

EVALUATION OF SECOND CYCLE INBRED LINES OF MAIZE

By

RAMA DAYAL SINGH

AN ABSTRACT

Submitted to the School of Advanced Graduate Studies  
of Michigan State University of Agriculture and  
Applied Science in partial fulfillment of  
the requirements for the degree of

DOCTOR OF PHILOSOPHY

Department of Farm Crops

1956

Approved

Kenyon H. Payne (for E. C. Rossmann)



An Abstract

Twenty S<sub>6</sub> second cycle lines developed by inbreeding and selection in the double cross Ohio M 15 (Oh 51 x Oh 26) x (Ill.A x W 23) were used to study the degree of relationship with the four parental lines and among themselves. These lines were crossed on ten testers, seven related (four parental inbreds, two single crosses and the double cross Ohio M 15) and three unrelated testers (inbred M 14, single cross M 14 x W F 9 and double cross Ia. 4483 (M 14 x W F 9) x (B<sub>8</sub> x B16)).

Seven of the second cycle lines, four parental lines and one unrelated line, M 14 were used to produce, 66, single crosses. Actual and predicted performance of double crosses were compared with the parental Ohio M 15.

A few of the second cycle lines were more vigorous than and superior to the parental inbreds in combining ability. Second cycle lines were genetically different from some of the parents and from each other.

A few double crosses equal to or slightly better than Ohio M 15 were produced by crossing four second cycle lines or by substituting them with one or more of the parental lines in the pedigree of Ohio M 15. Predicted yield, percentage of moisture and stalk lodging of the double crosses from the single cross data showed significant correlation with the actual yield, percentage of moisture and stalk lodging.

These results indicate that, even the lines of the same origin can be used to produce good hybrids, if they were





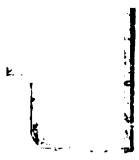
extracted from a wide genetic base.

Inbred and single-cross testers were very specific in evaluating the lines for yield and lodging. This suggests the use of more than one of these as testers for general combining ability. The 'r' value between the two double cross testers was a significant (.46) but low enough to suggest the use of more than one tester for evaluating the lines for general combining ability for yield. A high 'r' value for the mean of the four parental inbred testers with the mean of their two single crosses suggested that either four inbreds or their two single crosses may be used for evaluating general combining ability of the lines for yield.

Either the four inbred testers or their two single crosses, or the double cross of the four inbreds could be used to evaluate the lines for resistance to stalk lodging. A similar situation was indicated for resistance to root lodging.

Correlation for the two tester groups (related and unrelated) indicates that either related or unrelated testers, as a group, were reliable for estimating relative general combining ability for yield, maturity, and stalk lodging resistance.

The correlation coefficients for maturity were significant in all cases and were generally high, suggesting fewer testers would be needed to evaluate maturity than yield or lodging resistance.



For related lines, genes conditioning specific combining ability were relatively more important in influencing yield than genes for general combining ability.

Analysis of components of variance shows that for yield, line x tester interaction decreased with increased genetic variation in the tester. This same relationship did not exist for maturity.



THE [illegible] OF [illegible]

[illegible text]

**EVALUATION OF SECOND CYCLE INBRED LINES OF MAIZE**

**By**

**RAMA DAYAL SINGH**

**A THESIS**

**Submitted to the School of Advanced Graduate Studies  
of Michigan State University of Agriculture and  
Applied Science in partial fulfillment of  
the requirements for the degree of**

**DOCTOR OF PHILOSOPHY**

**Department of Farm Crops**

**1956**



### ACKNOWLEDGEMENTS

Direction and guidance was provided by Dr. E. C. Rossman. The assistance of Dr. W. D. Baten in statistical analysis of the data and helpful suggestions on writing from Dr. K. T. Payne and Dr. S. T. Dexter are acknowledged.

Financial support of the Michigan Certified Hybrid Seed Corn Producers Association helped to complete this investigation.

## TABLE OF CONTENTS

	Page
INTRODUCTION .....	1
REVIEW OF LITERATURE .....	4
MATERIALS AND METHODS .....	10
EXPERIMENTAL RESULTS .....	14
Performance of 20 S <sub>6</sub> second cycle lines .....	14
Combining ability of second cycle lines compared with parents .....	16
Genetic similarity of second cycle lines .....	25
Performances of the single and double crosses of second cycle lines .....	42
Evaluation of second cycle lines by different types of related and unrelated testers .....	61
DISCUSSION .....	83
SUMMARY .....	89
LITERATURE CITED .....	92
APPENDIX .....	95





## Introduction

The need of more efficient methods of isolating and evaluating improved inbred lines of corn is paramount if corn breeding is to progress significantly beyond its present status. In the early stages of hybrid corn breeding, inbred lines were produced solely from open pollinated varieties. While some of these lines were very desirable for hybrid corn production and are still among the more popular lines in commercial production, a very high percentage was discarded because of poor plant characteristics or inability to transmit high yields and other desirable agronomic characteristics to their hybrids.

In more recent years, new lines have been produced from previously developed lines after combining them in crosses. A number of desirable lines have been isolated by second cycle inbreeding, but very few have been superior in commercial production to the best lines developed through inbreeding in open pollinated varieties. Several workers have reported that the isolation of second cycle inbred lines from single crosses precludes their use in hybrid combinations with each other or with the parental inbreds due to close genetic similarity. Second cycle inbreeding and selection in double cross hybrids and other crosses involving more than four inbred lines of diverse origin might reduce the dangers of close relationship among the inbreds.

UJ

Page 10

The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that every entry must be supported by proper documentation, such as receipts or invoices. This ensures transparency and allows for easy verification of the data.

Furthermore, the document highlights the need for regular audits. By conducting periodic reviews, any discrepancies or errors can be identified and corrected promptly. This proactive approach helps in maintaining the integrity of the financial system and prevents potential issues from escalating.

In addition, the document stresses the importance of clear communication between all parties involved. Regular meetings and reports should be used to keep everyone informed about the current status and any changes that may occur. This collaborative effort is essential for the successful operation of the organization.

The second part of the document provides a detailed overview of the current financial performance. It includes a summary of the revenue generated, the expenses incurred, and the resulting profit or loss. This information is crucial for understanding the overall health of the business and for making informed decisions about future investments and strategies.

Key findings from the analysis include a steady increase in revenue over the past quarter, which is attributed to the successful launch of new products and services. However, there is a notable increase in operational costs, particularly in the area of marketing and distribution. This suggests that while sales are growing, the cost of reaching the market is also rising.

Based on these findings, the document recommends several actions to improve efficiency and reduce costs. These include negotiating better terms with suppliers, optimizing the distribution network, and implementing more targeted marketing campaigns. By following these recommendations, the organization can enhance its profitability and maintain its competitive edge in the market.

The document concludes by reiterating the importance of ongoing monitoring and reporting. It encourages the management team to stay vigilant and to continue to seek opportunities for improvement. The goal is to ensure that the organization remains financially sound and capable of achieving its long-term objectives.

Continued inbreeding and selection in open pollinated varieties and other broad gene bases is necessary to maintain or extend genetic diversity among inbred lines. Second and continued cycles of inbreeding and selection among crosses of these lines may lead to further improvement and refinement in the inbreds and their hybrids.

Thus far it has been impossible to isolate inbred lines superior for complexly inherited characteristics such as yield by visual means. Superior lines can be developed only by extensive and expensive testing programs. The top-cross method, using an open pollinated variety or double cross hybrid as a tester to identify lines of superior general combining ability, has been widely used.

In 1948, inbreeding and visual selection for desirable agronomic characteristics was started in the double cross hybrid Ohio M 15 (Oh. 26 X Oh. 51) x (Ill.A x W 23). The hybrid was a popular, productive, medium-early maturing hybrid, well adapted throughout central Michigan. During the course of routine inbreeding and selection, it became apparent that a group of lines distinctly different from the four parental lines in appearance was being developed. No evaluation for combining ability in test crosses had been made during the six generations of inbreeding and selection. Since it has become more or less standard procedure in corn breeding to avoid hybrids containing related inbred lines, it appeared desirable to determine the extent of genetic relationship in this material and how detrimental this



relationship might be in producing improved hybrids in the Ohio M 15 maturity group. The present study has been conducted toward the above end.

