9	37.8
Tenn. 604B		24.4	48.5	36.5		12.4	21.3	16.9		11.7	20.0	15.9		16.1	29.9	23.0
Tenn. 604C		37.2	32.4	34.8		11.3	18.4	14.9		4.7	8.5	6.6		17.7	19.8	18.8
Dixie 22	91.8	16.9	35.7	48.1	85.2	7.0	19.5	37.2	87.1	11.4	23.3	40.6	88.0	11.8	26.2	42.0
Average	75.6	24.1	35.0	37.6	78.3	7.7	14.3	21.8	69.7	5.2	14.3	22.7	74.5	12.3	21.2	26.1
L. S. D. (.05)	for potassium means	1961	1962	1963	for potassium means	1961	1962	1963	for hybrid means	1961	1962	1963	for hybrid means	1961	1962	1963
(.01)	for potassium means	N.S.	4.0	N.S.	N.S.	N.S.	4.0	N.S.	20.6	N.S.	N.S.	N.S.	20.6	N.S.	N.S.	N.S.
	for potassium means	N.S.	6.6	N.S.	N.S.	N.S.	6.6	N.S.	for hybrid means	N.S.	N.S.	N.S.	for hybrid means	N.S.	N.S.	N.S.

^aAll figures represent an average of 3 replications.

^bAll figures represent an average of 2 replications.

X. CRUSHING STRENGTH AND RIND THICKNESS

A summary of the pounds of pressure necessary to crush a 2-inch section of corn internode is found in Tables 32 and 33. A highly significant difference was found between the 0 and 40 and between the 0 and 120 pound K_2O levels for inbreds, but hybrids gave only a significant difference. A highly significant difference was found between varieties in both inbreds and hybrids. The inbred NC 7 had about twice the crushing strength of T218, T220 or T224. The second internode above the brace roots required an average of 64 pounds less pressure to crush than the first internode. In the hybrids this difference was 121 pounds, and hybrids required almost twice as much pressure as inbreds.

In hybrids, stalk rind thickness gave no significant difference between K_2O levels or between hybrids (Tables 34 and 35). Data were incomplete for inbreds and no statistical analyses were made, but the same general trends were observed as in the hybrids. The rind thickness of the second internode was about 5 thousandths of an inch less than the first in both inbreds and hybrids.

TABLE 32. Pounds of pressure necessary to crush a 2-inch section of corn internode for 12 inbreds grown at 3 levels of potassium fertilization in 1962

Corn Inbred	0 pound K ₂ O/acre		40 pounds K ₂ O/acre		120 pounds K ₂ O/acre		Variety average	
	Internode		Internode		Internode		Internode	
	1 ^a	2 ^b	1	2	1	2	1	2
T101	426 ^c	360	708	635	718	667	617	554
T105	444	357	561	433	609	485	538	425
T111	263	262	479	495	627	591	456	449
T115	288	233	678	496	803	615	590	448
T218	302	269	404	353	397	283	368	302
T220	215	155	485	456	309	324	336	312
T222	307	284	466	338	422	398	398	340
T224	200	206	403	331	464	411	356	316
T202	293	283	523	493	503	467	440	414
T204	364	300	593	509	806	745	588	518
NC7	701	628	673	714	790	671	721	671
CL 21	412	360	681	579	638	490	577	476
Average	351	308	555	486	591	512	499	435
L. S. D. (.05) for potassium means (.01) for potassium means		Internode 1 2 71 66 97 90	Internode 1 2 for inbred means for inbred means		Internode 1 2 143 132 194 179			

^aThe first internode above the brace roots.

^bThe second internode above the brace roots.

^cAll figures represent an average of 10 samples.

TABLE 33. Pounds of pressure necessary to crush a 2-inch section of corn internode for 19 hybrids grown at 3 levels of potassium fertilization in 1962

Corn	0 pound K ₂ O/acre		40 pounds K ₂ O/acre		120 pounds K ₂ O/acre		Variety average	
	Internode		Internode		Internode		Internode	
	1 ^a	2 ^b	1	2	1	2	1	2
Hybrid								
T101 x T105	896 ^c	802	1321	1114	1355	1171	1191	1029
T101 x T111	601	549	803	702	949	807	784	686
T101 x T115	817	718	1119	996	1132	1026	1022	913
T105 x T111	804	680	943	807	1009	891	918	793
T105 x T115	805	683	1311	1120	1258	1076	1125	959
T111 x T115	642	461	968	806	933	772	847	679
Dixie 29A	978	822	925	819	1055	1078	986	906
Dixie 29B	915	752	1017	891	1053	869	995	837
Dixie 29C	802	678	921	833	1119	909	947	806
T218 x T220	528	446	1136	1018	947	783	870	749
T218 x T222	558	497	869	710	1288	1083	905	763
T218 x T224	738	570	894	784	955	817	863	723
T220 x T222	644	554	730	634	1042	987	805	725
T220 x T224	918	847	1050	901	910	828	959	859
T222 x T224	847	793	946	871	1031	912	941	859
Tenn. 604A	650	626	988	855	976	702	871	727
Tenn. 604B	788	702	979	854	730	640	832	732
Tenn. 604C	658	599	1050	806	834	845	847	750
Dixie 22	729	637	824	730	870	829	809	732
Average	753	653	989	855	1024	896	922	801
Internode								
1 2								
L. S. D. (.05) for potassium means	229	101	for hybrid means		184	171		
(.01) for potassium means	N.S.	N.S.	for hybrid means		245	229		

^aThe first internode above the brace roots.

^bThe second internode above the brace roots.

^cAll figures represent an average of 10 samples.