## Review of literature

Isolation of second cycle lines has been designated by various names such as 'pedigree system of breeding' and 'cumulative selection'. Wu (30), in studying the pedigree method of breeding for improvement of inbred lines isolated from single crosses, measured 11 characters in the progeny inbred lines and in the original parental inbred lines. All of these characters except two showed significant variability. Selection for certain characters by the pedigree method of breeding was effective in isolating inbred lines more desirable in these characters than either parent. Hayes and Johnson (12) isolated inbred lines from single crosses that were improved in vigor, lodging resistance and smut resistance. Similar results were reported by Johnson and Hayes (18), Sprague (27) and Green (11) in the improvement of inbred lines by the pedigree method of breeding.

Genetic diversity among inbred lines has generally produced higher yielding hybrids than when the inbreds were closely related. Wu (30) showed that related inbred lines produced single cross hybrids that yielded consistently lower than single crosses composed of inbred lines of diverse genetic origin. Hayes and Johnson (12) reported results from the same type of study. In crosses of unrelated lines, twenty eight of forty-three single crosses were equal to or better than standard double crosses in yielding ability and





moisture percentage. Where one parent was common, six out of fifteen crosses and where both parents were common one out of fifteen were equal or better in yield and moisture percentage than the standard double crosses. Johnson and Hayes (18) presented additional data from crosses between related inbred lines to show that genetic diversity was important to obtain maximum expression of hybrid vigor. Eckhardt and Bryan (8 and 9) and Cowan (5) also confirmed the importance of genetic diversity for the production of high yielding hybrids.

Development of inbred lines is comparatively simple compared to problems of evaluating the lines. The importance of this was stressed as early as 1909 by Shull (25). For a time it was customary to make and test as single crosses all possible combinations among the lines. This method was expensive and inefficient, even for the small number of inbreds used.

Jenkins (14) reported correlations for the yield of double crosses with: (a) the mean yield of all six possible single crosses from four inbreds, (b) with the mean yield of the four nonparental single-cross combinations, (c) with the mean yield of all single crosses involving the four lines of the double cross, (d) with the mean yield of the inbred x variety top cross results for the four parent inbreds. Method (b) was more genetically sound and the results agreed better with the actual double cross performance. The correlations for predicted and actual yields for methods (a), (b) and (c)



were 0.75, 0.76 and 0.73 respectively showing little difference for the three methods. The correlations for the inbred variety crosses was 0.61, still significant.

Methods (a), (c) and (d) all assume additive gene action. Method (b) no additive effects arising from dominance, epistasis etc.

The effectiveness of predicting the yields of double crosses from the mean yields of the four nonparental single crosses has now been tested at several experiment stations. Doxtator and Johnson (7) compared the predicted and observed yield of seven double crosses and two three way crosses. They reported that by appropriate use of single cross data, the highest yielding double cross combination could be predicted. Anderson (1) compared the actual yield of 15 double crosses with the predicted yield by method (b) of Jenkins and found close agreement between predicted and actual yields. The correlation was 0.9. Hayes, Murphy and Rinke (13) reported a comparison between actual and predicted yield and moisture content of 114 double crosses. There was excellent agreement between the predicted and actual results. Prediction of double-cross yields from data of the four nonparental single crosses has become an accepted method in corn breeding. Millang and Sprague (22), Combs and Zuber (4) have prepared a procedure which facilitates the prediction of the double crosses by use of the punchcard machine method.

The ultimate use of the inbred lines in hybrids and their final selection is based on hybrid performances. In

— *Journal of the American Medical Association*, 1997

the 1990s, the number of people in the world who are illiterate has increased from 1.2 billion to 1.5 billion. The number of illiterate people in the world is projected to reach 1.7 billion by the year 2015. The number of illiterate people in the world is projected to reach 1.7 billion by the year 2015.

1. *Journal of the American Medical Association*, 1997; 277: 1033-1036.

earlier days, all the lines were crossed with each other and tested. It was a very tedious and expensive job. A more efficient method was available in the use of the inbred x variety crosses.

Jones (19) reported on inbred x variety crosses. He was mainly interested in relative performance, rather than as a method of evaluating the lines. Davis (6) used this method of inbred variety crosses for determining the combining ability of  $S_2$  lines.

Jenkins and Brunson (16) compared the ranking of inbred lines by the inbred x variety crosses and single crosses. Coefficients of correlation for many characters were calculated between the mean performance of inbred lines as single crosses and their performance x in crosses with an open pollinated variety. They concluded that open pollinated varieties were effective in the preliminary testing of new lines.

Johnson and Hayes (18) reported the relation between top cross yield and single yields for 11 inbred lines derived from the variety "Golden Bantam". It was found that the inbreds yielding high in top crosses were most likely to produce the high yielding single crosses. They also recommended this method for the preliminary evaluation of inbred lines.

The choice of the tester depends upon the use to be made of the lines. A suitable tester should detect inherent differences in the combining ability of the lines. Beard (2) has compared the use of single crosses and an open pollinated



variety as testers. He concluded that the single crosses were at least equal to the open pollinated variety for evaluating combining ability. Federer and Sprague (10) concluded that increasing the number of testers improved the estimates of combining value more than increasing the number of replications.

Keller (20) reported the relationship between the use of a related and an unrelated single cross as the tester parent in evaluating a group of selected  $F_2$  plants of maize. The results indicate that the two testers did not rank the lines in the same order due to differences in specific combining ability of the testers. Another study was made to determine the association among the four testers for evaluating the lines. The results suggest that the inbred lines and the variety Krug as testers did not rank the lines similarly. The data suggest the use of a number of testers for evaluating general combining ability. It was also concluded that the use of the tester should be decided by the use to be made of the lines.

Matizinger (21) used 16 inbred lines, divided at random into two groups. One of the groups was used as testers and the other as lines to be tested. The testers included eight inbred lines, two double crosses and four component single crosses. The eight lines tested were placed in the same rank when averages were obtained over all testers within a given type. The variance component estimates of the interactions involving acre yields of the inbred testers x lines, single cross testers x lines and double cross testers x lines





indicate that as the genetic variation within a tester parent increased, the line x tester interaction decreased. This relationship did not hold good in the case of moisture percentage. He concluded that when specific combining ability is of importance the best tester is the opposite single cross parent of the double cross or its component lines. The results indicate that the ranking of lines for general combining ability can be attained the most economically through the use of a tester having a broad gene base.

General and specific combining ability were defined by Sprague and Tatum (29). Variances for these characteristics were obtained from single-cross yield trials. They concluded that general combining ability was relatively more important than specific combining ability among untested lines. Specific combining ability was relatively more important than general combining ability among previously tested lines.

—

1. *Journal of the American Medical Association*, 1997; 277: 1033-1038.

— *Journal of the American Medical Association*, 1967, 202: 1033.

• • •

## Materials and Methods

Twenty S<sub>6</sub> second cycle inbreds developed by inbreeding and selection in the double cross Ohio M 15 (Oh 51 x Oh 26) x (Ill.A x W 23) were each crossed to ten testers in 1954. Inbreeding and visual selection for desirable agronomic characteristics was started in 1948. None of the lines had been previously evaluated for combining ability. Since visual selection for combining ability for yield among and between inbreds has generally been ineffective (15), the 20 second cycle lines can be considered as a small random sample of the original population with respect to yielding ability.

Origin of the four parental inbreds is:

Oh 51-Early Clarage open pollinated variety

Oh 26-Early Clarage open pollinated variety

Ill.A-Funk Yellow Dent open pollinated variety

W 23-Golden Glow open pollinated variety.

The seven related testers were the four parental inbred lines, Oh 51, Oh 26, Ill.A, and W 23 and the two parental single cross hybrids: (Oh 51 x Oh 26) and (Ill.A x W23) and the parental double cross, Ohio M 15 (Oh 51 x Oh 26) x (Ill.A x W 23). The three unrelated testers were M14 (an inbred line), (M 14 x W F 9) and Ia. 4483 (M 14 x W F 9) x (B 8 x B 16). These 200 crosses were tested in 1955 at two locations (Ingham and Saginaw Counties) in a split plot design with testers as main plots and second cycle lines as sub-plots. Three replications were used at each location.



Seven of the second cycle lines, the four parental lines and the unrelated line M 14 were used to produce the 66 possible single cross combinations in 1954. These were tested in 1955 with two entries of Ohio M 15, Michigan 350, Michigan 480, Michigan 570 and single cross (M 14 x W F 9) in an 8 x 9 rectangular lattice design with three replications at two locations, Saginaw and Ingham Counties.

Each of the five tester inbreds, (Oh 51, Oh 26, Ill.A, W 23, and M 14) was crossed with the other nine testers making 35 crosses. These 35 crosses were tested with the three tester single crosses, (Oh 51 x Oh 26), (Ill.A x W23) and (M 14 x W F 9) and the two double cross testers Ia. 4483 and Ohio M 15. The experiment was planted at two locations (Ingham and Saginaw Counties) in a randomized design with three replications at each location.

Double-cross seed was produced in Florida during the winter of 1954-55. Twenty seven double crosses were made in which one of the four parental lines of Ohio M 15 was replaced with a second cycle line and four crosses with M 14. Forty three double crosses were made using only the second cycle lines. All were "guess" combinations since single-cross and test-cross data were not available for predicting the best double crosses that could be produced. These double crosses were tested in 1955 with three entries of Ohio M 15, Michigan 350, Michigan 430, Michigan 480 and Michigan 570 as standards. The experiment was planted at two locations (Ingham and Saginaw Counties) in a 9 x 9 triple lattice design with three replications.



The Ingham County location was planted on the May 7, 1955 at the Farm Crops Field Laboratory of Michigan State University and the Saginaw County location was planted on May 3, 1955 on the farm of Walter Reinbold near Reese, Michigan. Plots were 2 x 5 hills, thinned to three plants per hill.

The twenty second cycle inbreds, the four parental inbreds and the unrelated inbred M 14 were compared in a randomized block design with four replications in 1954 and in a simple lattice design with four replications in 1955. Plots were 15 feet long, thinned to 15 plants per plot.

### Yield trials in 1955

There were five yield trials in 1955 at each of two locations, Ingham and Saginaw Counties.

- 1) Test crosses        - 200 test crosses (20 inbreds x 10 testers)
- 2) Single crosses     - 66 single crosses plus 6 standard hybrids (72 entries)
- 3) Tester crosses    - 35 test crosses plus 5 standards (40 entries)
- 4) Double crosses    - 74 crosses plus 7 standards hybrids (81 entries)
- 5) Inbred lines       - 25 inbreds.

### Observations

Stand and missing-hill counts were made before harvest at both locations. Counts of stalk lodging (plants broken below the ear) were made. Root lodging counts were made for plants leaning at an angle of 30° or more from vertical.

• The first of these is the fact that the  
• second is the fact that the  
• third is the fact that the  
• fourth is the fact that the  
• fifth is the fact that the  
• sixth is the fact that the  
• seventh is the fact that the  
• eighth is the fact that the  
• ninth is the fact that the  
• tenth is the fact that the

#### THE SECOND PART

• The first of these is the fact that the  
• second is the fact that the  
• third is the fact that the  
• fourth is the fact that the  
• fifth is the fact that the  
• sixth is the fact that the  
• seventh is the fact that the  
• eighth is the fact that the  
• ninth is the fact that the  
• tenth is the fact that the

• The first of these is the fact that the

#### THE THIRD PART

• The first of these is the fact that the  
• second is the fact that the  
• third is the fact that the  
• fourth is the fact that the  
• fifth is the fact that the  
• sixth is the fact that the  
• seventh is the fact that the  
• eighth is the fact that the  
• ninth is the fact that the  
• tenth is the fact that the

• The first of these is the fact that the

#### THE FOURTH PART

• The first of these is the fact that the  
• second is the fact that the  
• third is the fact that the  
• fourth is the fact that the  
• fifth is the fact that the  
• sixth is the fact that the  
• seventh is the fact that the  
• eighth is the fact that the  
• ninth is the fact that the  
• tenth is the fact that the

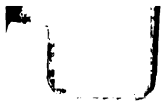


The Ingham County experiments were harvested on October 3, and Saginaw County on October 23, 1955. Ten ears were taken at random from each plot for determination of moisture percentage in the ear at harvest. A one inch section was cut from the center of each ear with a special machine (3). The composite sample of 10 sections from each plot was weighed in grams, dried in an oven at about 160°F., re-weighed in grams, and moisture percentage calculated by weight loss.

Weight adjustments were made for missing hills but no adjustments were made for missing plants within a hill. Double cross predictions for yield, moisture content and stalk lodging were made from the single-cross data (14).

Weather conditions in 1955 were generally favorable for good corn production. Stalk lodging was relatively high while root lodging was comparatively low.

Correlation coefficients for all combination of testers were calculated for yield, percentage of moisture, stalk and root lodging to determine how closely the testers were evaluating the lines in a similar manner. All possible correlations among the 20 second cycle lines were calculated for average yield, percentage of moisture, and stalk lodging to determine the genetic similarity of the second cycle lines with the four parents and with each other. High correlation coefficients indicate a close genetic relationship and low correlation coefficients indicate greater genetic dissimilarity.



## Experimental Results

### Performance of 20 S<sub>6</sub> Second Cycle Lines

High performance of inbred lines provides an economic advantage in the ultimate production of hybrid corn seed. The results of the yield trials of twenty-five inbred lines (twenty second cycle S<sub>6</sub> lines, four parental inbreds and the unrelated inbred line, M 14), (Table 1) show that one second cycle line yielded significantly higher than the two highest yielding parental lines, W 23 and Oh 51, and the unrelated line M 14. Eleven second cycle lines were equal to W 23 and fourteen were equal to Oh 51 and M 14 in yield. Eight second cycle lines yielded lower than W 23 and five were lower than Oh 51 and M 14. The comparison of second cycle lines with the two lowest yielding parental lines (Oh 26 and Ill.A) indicate that nine second cycle lines yielded higher than Oh 26 and eight were better than Ill.A. None yielded lower than the two lowest yielding parental lines (Oh 26 and Ill.A). These results indicate that the chances of obtaining lines more vigorous than the high yielding parental lines were small, but the possibilities were relatively good for isolating lines equal to the high parents and more vigorous than the low yielding parents.

Moisture percentage in the ear (Table 1) at harvest showed that two second cycle lines were earlier and one later in maturity than the parental lines and unrelated line M 14.



Table No. 1

Yield, percentage of moisture, stalk and root lodging  
in the inbred lines

Av. for 1954 and 1955, two locations

Code No.	Pedigree	Yield in Bu. per Acre at 15.5% Moisture	Moisture in ear %	Stalk Lodging %	Root Lodging %
1.	397-1-1-1-1	64.1	25.3	3.5	1.2
2.	236-1-1-4-2	30.8	45.8	0.9	4.6
3.	376-2-1-4-2	46.1	31.7	11.8	12.2
4.	376-2-1-3-2	44.2	32.6	8.8	11.2
5.	376-2-1-4-1	49.7	29.9	13.5	14.8
6.	28-1-1-2-1	56.8	25.1	13.6	1.1
7.	82-1-1-5-1	39.8	27.8	4.3	1.1
8.	3-1-2-2-1	49.5	25.9	12.0	1.2
9.	342-2-1-7-1	39.3	37.1	1.3	1.8
10.	58-3-1-1-1	30.3	20.8	13.7	3.1
11.	50-1-1-3-1	44.4	28.1	0.6	-
12.	52-2-2-3-3	41.6	24.8	8.3	2.4
13.	319-1-1-1-1	51.6	23.0	8.4	1.7
14.	310-1-3-9	49.4	31.7	15.3	5.1
15.	310-1-2-2-3	38.7	24.1	32.5	0.6
16.	163-1-1-2-1	41.4	22.4	16.2	2.3
17.	346-1-3-2-1	51.9	24.6	4.2	-
18.	381-2-1-6-1	43.0	27.6	19.7	18.2
19.	105-1-1-1-2	53.4	25.7	7.1	-
20.	427-1-4-1-2	37.5	19.7	4.6	-
21.	Oh. 51	49.4	25.9	6.8	9.5
22.	Oh. 26	36.2	25.3	-	1.8
23.	Ill. A	37.5	38.2	10.6	2.3
24.	W 23	52.2	26.3	40.1	2.0
25.	M 14	49.3	30.6	1.8	3.0
	L. S. D.	9.6 bu.	4.2		



Among the parental lines, Ill.A was significantly later in maturity than the other parents. Eighteen second cycle lines were earlier in maturity than the late maturing Ill.A, while about one fourth were later than the other three parental lines. It may be concluded that it was possible to select lines earlier or later in maturity than the parents.