TABLE 34. Stalk rind thickness (thousandths of an inch) for the first and second internode above the brace roots for 12 inbreds grown at 3 levels of potassium fertilization in 1962

Corn Inbred	0 pound K ₂ O/acre		40 pounds K ₂ O/acre		120 pounds K ₂ O/acre		Variety average	
	Internode		Internode		Internode		Internode	
	1	2	1	2	1	2	1	2
T101	a	a	47	41	49	44	48	43
T105	36 ^b	30	37	33	39	37	37	33
T111	34	28	38	33	41	34	38	32
T115	a	a	41	37	46	40	44	39
T218	38	37	38	35	39	31	38	34
T220	a	a	48	42	49	39	49	41
T222	35	29	48	39	41	33	41	34
T224	a	a	42	36	42	35	42	36
T202	35	33	44	40	47	39	42	37
T204	52	46	42	43	55	50	50	46
NC7	44	40	47	45	44	43	45	43
CI. 21	46	38	46	40	45	36	46	38
Average	40	35	43	39	45	38	43	38

^aNo data available.

^bAll figures represent an average of 10 samples.

TABLE 35. Stalk rind thickness (thousandths of an inch) for the first and second internode above the brace roots for 19 hybrids grown at 3 levels of potassium fertilization in 1962

Corn Hybrid	0 pound K ₂ O/acre		40 pounds K ₂ O/acre		120 pounds K ₂ O/acre		Variety average	
	Internode		Internode		Internode		Internode	
	1	2	1	2	1	2	1	2
T101 x T105	52 ^a	48	53	53	65	57	57	53
T101 x T111	43	38	48	41	50	44	47	41
T101 x T115	59	54	45	44	53	48	52	49
T105 x T111	46	41	47	41	49	46	47	43
T105 x T115	48	44	52	45	49	45	50	45
T111 x T115	48	41	44	39	58	48	50	43
Dixie 29A	53	46	55	46	48	44	52	45
Dixie 29B	49	41	48	47	54	46	50	45
Dixie 29C	48	43	45	42	56	49	50	45
T218 x T220	44	39	52	43	51	44	49	42
T218 x T222	52	47	54	47	58	50	55	48
T218 x T224	42	41	52	45	53	46	49	44
T220 x T222	48	41	55	46	48	43	50	43
T220 x T224	55	46	50	42	51	46	52	45
T222 x T224	50	41	51	44	52	48	51	44
Tenn. 604A	46	40	55	49	48	43	50	44
Tenn. 604B	48	43	45	43	50	45	48	44
Tenn. 604C	48	41	51	47	50	47	50	45
Dixie 22	48	42	46	43	51	46	48	44
Average	49	43	50	45	52	47	50	45
Internode								
	1		2		1		2	
L. S. D. (.05) for potassium means	N. S.		N. S.		N. S.		N. S.	
(.01) for potassium means	N. S.		N. S.		for hybrid means		N. S.	
					for hybrid means		N. S.	

^aAll figures represent an average of 10 samples.

CHAPTER V

DISCUSSION AND CONCLUSION

I. YIELD

A significant or highly significant yield difference was obtained between K_2O levels for both inbreds and hybrids for all three years (Tables 4 and 5, pages 16 and 18). These results agree with data on lodging for inbreds and hybrids in 1962. Lodging decreased progressively with increased levels of potassium fertilization (Tables 30 and 31, pages 49 and 51). The three year yield average shows that inbred yields more than doubled with the addition of 40 pounds of K_2O per acre and tripled when 120 pounds of K_2O per acre was added. T220 produced consistent yields for all three years when 40 or more pounds of K_2O per acre was applied, but failed completely in 1962 when no potassium was applied and periods of moisture stress were encountered. The inbred yields in 1961 suggest that there was enough potassium in the soil the first year to benefit the plants in the 0 pound K_2O treatment. This is substantiated by the per cent potassium found in the ear leaf. There was adequate rainfall for corn production in 1963, and T101 x T115 was able to utilize more potassium from the 120 pound K_2O level and produce higher yields (90 versus 142 bushels) than on the 40 pound K_2O level. T218 x T224 produced about the same yield (85 versus 87 bushels) with inadequate moisture. Inbred corn yields were higher in 1962 than in 1963 for all potassium levels.

Correlation coefficients for several selected characteristics are given in Tables 36 to 40.

Potassium in the plant at any stage measured gave a highly significant positive correlation with yield, and magnesium gave a highly significant negative correlation. Calcium was very inconsistent. A highly significant negative correlation occurred between yield and calcium in the ear leaf of the hybrids in 1962, a positive correlation occurred between yield and calcium in the mature plants of inbreds in 1962, while all other correlations were not significant.

The inbreds in Dixie 29 and Tenn. 604 varied greatly in their response to added potassium. Grain yields and per cent increases are shown in Table 41 as an average of 1962 and 1963 data.

In the inbreds of Dixie 29, T111 had the smallest percentage increase in yield with the addition of either 40 or 120 pounds K_2O per acre. A 70 per cent increase in yield was obtained from 40 pounds K_2O , and no further increase occurred for 120 pounds of K_2O . The yield of T111 was double that of any other inbred in Dixie 29 when no potassium was added, however, T101 gave a 55 per cent increase when the applied potassium was increased from 40 to 120 pounds, whereas, T105 gave an 8 per cent increase.

The yields of the six possible single crosses from the four inbreds of Dixie 29 show that the yields were influenced by the inbreds. T105 x T111 increased only 28 bushels per acre or 38 per cent with the addition of 120 pounds of K_2O per acre while all single crosses with T115 showed almost a 3-fold increase. Even though the yield of T105 x

TABLE 36. Correlation coefficients (r) for several selected characteristics of corn inbreds grown at Crossville, Tennessee in 1961

Characteristic	Yield	Per cent lodged	Per cent dead stalks	Per cent element in mature plant (omitting ear)			Per cent element in mature plant (including ear)			Per cent element in ear leaf		
				K	Ca	Mg	K	Ca	Mg	K	Ca	Mg
Per cent lodged	-0.04											
Per cent dead stalks	-0.19	0.67**										
Potassium in mature plant omitting ear	0.64**	-0.24	-0.37*									
Calcium in mature plant omitting ear	0.22	0.30	0.31	0.12								
Magnesium in mature plant omitting ear	-0.46**	0.20	0.24	-0.53**	0.52**							
Potassium in mature plant including ear	0.63**	-0.21	-0.37*	0.98**	0.18	-0.50**						
Calcium in mature plant including ear	0.22	0.29	0.32	0.13	0.99**	0.50**	0.20					
Magnesium in mature plant including ear	-0.50**	0.21	0.25	-0.57**	0.48**	0.99**	-0.54**	0.46**				
Potassium in ear leaf	0.52**	-0.47**	-0.57**	0.76**	-0.09	-0.54**	0.74**	-0.07	-0.57**			
Calcium in ear leaf	0.02	0.41*	0.37*	-0.26	0.72**	0.53**	-0.20	0.71**	0.53**	-0.34		
Magnesium in ear leaf	-0.43**	0.34*	0.32	-0.60**	0.42**	0.78**	-0.55**	0.40*	0.79**	-0.69**	0.74**	

* and ** are correlation coefficients significantly different from 0.0 at the 5% and 1% levels, respectively.

TABLE 37. Correlation coefficients (r) for several selected characteristics of corn inbreds grown at Crossville, Tennessee in 1962

Characteristics	Yield	Per cent lodged	Per cent dead stalks		Per cent element in mature plant (Including ear)			Per cent element in ear leaf			Crushing strength		Rind thickness	
			(Days after planting)								Internode		Internode	
			129	150	K	Ca	Mg	K	Ca	Mg	1	2	1	2
Per cent lodged	-0.53**													
Per cent dead stalks (129)	0.06	0.25												
Per cent dead stalks (150)	0.29	0.31	0.75**											
Potassium in mature plant	0.64**	-0.33*	-0.18	-0.01										
Calcium in mature plant	0.51**	-0.46**	-0.03	0.09	0.25									
Magnesium in mature plant	-0.53**	0.31	-0.12	-0.12	-0.64**	0.15								
Potassium in ear leaf	0.71**	-0.57**	-0.19	-0.09	0.84**	0.27	-0.75**							
Calcium in ear leaf	0.04	0.09	0.21	0.35*	-0.19	0.68**	0.53**	-0.28						
Magnesium in ear leaf	-0.58**	0.46**	-0.07	-0.02	-0.66**	0.05	0.89**	-0.77**	0.60					
Crushing strength Internode 1	0.32	-0.65**	0.04	-0.20	0.25	-0.11	-0.47**	0.51**	-0.25	-0.55**				
Crushing strength Internode 2	0.23	-0.64**	-0.12	-0.35*	0.22	0.13	-0.40*	0.50**	-0.25	-0.49**	0.92**			
Rind thickness Internode 1	0.31	-0.34*	-0.17	-0.23	0.33	0.08	-0.31	0.40*	-0.18	-0.39**	0.43**	0.45**		
Rind thickness Internode 2	0.12	-0.35*	-0.17	-0.29	0.11	0.04	-0.23	0.31	-0.20	-0.29	0.52**	0.57**	0.88**	

* and ** are correlation coefficients significantly different from 0.0 at the 5% and 1% levels, respectively.

TABLE 38. Correlation coefficients (r) for several selected characteristics of corn hybrids grown at Crossville, Tennessee in 1962

Characteristic	Yield	Per cent lodged	Per cent dead stalks		Per cent elemenet in mature plant (Including ear)			Per cent element in ear leaf			Crushing strength		Rind thickness	
			(Days after planting)								Internode		Internode	
			129	150	K	Ca	Mg	K	Ca	Mg	1	2	1	2
Per cent lodged	-0.68**													
Per cent dead stalks (129)	-0.26	0.30*												
Per cent dead stalks (150)	-0.20	0.18	0.76**											
Potassium in mature plant	0.68**	-0.56**	-0.35**	-0.22										
Calcium in mature plant	0.05	-0.06	-0.43**	-0.38**	0.02									
Magnesium in mature plant	-0.76**	0.64**	0.13	0.05	-0.81**	0.24								
Potassium in ear leaf	0.79**	-0.70**	-0.28*	-0.20	0.90**	-0.03	-0.83**							
Calcium in ear leaf	-0.70**	0.42**	0.15	0.04	-0.73**	0.23	0.76**	-0.69**						
Magnesium in ear leaf	-0.86**	0.77**	0.16	0.09	-0.81**	0.10	0.87**	-0.93**	0.76**					
Crushing strength Internode 1	0.54**	-0.71**	-0.35**	-0.24	0.43**	0.03	-0.51**	0.54**	-0.19	-0.56**				
Crushing strength Internode 2	0.54**	-0.67**	-0.37**	-0.28*	0.45**	0.06	-0.51**	0.54**	-0.20	-0.56**	0.95**			
Rind thickness Internode 1	0.28*	-0.18	-0.17	-0.13	0.23	0.08	-0.12	0.29*	-0.12	-0.21	0.46**	0.43**		
Rind thickness Internode 2	0.29*	-0.32*	-0.35**	-0.28*	0.30*	0.20	-0.17	0.31*	-0.06	-0.24	0.56**	0.54**	0.85**	

* and ** are correlation coefficients significantly different from 0.0 at the 5% and 1% levels, respectively.