The tabulation of stalk lodging, (Table 1), shows that three inbreds were almost as resistant to lodging as Oh 26, the parental line with the best lodging resistance, and the unrelated line M 14. None lodged as badly as the parental line W 23. Again, the chances of improving lodging resistance of inferior parents were good.

Root lodging (Table 1) was greater for four second cycle lines than for the parental lines. A majority were better than the poorest parent (Oh 51). The root lodging in three of the parents and in thirteen second cycle lines was negligible. There were good possibilities for obtaining lines with better resistance to root lodging than the highly susceptible parent.

#### Combining Ability of Second Cycle Lines Compared With Parents

Performances of crosses among the testers are given in Table 2. Table 3 presents the performances of second cycle lines with each tester parent. The four parental lines, (Oh 26, Ill.A, Oh 51 and W 23) when crossed on inbred tester M 14 yielded 87.5, 87.6, 92.0 and 95.1 bushels per acre respectively. Five of the twenty second cycle lines crossed with







Table 2

Average yield, percentage of moisture, stalk and root lodging in tester crosses at two locations

Yield in bushels per acre at 15.5% moisture

	Oh51	Oh26	I11.A	W23	Oh51 X Oh26
Oh51	-	72.6	93.1	84.7	50.4
Oh26	72.6	-	90.5	81.9	52.5
I11.A	93.1	90.5	-	90.6	80.8
W23	84.7	81.9	90.6	-	90.2
M14	92.0	87.5	87.6	95.1	87.2
L. S. D. at 5% level 15.1 bushels					

Moisture in ear  
%

	Oh51	Oh26	I11.A	W23	Oh51 X Oh26
Oh51	-	18.6	23.2	19.1	18.6
Oh26	18.6	-	23.5	18.2	15.2
I11.A	23.2	23.5	-	23.4	26.0
W23	19.1	18.2	23.4	-	17.7
M14	19.6	19.4	27.9	22.5	17.3
L. S. D. at 5% level 3.7 percent of moisture					

Stalk lodging  
%

	Oh51	Oh26	I11.A	W23	Oh51 X Oh26
Oh51	-	12.8	37.8	12.4	27.9
Oh26	12.8	-	11.4	8.9	6.7
I11.A	37.8	11.4	-	24.6	31.4
W23	12.4	8.9	24.6	-	11.2
M14	2.5	4.0	21.6	5.5	1.3

Table 2 (Continued)

Ill.A X W23	Ohio M15	M14	M14 X WF9	Ia. 4483	Average
87.2	78.2	92.0	93.3	90.6	82.5
76.6	71.5	87.5	97.2	83.9	79.4
64.7	87.3	87.6	105.8	97.8	88.7
68.7	76.0	95.1	100.6	92.0	86.6
84.3	87.1	-	68.3	76.0	85.0

Ill.A X W23	Ohio M15	M14	M14 X WF9	Ia. 4483	Average
20.9	17.8	19.6	23.9	17.6	19.9
18.3	17.3	19.4	19.6	20.0	18.9
26.0	25.9	27.9	24.1	21.3	24.5
22.8	22.4	22.5	25.2	20.9	21.4
20.4	20.8	-	24.1	21.1	21.5

Ill.A X W23	Ohio M15	M14	M14 X WF9	Ia. 4483	Average
36.6	10.5	2.5	8.1	16.1	18.3
31.7	30.9	4.0	2.4	4.7	12.6
42.9	15.2	21.6	8.0	8.5	22.4
21.5	24.3	5.5	7.5	22.7	15.4
8.6	9.7	-	6.5	7.6	7.5



Handwriting practice line with dashed lines and a solid line.

Handwriting practice line with dashed lines and a solid line. The text "Handwriting practice" is written in a dotted font for tracing.

Handwriting practice line with dashed lines and a solid line. The text "Handwriting practice" is written in a dotted font for tracing.

Handwriting practice line with dashed lines and a solid line. The text "Handwriting practice" is written in a dotted font for tracing.

# Unit 1: Introduction

## Unit 1: Introduction

Unit 1: Introduction					
Unit 1: Introduction					
Unit 1: Introduction	Unit 1: Introduction	Unit 1: Introduction	Unit 1: Introduction	Unit 1: Introduction	Unit 1: Introduction
Unit 1: Introduction	Unit 1: Introduction	Unit 1: Introduction	Unit 1: Introduction	Unit 1: Introduction	Unit 1: Introduction
Unit 1: Introduction	Unit 1: Introduction	Unit 1: Introduction	Unit 1: Introduction	Unit 1: Introduction	Unit 1: Introduction
Unit 1: Introduction	Unit 1: Introduction	Unit 1: Introduction	Unit 1: Introduction	Unit 1: Introduction	Unit 1: Introduction

Table 2 (Continued)

Root lodging  
%

	Oh51	Oh26	I11.A	W23	Oh51 X Oh26
Oh51	-	4.6	0.6	0.6	12.1
Oh26	4.6	-	6.9	1.1	0.6
I11.A	0.6	6.9	-	-	1.9
W23	0.6	1.1	-	-	-
M14	1.8	-	3.5	-	-

Table 2 (Continued)

I11.A X W23	Ohio M15	M14	M14 X WF9	Ia. 4483	Average
2.3	-	1.8	4.0	-	2.9
2.4	3.5	-	-	-	2.1
4.6	-	3.5	1.1	1.7	2.3
-	-	-	-	-	0.2
0.6	2.3	-	0.6	1.7	1.2

U

1947

1947



1. The first part of the paper is devoted to the study of the properties of the function  $f(x)$  defined by the equation

$$f(x) = \int_0^x \frac{1}{1+t^2} dt.$$

$x$	$f(x)$	$f'(x)$	$f''(x)$	$f'''(x)$	$f^{(4)}(x)$
0	0	1	0	0	0
0.1	0.0995	0.9901	-0.1980	0.3960	-0.7920
0.2	0.1961	0.9802	-0.3919	0.7838	-1.5676
0.3	0.2874	0.9608	-0.5774	1.1678	-2.3356
0.4	0.3737	0.9326	-0.7537	1.5391	-3.0782
0.5	0.4551	0.8944	-0.9208	1.8974	-3.7968
0.6	0.5317	0.8462	-1.0789	2.2428	-4.4916
0.7	0.6032	0.7886	-1.2281	2.5754	-5.1628
0.8	0.6693	0.7214	-1.3685	2.8954	-5.8104
0.9	0.7301	0.6457	-1.5001	3.2020	-6.4344
1.0	0.7854	0.5621	-1.6229	3.4952	-7.0352

1.1. 1.2. 1.3. 1.4. 1.5.

1.6. 1.7. 1.8. 1.9. 2.0.