TABLE 39. Correlation coefficients (r) for several selected characteristics of corn inbreds grown at Crossville, Tennessee in 1963

Characteristic	Yield	Per cent lodged	Per cent dead stalks (Days after planting)		Per cent element in mature plant (Including ear)			Per cent element in ear leaf			Per cent element in plant (46 days after planting)			Crushing strength Internode	
			144	159	K	Ca	Mg	K	Ca	Mg	K	Ca	Mg	1	2
Per cent lodged	-0.30														
Per cent dead stalks (144)	0.07	0.16													
Per cent dead stalks (159)	0.05	0.20	0.90**												
Potassium in mature plant	0.75**	-0.09	0.11	0.06											
Calcium in mature plant	0.20	-0.13	0.24	0.20	0.36*										
Magnesium in mature plant	-0.49**	-0.02	-0.17	0.12	-0.63**	0.29									
Potassium in ear leaf	0.81**	-0.12	0.07	0.03	0.88**	0.10	-0.78**								
Calcium in ear leaf	0.11	-0.05	0.13	0.19	-0.07	0.67**	0.53**	-0.34*							
Magnesium in ear leaf	-0.63**	0.02	-0.06	0.01	-0.67**	0.23	0.90**	-0.86**	0.66**						
Potassium in plant 46 days after planting	0.72**	0.01	0.07	0.06	0.84**	0.11	-0.72**	0.94**	-0.27	-0.80**					
Calcium in plant 46 days after planting	-0.47**	0.02	-0.07	0.10	-0.36*	0.46**	0.63**	-0.52**	0.70**	0.69**	-0.40*				
Magnesium in plant 46 days after planting	-0.62**	-0.08	-0.06	0.09	-0.63**	0.25	0.81**	-0.79**	0.59**	0.89**	-0.69**	0.86**			
Crushing strength Internode 1	0.50**	-0.28	-0.26	-0.42**	0.23	-0.10	-0.20	0.43**	-0.36*	-0.44**	0.40*	-0.34*	-0.42**		
Crushing strength Internode 2	0.53**	-0.29	-0.33*	-0.49**	0.28	-0.09	-0.26	0.48**	-0.39*	-0.50**	0.44**	-0.38*	-0.48**	0.97**	

* and ** are correlation coefficients significantly different from 0.0 at the 5% and 1% levels, respectively.

TABLE 40. Correlation coefficients (r) for several selected characteristics of corn hybrids grown at Crossville, Tennessee in 1963

Characteristic	Yield	Per cent lodged	Per cent dead stalks		Per cent element in mature plant (Including ear)			Per cent element in ear leaf			Per cent element in plant (46 days after planting)			Crushing strength Internode	
			(Days after planting)		K	Ca	Mg	K	Ca	Mg	K	Ca	Mg	1	2
			144	159											
Per cent lodged	-0.54**														
Per cent dead stalks (144)	-0.61**	0.46**													
Per cent dead stalks (159)	-0.59**	0.31	0.78**												
Potassium in mature plant	0.82**	-0.46**	-0.52**	-0.53**											
Calcium in mature plant	-0.21	0.12	0.02	-0.01	-0.46**										
Magnesium in mature plant	-0.74**	0.47**	0.42**	0.32*	-0.87**	0.61**									
Potassium in ear leaf	0.84**	-0.45**	-0.47**	-0.46**	0.96**	-0.49**	-0.88**								
Calcium in ear leaf	-0.61**	0.36**	0.46**	0.40**	-0.66**	0.64**	0.68**	-0.68**							
Magnesium in ear leaf	-0.84**	0.51**	0.52**	0.44**	-0.91**	0.53**	0.94**	-0.94**	0.77**						
Potassium in plant 46 days after planting	0.77**	-0.42**	-0.48**	-0.47**	0.95**	-0.47**	-0.84**	0.95**	-0.62**	-0.88**					
Calcium in plant 46 days after planting	-0.72**	0.25	0.43**	0.41**	-0.70**	0.58**	0.71**	-0.71**	0.79**	0.75**	-0.70**				
Magnesium in plant 46 days after planting	-0.88**	0.39**	0.51**	0.48**	-0.90**	0.50**	0.89**	-0.94**	0.74**	0.95**	-0.91**	0.83**			
Crushing strength Internode 1	0.68**	-0.44**	-0.51**	-0.36**	0.46**	0.16	-0.47**	0.47**	-0.27*	-0.52**	0.42**	-0.35**	-0.52**		
Crushing strength Internode 2	0.68**	-0.44**	-0.51**	-0.33*	0.42**	0.16	-0.42**	0.42**	-0.26*	-0.49**	0.36**	-0.35**	-0.48**	0.92**	

* and ** are correlation coefficients significantly different from 0.0 at the 5% and 1% levels, respectively.

TABLE 41. Increase in bushels per acre and per cent increase from applied potassium for inbreds, single crosses, and hybrid permutations of Dixie 29 and Tenn. 604 (average of 1962 and 1963 yields)

	0 Lb. K ₂ O	40 pounds K ₂ O		120 pounds K ₂ O		
Variety	Bu./acre	Bu./acre	% increase 0/40 pounds K ₂ O	Bu./acre	% increase 0/120 pounds K ₂ O	% increase 40/120 pounds K ₂ O
Dixie 29						
T101	4	22	450	34	750	55
T105	5	25	400	27	440	8
T111	10	17	70	17	70	0
T115	3	27	800	36	1100	33
T101 x T105	62	99	60	117	89	18
T101 x T111	69	103	49	114	65	11
T101 x T115	48	92	92	116	141	26
T105 x T111	73	97	33	101	38	4
T105 x T115	37	85	130	98	164	15
T111 x T115	49	103	110	120	145	15
Dixie 29A	60	96	60	114	90	19
Dixie 29B	54	97	80	110	104	13
Dixie 29C	49	100	104	103	110	3
Tenn. 604						
T218	8	34	325	32	300	-6
T220	3	41	1267	55	1733	34
T222	9	38	322	42	367	11
T224	1	13	1200	26	2500	100
T218 x T220	57	108	89	118	107	9
T218 x T222	52	101	94	118	127	17
T218 x T224	40	71	78	86	115	21
T220 x T222	71	104	46	121	70	16
T220 x T224	48	95	98	115	140	21
T222 x T224	58	96	66	114	97	19
Tenn. 604A	56	97	73	109	95	12
Tenn. 604B	58	104	79	116	100	12
Tenn. 604C	54	96	78	110	104	15

T115 increased 164 per cent compared to 38 per cent for T105 x T111, T105 x T111 actually produced 3 bushels more corn per acre at the 120 pound K_2O level.

Inbred T111 and its single crosses apparently have the ability to absorb enough potassium on soils low in available potassium to produce reasonably good yields. T115 does not have this ability but has the ability to respond to high applications of K_2O .

Double cross yields can be predicted from single cross yields by taking the average yield of the four single crosses (excluding the two used as parents of the particular double cross). Thus, for Dixie 29A which is (T115 x T111) x (T101 x T105) the predicted yield consists of the average yield of T115 x T101, T115 x 105, T111 x T101, and T111 x T105. The predicted value for Dixie 29A was 57 bushels per acre on the no K_2O plots and the actual yield was 60 bushels per acre. On the 120 pound K_2O plots the predicted yield was 107 and the actual yield was 114 bushels per acre.

The yields of inbreds in Tenn. 604 varied greatly on the no potassium plots. T224 produced only one bushel per acre while T222 produced 9 bushels. This same general relationship occurred at the 120 pound K_2O level with T224 producing 26 bushels compared to 42 bushels for T222.

Inbreds T218 and T224 and their single crosses apparently do not have the ability to produce well at either medium or high levels of potassium fertilization, whereas, inbreds T220 and T222 do produce well.

The predicted yield for the no potassium plots of Tenn. 604A was 53 bushels and the actual yield was 56 bushels, and on the 120 pound plots the predicted was 110 and the actual harvested yield was 109 bushels.

II. MINERAL COMPOSITION

The highest percentage of potassium was found in the entire plant 46 days after planting (Tables 6 and 7, pages 20 and 21). Calcium was greatest in the ear leaf and magnesium percentages were about the same in the 46 days after planting sampling and the ear leaf sampling.

The amount of potassium decreased as the season progressed. A portion of this decrease can be attributed to the increase in the dry matter produced which would cause a concentration change. There have been suggestions that as the plant matures a large percentage of the potassium is lost from the leaves (23, 28).

The per cent potassium in the ear leaf, mature plant, and the per cent increase from applied potassium is shown in Tables 42 and 43.

T115 produced the greatest per cent increase in the potassium content of the ear leaf by addition of 120 pounds K_2O per acre. The actual per cent potassium was the lowest and appears to be transmitted to the single crosses containing T115.

The predicted potassium content of Dixie 29A was 0.60 per cent for the no potassium plots and the actual amount found was 0.64 per cent. When 120 pounds K_2O had been applied, the predicted percentage was 1.75 and the actual percentage measured was 1.81.

TABLE 42. Increases in potassium content of the ear leaf from applied potassium for inbreds, single crosses, and hybrid permutations of Dixie 29 and Tenn. 604 (average of 1962 and 1963 data)

Variety	0 Lb. K ₂ O	40 pounds K ₂ O		120 pounds K ₂ O		% increase 40/120 pounds K ₂ O
	% K	% K	% increase 0/40 pounds K ₂ O	% K	% increase 0/120 pounds K ₂ O	
Dixie 29						
T101	.60	1.00	67	1.62	170	62
T105	.50	1.25	150	1.69	238	35
T111	.58	1.11	91	1.54	166	39
T115	.36	.86	139	1.43	297	66
T101 x T105	.57	.89	56	1.81	218	103
T101 x T111	.68	1.14	68	1.80	165	58
T101 x T115	.51	.90	76	1.68	229	87
T105 x T111	.71	.98	38	1.78	151	82
T105 x T115	.50	1.11	122	1.74	248	57
T111 x T115	.53	1.19	125	1.65	211	39
Dixie 29A	.64	.99	55	1.81	183	83
Dixie 29B	.62	1.00	61	1.70	174	70
Dixie 29C	.52	1.04	100	1.83	252	76
Tenn. 604						
T218	.58	1.11	91	1.88	224	69
T220	.58	1.37	136	2.01	247	47
T222	.63	1.13	79	1.67	165	48
T224	.45	.84	87	1.46	224	74
T218 x T220	.54	1.28	137	2.11	291	65
T218 x T222	.52	1.25	140	1.93	271	54
T218 x T224	.62	1.25	102	2.04	229	63
T220 x T222	.69	1.11	61	1.83	165	65
T220 x T224	.51	1.24	143	1.93	278	54
T222 x T224	.62	1.10	77	1.92	210	75
Tenn. 604A	.59	1.06	80	1.90	222	79
Tenn. 604B	.61	1.08	77	1.81	197	68
Tenn. 604C	.50	1.06	112	1.80	260	70

CRANES CREST

TABLE 43. Increases in potassium content of the mature plant (including ear) from applied potassium for inbreds, single crosses, and hybrid permutations of Dixie 29 and Tenn. 604 (average of 1962 and 1963 data)