2. The second part of the paper is devoted to the study of the properties of the function  $g(x)$  defined by the equation

Table 3

Average yields of test crosses at two locations  
(yield in bu. per acre at 15.5% moisture)

Second cycle lines	Oh51	Oh26	Il1.A	W23	Oh51 x Oh26
1	89.8	84.8	83.8	83.6	70.4
2	70.9	94.0	87.1	82.5	81.5
3	94.2	90.4	66.9	96.3	91.7
4	86.2	91.9	76.5	90.9	86.7
5	81.9	95.2	58.6	83.1	82.5
6	77.8	79.3	76.6	73.6	79.3
7	78.0	69.7	91.5	88.2	77.2
8	85.9	82.2	72.2	87.0	76.5
9	88.1	80.1	74.3	96.0	83.8
10	64.4	66.9	68.6	73.2	62.6
11	76.0	66.4	94.1	97.2	71.1
12	81.1	68.9	84.2	82.2	68.3
13	52.4	66.9	90.3	78.4	61.7
14	62.9	82.1	88.4	85.7	70.0
15	70.1	91.7	83.4	86.6	74.2
16	66.9	60.1	78.6	83.4	65.8
17	63.9	78.6	78.3	83.3	70.8
18	70.1	88.4	53.6	82.0	79.8
19	70.9	62.1	77.4	88.5	83.5
20	59.6	91.1	77.6	94.7	84.1
Av.	74.6	79.5	78.1	85.8	76.1

L. S. D. at 5%

Mean of testers 6.3 bu.

Mean of inbreds 4.7 bu.

Two inbred at the same level of tester 14.5 bu.

Two tester at the same level of inbred 14.9 bu.

To test diagonally 14.9 bu.

Table 3 (Continued)

---

I11.A X W23	Ohio M15	M14	M14 X WF9	Ia. 4483	Average
<hr/>					
78.0	80.4	87.8	88.5	87.9	83.5
87.2	85.9	110.7	101.5	102.6	90.4
76.6	83.0	94.7	101.8	100.2	89.6
91.0	74.8	97.6	109.2	89.1	89.4
83.1	80.0	83.4	98.2	94.2	85.0
70.6	72.7	85.9	93.7	84.6	79.4
82.5	88.3	89.9	94.1	93.8	84.8
75.8	78.4	97.7	99.2	86.8	84.2
84.8	83.0	83.1	103.6	93.2	88.0
79.5	74.8	74.4	85.9	78.9	72.9
88.0	77.3	97.6	95.3	101.3	86.5
81.0	71.3	86.2	89.4	94.5	80.7
79.0	71.6	95.9	97.3	87.9	78.1
83.4	67.5	86.0	94.2	92.2	81.2
80.5	77.4	91.1	83.9	88.1	82.7
77.3	85.4	86.9	91.7	90.8	78.7
81.7	64.9	81.9	88.2	88.8	77.9
62.6	69.0	87.9	92.7	85.3	76.7
70.3	76.0	91.6	105.5	92.0	81.8
84.4	73.1	82.0	88.8	85.3	82.1
79.9	76.5	90.6	94.9	90.9	
Average					82.7

---



M 14 yielded more than W 23 x M 14. Since these two tests were grown as separate tests but in the same field, there is no valid L.S.D. and only general comparisons can be made.

Crosses of second cycle lines with the parental testers showed the same general results. Crosses of Oh 26, Ill.A and Oh 51 with W 23 yielded 81.9, 90.6 and 84.7 bushels respectively. When the second cycle lines were crossed with W 23, five second cycle lines (Table 3) yielded higher than the best yielding parental line crossed with W 23.

A comparison of performances of second cycle lines and parental lines crossed on a related and unrelated double cross tester was made. Parental lines Oh 26, Ill.A, Oh 51 and W 23 crossed with Ia. 4483, the unrelated double cross tester, yielded 83.9, 97.8, 90.6 and 92.0 bushels, respectively. Three of the twenty second cycle lines crossed with Ia. 4483 yielded more than 97.8 bushels per acre.

Crosses of Oh 26, Ill.A, Oh 51 and W 23 with Ohio M 15, the parental double cross tester, yielded 71.5, 87.3, 78.2 and 76.0 bushels per acre, respectively. Results for second cycle lines crossed with this same tester show that one line yields higher than the maximum yielding test cross of parental lines crossed with Ohio M 15.

These results and similar results with other testers for second cycle lines compared with parental lines show that some second cycle lines were superior to the parental lines for yield in either specific or general combining ability.



Percentages of moisture for parental lines Oh 26, Ill.A, Oh 51 and W 23 (Table 2) crossed on M 14 were 19.4, 27.9, 19.6 and 22.5 respectively. Results for second cycle lines crossed on these inbred testers (Table 5) show that there were three crosses with a moisture content of 17.1 or 17.2% and the highest moisture content was 26.0%.

A comparison of the moisture percentage of test crosses (Table 5) with moisture percentage of tester crosses (Table 2) shows that the moisture percentage in some of the second cycle line crosses was lower than the lowest moisture percentage of the parental lines crossed with the same tester. Likewise, moisture contents for some second cycle test crosses were higher than that of the parental lines crossed with the same tester. Crosses with inbred 20 generally gave the lowest moisture percentage, while inbred 2 produced relatively late crosses.

Test cross results for stalk lodging (Table 7) and parental tester cross results (Table 2) indicate that there were no second cycle lines superior in stalk lodging resistance to the best parental line (Oh 26), although some of the second cycle lines were superior in stalk lodging resistance to the more lodging susceptible parental lines.

Tabulation of root lodging (Tables 8 and 2) was comparatively low in both second cycle line crosses and parental line crosses. In one parental line (Oh 51) root lodging was 2.9 percent and in second cycle line number 18 it was 6.8 percent.





These results indicate that through inbreeding and selection in a double cross hybrid, a few second cycle lines slightly superior in combining ability and either later or earlier in maturity than the parental lines can be obtained. No improvement in lodging resistance over one excellent parent was found. The results show that there was a good chance of improvement over highly susceptible parents.

#### Genetic Similarity of the Second Cycle Lines

Yields of the test crosses (Table 3) indicate that second cycle lines, when crossed with the parental lines, showed variations in yielding capacity. When crossed to certain parental lines, a second cycle line yielded as high as it did in crosses with the unrelated inbred M 14, but when crossed to another parent it yielded significantly lower. This was true for all second cycle lines with exception of inbreds 1, 2, 6, 9 and 10. None of the crosses of inbreds 1, 6, 9 and 10 with the parental line yielded higher or lower than with M 14. Inbred 2 yielded significantly lower in crosses with the parental lines than it did in crosses with M 14. These results indicated that except for inbred 2, all the second cycle lines were equal to the unrelated line M 14 in genetic diversity from some of the parental lines. The difference in performances of second cycle lines with parental inbreds as testers shows variation in their genetic relationship with the four parents.



Second cycle lines 3 and 4 were common in pedigree during the first three years of selfing and 3 and 5 were common for the first four years of selfing. The inbred yield trial (Table 1) indicates that the above three inbred lines were similar in yield, maturity, and stalk and root lodging. In general combining ability (Table 3), the three lines produced similar average yields. The 'r' values for yield (Table 4) between line 3 and 4, 3 and 5, and 4 and 5 were .659, .899 and .711 respectively. The higher 'r' value between 3 and 5 may be due to one more year of common pedigree for these lines. The three lines had similar maturity (Table 5). Stalk lodging percentages ranged from 21.2 to 27.3 which were comparatively similar. Also in root lodging, the three lines were similar (Table 8). The 'r' values for maturity and lodging were high in all cases between these three lines, again indicating genetic similarity.

There had been little genetic segregation among these three lines after they were separated with three or four years of inbreeding. This indicates that the lines had established their identity very early and, in a small way, confirm the validity of early testing of inbred lines as suggested by Jenkins (15) and Sprague (27).