Variety	0 Lb. K ₂ O	40 pounds K ₂ O		120 pounds K ₂ O		% increase 40/120 pounds K ₂ O
	% K	% K	% increase 0/40 pounds K ₂ O	% K	% increase 0/120 pounds K ₂ O	
Dixie 29						
T101	.54	.79	46	1.07	98	35
T105	.48	.54	13	.93	94	72
T111	.45	.53	18	.81	80	53
T115	.45	.54	20	.75	67	39
T101 x T105	.40	.50	25	.97	143	94
T101 x T111	.39	.61	56	1.11	185	82
T101 x T115	.40	.48	20	1.05	163	119
T105 x T111	.34	.52	53	1.05	209	102
T105 x T115	.37	.59	59	.94	154	59
T111 x T115	.35	.58	66	.84	140	45
Dixie 29A	.42	.48	14	1.20	186	150
Dixie 29B	.37	.55	49	1.15	211	109
Dixie 29C	.39	.58	49	1.01	159	74
Tenn. 604						
T218	.48	.66	38	1.37	185	108
T220	.54	.82	52	1.28	137	56
T222	.44	.58	32	.98	123	69
T224	.51	.51	0	.74	45	45
T218 x T220	.34	.61	79	1.32	288	116
T218 x T222	.34	.59	74	1.05	209	78
T218 x T224	.47	.59	26	.87	85	47
T220 x T222	.38	.62	63	1.00	163	61
T220 x T224	.32	.56	75	.90	181	61
T220 x T224	.42	.51	21	1.02	143	100
Tenn. 604A	.34	.53	56	.97	185	83
Tenn. 604B	.41	.67	63	.93	127	39
Tenn. 604C	.37	.58	57	.94	154	62

Tenn. 604 is somewhat similar to Dixie 29 with T224 being much like the inbred T115 in Dixie 29.

The same general trends were found when the per cent potassium in a mature plant was used instead of per cent in the ear leaf. T115 and T224 were low and the single crosses containing them were lower than other single crosses containing different inbreds. The per cent potassium in a double cross hybrid could be predicted fairly accurately for Tenn. 604, but not for Dixie 29.

When the per cent potassium in the plant 46 days after planting was correlated with the per cent potassium in the ear leaf, it gave a r value of 0.94. When the per cent in the ear leaf was correlated with the per cent at maturity, it gave a r value of 0.88 in the 1963 inbreds. A correlation between any two of the three different sampling dates given above gave an r of 0.95 or higher in the 1963 hybrids. Magnesium in the inbreds for one date correlated with magnesium at another date gave r values of 0.81 or higher for the three sampling dates, and in the hybrids the lowest r was 0.89. The per cent calcium for the three sampling dates was correlated, but all r values except one were between 0.50 and 0.70. The per cent potassium was negatively correlated with per cent magnesium for all sampling dates for both inbreds and hybrids in 1963.

Increased potassium fertilization generally decreased the content of magnesium and decreased calcium for the first two sampling dates, but had very little effect on per cent calcium in the mature plant.

The potassium content of the ear leaf of the plants in the 0 pound K_2O treated plots was approximately 0.65 per cent, calcium 0.90 per cent, and magnesium 0.80 per cent; whereas, in plots with 120 pounds K_2O applied, the potassium content was 1.75 per cent, calcium 0.67 per cent, and magnesium 0.28 per cent. Stanford, et al. (30) found a ratio of calcium plus magnesium to potassium of 3.5 or less occurred in normal plants and ratios of 5 or above occurred in plants showing visible potassium symptoms.

III. DEAD STALKS

The addition of potassium decreased per cent dead stalks for the one sampling date in both inbreds and hybrids for 1961 (Table 26 through 29, pages 43, 44, 46, and 47). The 1961 decrease in inbreds was not significant even though the actual percentages decreased from 31 per cent to 25 per cent to 15 per cent for the 0, 40, and 120 pound K_2O levels. In 1962, the addition of potassium significantly increased the amount of dead stalks between the 0 pound K_2O level and the 40 pound K_2O level in the inbreds 129 days after planting. In 1962, there was no significant difference between the 0 and 40 pound K_2O plots. There was no significant difference between K_2O levels for the second date which was 150 days after planting. In the 1963 inbreds, potassium increased the per cent dead stalks for both dates, but the difference was not significant for either date. With very poor yields on the 0 pound K_2O plots, the potassium demands of the plants were lower and less potassium was needed to keep the plant from dying. There was a significant

decrease in the per cent dead stalks for both dates in the 1963 hybrids.

In some varieties the amount of potassium found in the ear leaf seems to be related to the per cent dead stalks and dead stalks related to lodging, but in other varieties the reverse of the above is true.

In 1963 inbreds, no characteristic except crushing strength was significantly correlated with dead stalks. As dead stalks increased, crushing strength decreased. Dead stalks decreased as per cent potassium in the plant increased in the hybrids. The correlation between per cent dead stalks for two different dates gave a r value of 0.90 for the inbreds and 0.78 for the hybrids.

IV. LODGING

In 1963, there was more lodging on the 120 pound K_2O plots in the inbreds than on the plots which had received no K_2O (Tables 30 and 31, pages 49 and 51). This was in agreement with per cent dead stalks 144 and 159 days after planting (Table 26 through 29, pages 43, 44, 46, and 47). There was more lodging in the 120 pound K_2O plots in both 1962 and 1963 than in the 40 pound K_2O plots. Generally, the inbreds produced very small yields on the 0 K_2O plots. With no grain there was no reason for them to go prematurely dead and to lodge. This may suggest an unbalanced nutrient condition which caused poor stalk strength or it may have been due to other complicating factors. Of the stalks lodged in the 0 pound K_2O level, 95 per cent had corn borer tunnels, 80 per cent in the 40 pound K_2O level, and 85 per cent in the 120 pound K_2O level had tunnels. There was a significant correlation between per cent

lodging and per cent dead stalks for one date in 1961 inbreds and in 1962 and 1963 hybrids.

The per cent lodging and crushing strength gave a significant negative correlation for inbreds and hybrids in 1962 and for 1963 hybrids. The percentage of the lodged stalks which contained borer tunnels in the hybrids in 1963 was 24, 36, and 63 for the 0, 40, and 120 pound K_2O levels, respectively. NC 7 had a three year variety average of 5 per cent lodged stalks compared to 43 per cent for T224. In the hybrids T105 x T111 and T218 x T222 had less than one-third as much lodging as Dixie 29A or Tenn. 604A.

There was no characteristic significantly correlated with lodging in 1963 inbreds, but generally as crushing strength increased lodging decreased. Lodging gave a positive correlation with per cent dead stalks 144 days after planting in the hybrids. A negative correlation was found between lodging and per cent potassium in the plant at all three sampling dates. When lodging was correlated with crushing strength a highly significant negative correlation was found.

V. PHYSICAL PROPERTIES

The r value for the correlation of the crushing strength of the first internode above the brace roots with the second internode was 0.97 for the inbreds and 0.92 for the hybrids in 1963. The rind thickness of the first internode correlated with the second gave an r of 0.88 for the inbreds and 0.85 for the hybrids in 1962. A highly significant

positive correlation was found between crushing strength and rind thickness for both internodes in 1962 inbreds and hybrids.

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CHAPTER VI

SUMMARY

The four inbreds, six possible single cross combinations for them, and the three possible permutations of the hybrids Dixie 29 and Tenn. 604 were grown on a Hartsells soil low in "available" potassium at the Plateau Experiment Station, Crossville, Tennessee, in 1961, 1962, and 1963. The four inbreds making up Dixie 22 and the hybrid Dixie 22 were also studied. The amount of dead stalks and lodging were determined at harvest. The potassium, calcium, and magnesium content of plant tissue were determined periodically throughout the growing season. Grain yields were determined at harvest.

The major results were as follows:

1. Additions of 40 and 120 pounds of K_2O significantly increased yields for inbreds and hybrids for all three years studied.
2. A highly significant difference in yield was found between variety means for inbreds for 1961 and 1963, and for hybrids for all three years.
3. There was no consistent difference between per cent lodged stalks and applied potassium in either inbreds or hybrids.
4. Potassium fertilization generally decreased dead stalks in hybrids. Potassium increased dead stalks in 1962 and 1963 inbreds, but decreased dead stalks in 1961 inbreds.

5. Potassium fertilization decreased the content of calcium and magnesium early in the season, but no significant differences in the amount of calcium was found when the plant approached maturity.
6. A highly significant difference was found between variety means for potassium, calcium, and magnesium content early in the season, but this difference was not found near maturity for calcium.
7. The maximum potassium content of the plant was found at the first sampling date; 46 days after planting. Potassium percentages decreased as the season progressed.
8. The per cent potassium in the plant 46 days after planting, in the ear leaf, and in the mature plant gave a high positive correlation.



LITERATURE CITED

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1. Baker, D. E., G. W. Gorsline, C. B. Smith, W. I. Thomas, W. E. Grube, and J. L. Ragland. 1964. Technique for rapid analyses of corn leaves for eleven elements. *Agron. J.* 56:133-136.
2. Beasley, A. B. 1950. Magnesium levels of Tennessee soils in relation to crop growth. Unpublished Master's Thesis, Univ. of Tenn., Knoxville, 41 p.
3. Chandler, W. V. 1960. Nutrient uptake by corn in North Carolina. *North Carolina Agr. Exp. Sta. Tech. Bull.* 143. 28 p.
4. Cochran, W. G. and G. M. Cox. 1957. *Experimental Designs.* John Wiley and Sons, Inc. New York, N. Y. 611 p.
5. Foley, D. C. and C. C. Wernham. 1957. The effect of fertilizers on stalk rot of corn in Pennsylvania (Abs.). *Phytopathology* 47:11-12.
6. Foy, C. D. and S. A. Barber. 1958. Magnesium deficiency and corn yield on two acid Indiana soils. *Soil Sci. Soc. of Am. Proc.* 22:145-148.
7. Giesecking, J. E., H. J. Snider, and C. A. Getz. 1935. Destruction of organic matter in plant material by the use of nitric and perchloric acids. *Ind. and Eng. Chem. Anal. Ed.* 7:185-186.
8. Gorsline, G. W., J. L. Ragland, and W. I. Thomas. 1961. Evidence of inheritance of differential accumulation of calcium, magnesium, and potassium. *Crop Sci.* 1:155-156.
9. Gorsline, G. W., W. I. Thomas, D. E. Baker, and J. L. Ragland. 1964. Relationships of strontium-calcium accumulation within corn. *Crop Sci.* 4:154-156.
10. Gorsline, G. W., W. I. Thomas, D. E. Baker, and C. C. Wernham. 1963. Corn leaf blight severity associated with genetically controlled element content. *Plant Disease Rept.* 47:(5)359-361.
11. Hanaway, J. J. 1962 a. Corn growth and composition in relation to soil fertility: I. Growth of different plant parts and relation between leaf weight and grain yield. *Agron. J.* 54: 145-148.

12. Hanaway, J. J. 1962 b. Corn growth and composition in relation to soil fertility: II. Uptake of N, P, and K and their distribution in different plant parts during the growing season. Agron. J. 54:217-222.
13. Hanaway, J. J. 1962 c. Corn growth and composition in relation to soil fertility: III. Percentages of N, P, and K in different plant parts in relation to stage of growth. Agron. J. 54: 222-229.
14. Hanaway, J. J. 1964. The marvelous corn plant. Plant Food Rev. 10:(1)2-3.
15. Ibach, D. B., J. R. Adams, and E. I. Fox. 1964. Commercial fertilizer used on crops and pasture in the United States - 1959 estimates. U. S. Dept. Agr. Stat. Bull. 348, 201 p.
16. Josephson, L. M. 1962. Effects of potash on premature stalk dying and lodging of corn. Agron. J. 54:179-180.
17. Key, J. L. and L. T. Kurtz. 1960. Response of corn and soybeans to magnesium fertilizers. Agron. J. 52:300.
18. Koehler, B. 1960. Cornstalk rots in Illinois. Illinois Agr. Exp. Sta. Bull. 658, 90 p.
19. Krantz, B. A. and W. V. Chandler. 1954. Fertilize corn for higher yields. North Carolina Agr. Exp. Sta. Bull. 366 (revised), 71 p.
20. Krantz, B. A. and W. V. Chandler. 1951. Lodging, leaf composition, and yield of corn as influenced by heavy applications of nitrogen and potash. Agron. J. 43:547-552.
21. Krantz, B. A. and P. H. Harvey. 1948. How to get that new hybrid sooner! Crops and Soils 1:(1)19, 22.
22. Magnitski, K. P. 1960. The diagnosis of mineral nutrition of plants according to chemical composition of leaves, p. 159-179. In W. Reuther (ed.), Plant analysis and fertilizer problems. Am. Inst. of Biol. Sci., Wash., D. C.
23. Nelson, L. B. 1956. The mineral nutrition of corn as related to its growth and culture, p. 321-375. In A. G. Norman (ed.), Advances in Agronomy. Academic Press Inc. New York, N. Y.
24. Otto, H. J. and H. L. Everett. 1956. Influence of nitrogen and potassium fertilization on the incidence of stalk rot of corn. Agron. J. 48:301-305.