Variation in genetic relationship of second cycle lines with the four parental inbreds was seen in comparisons of yields of their crosses with each of the four parents. All second cycle lines (Table 3) with the exception of 1, 6, 8 and

the first of these is the fact that the  
the second is the fact that the  
the third is the fact that the  
the fourth is the fact that the  
the fifth is the fact that the  
the sixth is the fact that the  
the seventh is the fact that the  
the eighth is the fact that the  
the ninth is the fact that the  
the tenth is the fact that the  
the eleventh is the fact that the  
the twelfth is the fact that the  
the thirteenth is the fact that the  
the fourteenth is the fact that the  
the fifteenth is the fact that the  
the sixteenth is the fact that the  
the seventeenth is the fact that the  
the eighteenth is the fact that the  
the nineteenth is the fact that the  
the twentieth is the fact that the  
the twenty-first is the fact that the  
the twenty-second is the fact that the  
the twenty-third is the fact that the  
the twenty-fourth is the fact that the  
the twenty-fifth is the fact that the  
the twenty-sixth is the fact that the  
the twenty-seventh is the fact that the  
the twenty-eighth is the fact that the  
the twenty-ninth is the fact that the  
the thirtieth is the fact that the  
the thirty-first is the fact that the  
the thirty-second is the fact that the  
the thirty-third is the fact that the  
the thirty-fourth is the fact that the  
the thirty-fifth is the fact that the  
the thirty-sixth is the fact that the  
the thirty-seventh is the fact that the  
the thirty-eighth is the fact that the  
the thirty-ninth is the fact that the  
the fortieth is the fact that the  
the forty-first is the fact that the  
the forty-second is the fact that the  
the forty-third is the fact that the  
the forty-fourth is the fact that the  
the forty-fifth is the fact that the  
the forty-sixth is the fact that the  
the forty-seventh is the fact that the  
the forty-eighth is the fact that the  
the forty-ninth is the fact that the  
the fiftieth is the fact that the  
the fifty-first is the fact that the  
the fifty-second is the fact that the  
the fifty-third is the fact that the  
the fifty-fourth is the fact that the  
the fifty-fifth is the fact that the  
the fifty-sixth is the fact that the  
the fifty-seventh is the fact that the  
the fifty-eighth is the fact that the  
the fifty-ninth is the fact that the  
the sixtieth is the fact that the  
the sixty-first is the fact that the  
the sixty-second is the fact that the  
the sixty-third is the fact that the  
the sixty-fourth is the fact that the  
the sixty-fifth is the fact that the  
the sixty-sixth is the fact that the  
the sixty-seventh is the fact that the  
the sixty-eighth is the fact that the  
the sixty-ninth is the fact that the  
the seventieth is the fact that the  
the seventy-first is the fact that the  
the seventy-second is the fact that the  
the seventy-third is the fact that the  
the seventy-fourth is the fact that the  
the seventy-fifth is the fact that the  
the seventy-sixth is the fact that the  
the seventy-seventh is the fact that the  
the seventy-eighth is the fact that the  
the seventy-ninth is the fact that the  
the eightieth is the fact that the  
the eighty-first is the fact that the  
the eighty-second is the fact that the  
the eighty-third is the fact that the  
the eighty-fourth is the fact that the  
the eighty-fifth is the fact that the  
the eighty-sixth is the fact that the  
the eighty-seventh is the fact that the  
the eighty-eighth is the fact that the  
the eighty-ninth is the fact that the  
the ninetieth is the fact that the  
the ninety-first is the fact that the  
the ninety-second is the fact that the  
the ninety-third is the fact that the  
the ninety-fourth is the fact that the  
the ninety-fifth is the fact that the  
the ninety-sixth is the fact that the  
the ninety-seventh is the fact that the  
the ninety-eighth is the fact that the  
the ninety-ninth is the fact that the  
the hundredth is the fact that the

1. The first part of the document is a list of the names of the persons who were present at the meeting.

2. The second part of the document is a list of the names of the persons who were absent from the meeting.

3. The third part of the document is a list of the names of the persons who were present at the meeting.

4. The fourth part of the document is a list of the names of the persons who were absent from the meeting.

5. The fifth part of the document is a list of the names of the persons who were present at the meeting.

6. The sixth part of the document is a list of the names of the persons who were absent from the meeting.

7. The seventh part of the document is a list of the names of the persons who were present at the meeting.

8. The eighth part of the document is a list of the names of the persons who were absent from the meeting.

9. The ninth part of the document is a list of the names of the persons who were present at the meeting.

10. The tenth part of the document is a list of the names of the persons who were absent from the meeting.

11. The eleventh part of the document is a list of the names of the persons who were present at the meeting.

12. The twelfth part of the document is a list of the names of the persons who were absent from the meeting.

13. The thirteenth part of the document is a list of the names of the persons who were present at the meeting.

14. The fourteenth part of the document is a list of the names of the persons who were absent from the meeting.

15. The fifteenth part of the document is a list of the names of the persons who were present at the meeting.

16. The sixteenth part of the document is a list of the names of the persons who were absent from the meeting.

17. The seventeenth part of the document is a list of the names of the persons who were present at the meeting.

18. The eighteenth part of the document is a list of the names of the persons who were absent from the meeting.

19. The nineteenth part of the document is a list of the names of the persons who were present at the meeting.

20. The twentieth part of the document is a list of the names of the persons who were absent from the meeting.

21. The twenty-first part of the document is a list of the names of the persons who were present at the meeting.

22. The twenty-second part of the document is a list of the names of the persons who were absent from the meeting.

23. The twenty-third part of the document is a list of the names of the persons who were present at the meeting.

24. The twenty-fourth part of the document is a list of the names of the persons who were absent from the meeting.

25. The twenty-fifth part of the document is a list of the names of the persons who were present at the meeting.

26. The twenty-sixth part of the document is a list of the names of the persons who were absent from the meeting.

27. The twenty-seventh part of the document is a list of the names of the persons who were present at the meeting.

28. The twenty-eighth part of the document is a list of the names of the persons who were absent from the meeting.

29. The twenty-ninth part of the document is a list of the names of the persons who were present at the meeting.

30. The thirtieth part of the document is a list of the names of the persons who were absent from the meeting.

31. The thirty-first part of the document is a list of the names of the persons who were present at the meeting.

32. The thirty-second part of the document is a list of the names of the persons who were absent from the meeting.

Table 4

Correlation coefficients for yield between  
second cycle lines in test crosses

Second cycle lines	1	2	3	4	5	6	7	8	9	10
1	-	.356	.372	.351	.244	.485	.343	/.652*	.281	.326
2	.356	-	.304	.545	.404	/.670*	.467	.593	.175	.594
3	.372	.304	-	/.659*	/.899**	/.639*	.066	/.792**	/.766**	.215
4	.351	.545	/.659*	-	/.711*	/.730*	.127	/.810**	/.685*	.533
5	.244	.404	/.899**	/.711*	-	.525	-.133	.611	/.660*	.418
6	.485	/.670*	/.639*	/.730*	.525	-	.360	/.780*	.495	.392
7	.343	.467	.066	.127	-.133	.360	-	.358	.398	/.691*
8	/.652*	.593	/.792**	/.810**	.611	/.780*	.358	-	/.682*	.041
9	.281	.175	/.766**	/.685*	/.660*	.495	.398	/.682*	-	.605
10	.326	.594	.215	.533	.418	.392	.691	.041	.605	-
11	.431	.521	.138	/.665*	-.054	.382	/.883**	.430	.419	/.660*
12	/.655*	.486	.272	.401	.107	.499	/.774*	.525	.501	/.635*
13	.340	/.808**	.016	.430	.020	.513	/.803**	.445	.246	/.774**
14	.345	/.726*	.114	.528	.210	.489	.572	.262	.333	/.658*
15	.363	/.788**	.169	.390	.293	.333	.308	.383	.044	.369
16	.356	.571	.219	.261	.101	.380	/.952**	/.711*	.513	/.824*
17	.303	/.712*	.283	/.639*	.383	.494	.493	.446	.463	/.674*
18	.285	.565	/.891**	/.688*	/.846**	/.70*	.006	/.781**	.594	.265
19	.246	.536	.562	.579	.291	/.723*	/.761*	/.689*	/.709*	.598
20	-.175	.479	.240	.486	.409	.199	.093	.193	.311	.366

r value to be significant at 5% 0.632 degree of freedom 8  
r value to be significant at 1% 0.765 degree of freedom 8