25. Peech, M. and R. Bradfield. 1943. The effect of lime and magnesia on the soil potassium and on the absorption of potassium by plants. *Soil Sci.* 55:37-48.
26. Pierre, W. H. and C. A. Bower. 1943. Potassium absorption by plants as affected by cationic relationships. *Soil Sci.* 55:23-36.
27. Sayre, J. D. 1948. Mineral accumulation in corn. *Plant Physiol.* 23:267-281.
28. Sayre, J. D. 1955. Mineral nutrition of corn. *In* Corn and Corn Improvement, G. F. Sprague (ed.). *Agron. Mono.* 5:293-314.
29. Sommer, A. L., J. I. Wear, and A. Baxter. 1940. The response to magnesium of six different crops on sixteen Alabama soils. *Soil Sci. Soc. of Am. Proc.* 5:205-212.
30. Stanford, G., J. B. Kelly, and W. H. Pierre. 1941. Cation balance in corn grown on high-lime soils in relation to potassium deficiency. *Soil Sci. Soc. of Am. Proc.* 6:335-341.
31. Thomas, W. I., D. E. Baker, and G. W. Gorsline. 1963. Chemical element accumulation in corn. *Proc. of the Eighteenth Ann. Hybrid Corn Research-Industry Conf.* 53-61.
32. Tyner, E. H. 1946. The relation of corn yields to leaf nitrogen, phosphorus, and potassium content. *Soil Sci. Soc. of Am. Proc.* 11:317-323.
33. Wittels, H. and L. F. Seatz. 1953. Effect of potash fertilization on yield, stalk breakage and mineral composition of corn. *Soil Sci. Soc. of Amer. Proc.* 17:369-371.
34. York, E. T., Jr., R. Bradfield, and M. Peech. 1954. Influence of lime and potassium on yield and cation composition of plants. *Soil Sci.* 77:53-63.
35. Zuber, M. S., and F. F. Dicke. 1964. Interrelationship of european corn borer, plant populations, nitrogen levels, and hybrids on stalk quality of corn. *Agron. J.* 56:401-402.



APPENDIXES

APPENDIX A

PROCEDURE FOR DETERMINATION OF POTASSIUM, CALCIUM, AND MAGNESIUM, CONTENT OF PLANT TISSUE BY THE BEAKER METHOD

1. Plant samples are oven dried at 70 C., stored in air-tight bottles until analyzed.
2. Weigh a 0.500 gram plant sample into a 150 ml. beaker.
3. Add 5 ml. of concentrated nitric acid and take to dryness on hot plate.
4. Add 5 ml. of diluted acid (1 to 1) and 5 ml. of concentrated perchloric acid (70-72 per cent) and take to dryness on hot plate.
5. Add 5 ml. of diluted hydrochloric acid (1 to 1) and enough distilled water to wash off watch glass and gently warm.
6. Filter, using Whatman No. 42 filter paper, into 250 volumetric flasks.
7. Make up to volume with distilled water.
8. Mix well and procure a small portion of the solution (about 5 ml.) to determine potassium, calcium, and magnesium with a flame spectrophotometer.
9. The sample readings are compared with the calibration curve obtained from standard solutions and calculated.

APPENDIX B

PROCEDURE FOR DETERMINATION OF POTASSIUM, CALCIUM, AND MAGNESIUM BY THE ALUMINUM HEATING BLOCK METHOD

1. Plant samples are oven dried at 70 C., stored in air-tight bottles until analyzed.
2. Weigh into 50 ml. graduated tubes 0.500 grams of plant tissue.
3. Add 3 ml. of concentrated nitric acid and let stand overnight. Add 2 small glass beads to the tubes; place small glass funnels in the mouth of the tubes to act as condensers. Place tubes in the aluminum heating block on a hot plate. The temperature at the beginning of this digestion should be below 50 C.
4. After the tubes have been placed on the hot plate raise the temperature to 150 C. and digest at this temperature for one hour.
5. At the end of the hour of digestion, add 2 ml. of 60 to 70 per cent perchloric acid to the tube through the glass funnel.
6. Increase the temperature to 235 C. and digest for 2 hours at this temperature. Do not remove the funnels from the tubes until after one hour and 45 minutes at this temperature.
7. At the end of 2 hours remove the tubes and allow to cool then add 1 ml. of concentrated hydrochloric acid and place on the hot plate for 15-20 minutes at 120 C.
8. Transfer into 250 ml. volumetric flask, and make up to volume with distilled water.

9. Mix well and let set overnight and then a small portion of the solution is used to determine potassium, calcium, and magnesium with a flame spectrophotometer.
10. The sample readings are compared with the calibration curve obtained from standard solutions and calculated.

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