Table 4 (Continued)

11	12	13	14	15	16	17	18	19	20
.431	/.655*	.340	.345	.363	.356	.303	.285	.246	-.175
.521	.486	/.808**	/.726*	/.788**	.571	/.712*	.565	.536	.479
.138	.272	.016	.114	.169	.219	.283	/.891**	.562	.240
.665	.401	.430	.528	.390	.261	/.639*	/.688*	.579	.486
-.054	.107	.020	.210	.293	.101	.383	/.846**	.291	.409
.382	.499	.513	.489	.333	.380	.494	/.70*	/.723*	.199
/.883**	/.774*	/.803**	.572	.308	/.952**	.493	.006	/.761*	.093
.430	.525	.445	.262	.383	/.711*	.446	/.781**	/.689*	.193
.419	.501	.246	.333	.044	.513	.463	.594	/.709*	.311
/.660*	/.635*	/.774**	/.658*	.369	/.824**	/.674*	.265	.598	.366
-	/.900**	/.831**	/.746*	.441	/.849**	/.724*	.076	/.701*	.277
/.900**	-	/.700*	/.676*	.323	/.736*	/.673*	.134	/.641*	.063
/.831*	/.700*	-	/.872**	/.651*	/.797**	/.787**	.195	.102	.329
/.746*	/.676*	/.872**	-	/.779**	.571	/.965**	.312	/.811*	/.690*
.441	.323	/.651*	/.779**	-	.317	/.756*	.484	.229	/.710*
/.849**	/.736*	/.797**	.571	.317	-	.541	.173	/.772**	.193
/.724*	/.673*	/.787**	/.965**	/.756*	.541	-	.442	.573	/.754*
.076	.134	.195	.312	.484	.173	.442	-	.518	.521
/.701*	/.641*	.102	/.811*	.229	/.772**	.573	.518	-	.335
.277	.063	.329	/.690*	/.710*	.193	/.754*	.521	.335	-

U

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
Population	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100



10 yielded significantly higher with one or more parents than with the others. Differences in yield of second cycle lines crossed with the four parents may be interpreted to be due to the variation in the genetic relationship. For example (Table 3), inbred 20 crossed with the parental line Oh 51 yielded significantly lower than it did with the other three parents. This indicates close genetic similarity of inbred 20 with Oh 51 than with the other three parents. Inbred 18, when crossed with Ill.A, yielded significantly lower than it did in crosses with the other three parents, indicating that it was genetically more similar to Ill.A for yield factors. Close genetic relationship with one or more of the parents for yield did not generally show a similarly close relationship for other characteristics such as lodging resistance and maturity, indicating that genetic factors for these characteristics segregated and recombined.

These results suggest that second cycle lines, while segregating from the double cross, received varying proportions of genes from each inbred parent. This produced different degrees of genetic affinity, and was manifested by low yields in cases of genetic similarity and higher yields where genetic diversity from the parents was greater.

The correlations (Table 4) for yield among all possible comparisons of second cycle lines in test crosses were calculated to determine how closely they were genetically similar. Low coefficients of correlation indicate that there was a tendency



for the lines to be genetically different from each other. Some lines showed very little genetic relationship, the value of 'r' between line 1 and 20, 8 and 10, 5 and 13 were  $-.175$ ,  $.041$ , and  $.020$ , respectively. There were a few of the second cycle lines with high genetic similarity, where 'r' values approached 1.0. For example, the correlations between 17 and 14, 7 and 16, 11 and 12 were  $.965$ ,  $.952$  and  $.900$ , respectively. However, the results indicate that the chances were greater for obtaining second cycle lines that were genetically different from each other than for obtaining lines genetically similar to each other.

Test cross results (Table 3) indicate that second cycle lines showed variation in average yielding ability when compared with the mean of the experiment (82.7 bushels). Comparing average yields of the lines in all test crosses with the experiment average of 82.7 bushels as a measure of general combining ability for yield showed that lines 2, 3, 4 and 9 were the best and lines 10, 17 and 18 were the poorest. Among the rest of the lines, none yielded lower or higher than the mean of the experiment.

Results for moisture percentage of test crosses (Table 5) indicate that inbred 20 was the earliest (15.7% moisture) and line 10 was the next earliest line. The latest maturing line was inbred 2 (26.3% moisture) and lines 3, 4 and 9 were nearly as late.





Table 5

Average percentage of moisture for  
test crosses at two locations  
(M.S.U. Farm and Saginaw County)

Second cycle lines	Oh51	Oh26	I11.A	W23	Oh51 X Oh26
1	21.1	19.5	29.7	20.3	20.4
2	23.0	24.9	30.5	26.1	23.2
3	24.4	22.7	29.8	21.4	22.3
4	23.5	23.0	32.0	23.2	22.8
5	22.9	23.5	30.9	23.4	21.4
6	21.6	20.3	25.1	24.3	20.3
7	19.0	15.4	24.3	20.8	18.7
8	20.5	19.0	26.3	21.9	19.8
9	24.9	22.8	29.5	22.5	23.7
10	16.9	15.3	22.9	18.7	15.1
11	18.8	16.5	24.0	22.3	19.2
12	16.2	17.5	23.3	19.4	17.4
13	18.5	16.9	23.3	20.8	17.7
14	24.2	21.3	27.4	22.2	21.4
15	21.9	21.8	27.4	23.9	21.2
16	22.4	17.1	29.0	20.3	19.2
17	19.3	15.8	23.4	20.7	16.9
18	18.3	20.0	27.4	23.7	18.4
19	20.5	22.1	27.3	22.9	19.4
20	15.5	15.7	14.6	17.1	15.1
Av.	20.7	19.6	26.4	21.8	19.7

L. S. D. at 5%

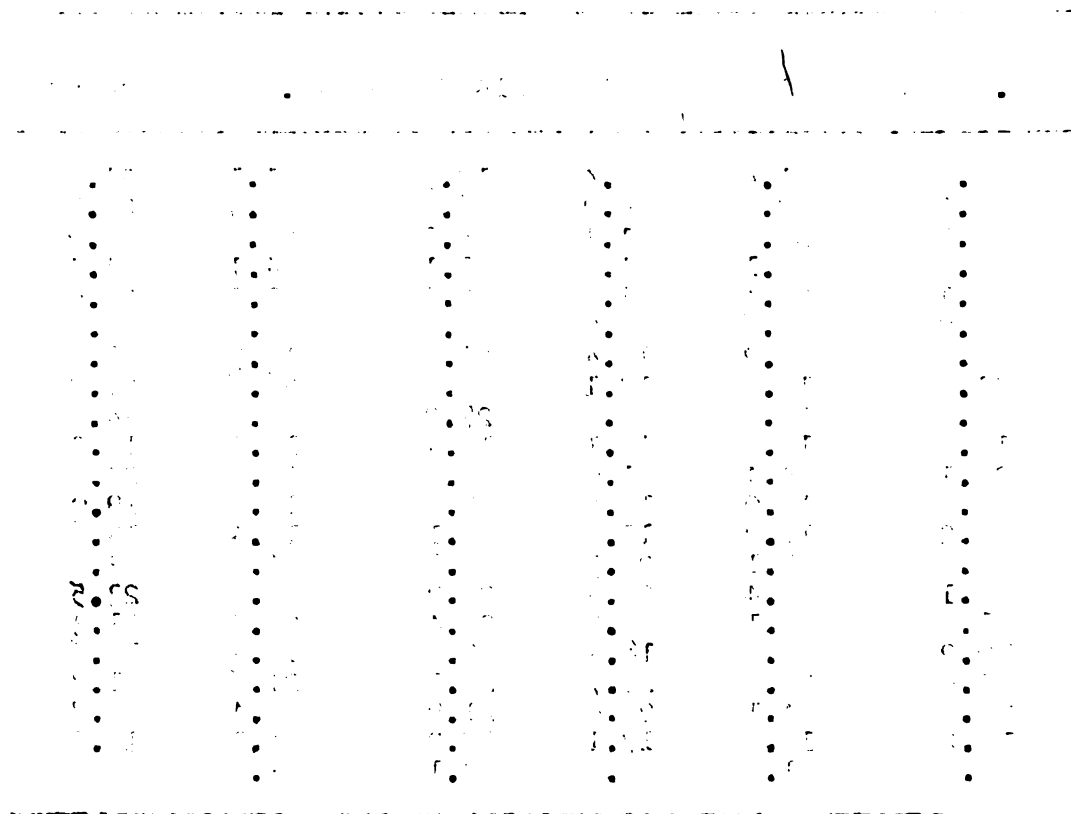
Average of experiment 21.7

Testers 1.8

Second cycle line 2.4

Table 5 (Continued)

Ill.A X W23	Ohio M15	M14	M14 X WF9	Ia. 4483	Average
22.9	21.4	22.4	19.7	21.1	21.8
28.5	27.7	26.0	26.4	20.4	26.3
24.3	25.0	21.1	25.3	22.3	23.9
26.2	24.1	21.5	23.1	24.1	24.4
25.1	22.4	21.9	22.9	21.5	23.6
23.0	23.5	23.9	24.0	21.7	22.8
21.8	20.2	18.4	21.3	17.9	19.8
21.5	19.5	19.1	22.8	26.5	21.7
26.0	23.8	23.8	27.2	23.8	24.8
19.4	17.2	17.1	18.4	19.3	18.0
20.1	24.4	21.0	20.6	19.4	20.6
20.8	19.0	18.5	20.0	18.5	19.0
22.2	17.9	17.2	22.1	19.4	19.6
25.8	23.1	24.3	23.3	21.8	23.5
25.1	25.4	20.9	23.9	23.6	23.5
21.0	22.1	20.2	22.4	20.2	21.3
19.9	20.8	18.3	20.3	19.7	19.5
24.6	20.6	22.7	20.1	21.5	21.7
23.5	24.1	22.8	21.9	22.4	22.7
15.2	15.9	17.1	17.0	14.3	15.7
22.8	21.9	20.9	22.1	21.3	





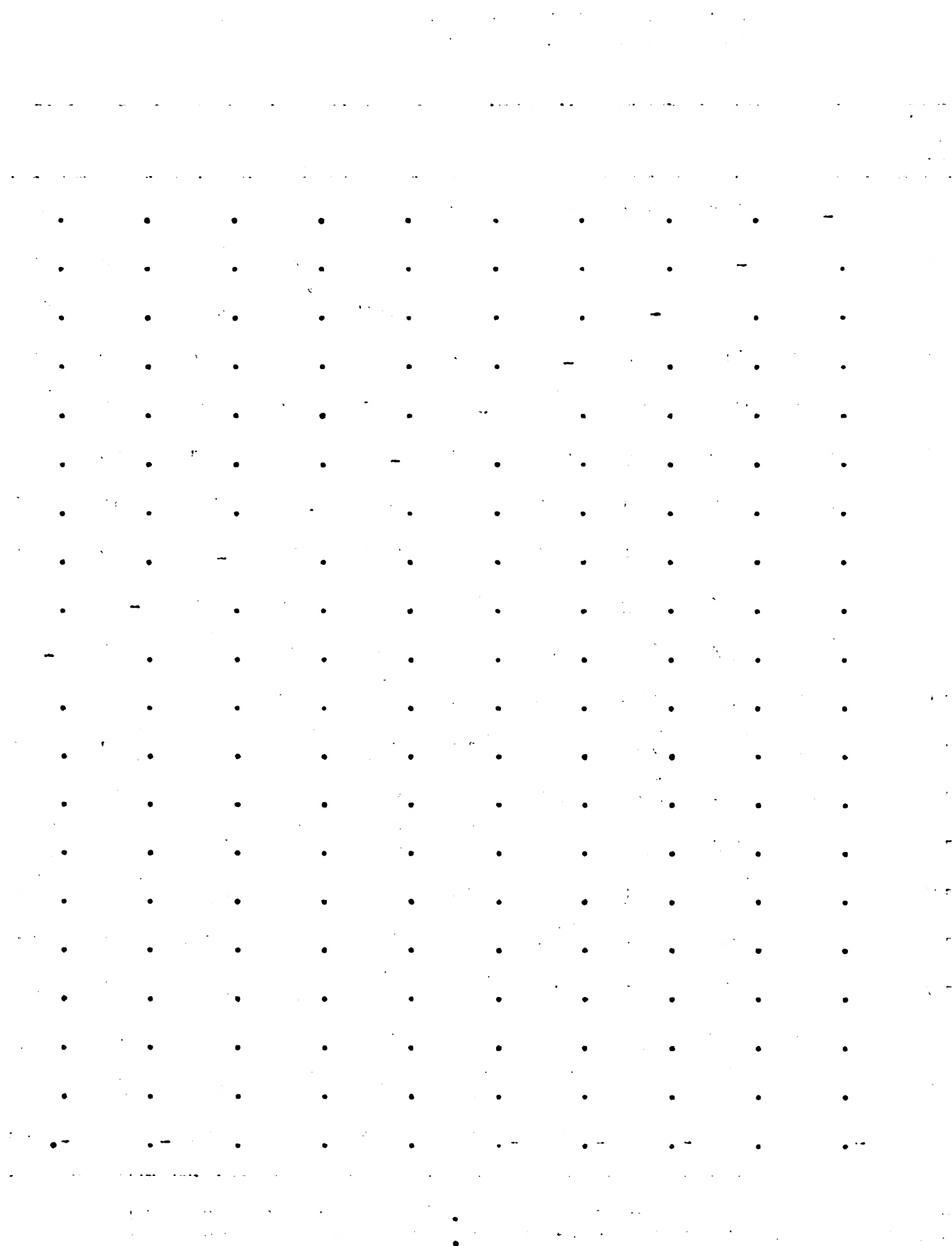
Most of the correlation coefficients for moisture percentage of test crosses of second cycle lines with different testers (Table 6) were significant indicating that, except for inbred 20 and 8, the second cycle lines were more genetically similar for maturity with each other than for yield. The low percentage of moisture for inbred 20 with different testers (Table 5) indicates its dominant effect for early maturity and it did not show relationship for maturity with the rest of the lines.

Second cycle lines showed variation among themselves for stalk lodging resistance (Table 7). Inbred 9 had the lowest lodging percentage, 13.6, and inbred 15 had the highest, 34.1. Inbreds 6, 14, and 15 were lowest in resistance to lodging while inbreds 9 and 11 had the best resistance. The rest of the lines were nearly alike in lodging resistance and ranged between 20.3 and 27.3%.

Correlations for stalk lodging among second cycle lines were significantly in most cases (Table 8). This indicates close genetic similarity of second cycle lines with each other for lodging resistance. Only one of the four parental inbreds, Oh 26, showed any appreciable degree of resistance to lodging and thus there was little opportunity to improve lodging resistance in the second cycle lines.

The percentages of root lodging were small (Table 9). The maximum lodging was 6.8 percent. In some cases it was nearly nil. Therefore no correlations were calculated.





Correlation coefficients for the moisture percentage  
between second cycle lines in test crosses

Second cycle lines	1	2	3	4	5	6	7	8	9	10
1	-	.629	*.754	**.907	**.884	.563	*.69	.536	*.760	**.794
2	.629	-	*.632	.613	*.736	*.713	*.743	*.735	.584	.524
3	*.754	*.632	-	**.866	*.828	.457	*.724	.483	**.892	*.669
4	**.907	.613	**.866	-	**.914	.444	*.745	*.659	**.787	**.832
5	**.884	*.736	*.828	**.914	-	.521	*.712	.498	**.775	**.780
6	.563	*.713	.457	.444	.521	-	**.789	.371	.522	*.730
7	*.69	*.743	*.724	*.745	*.712	*.789	-	.500	**.799	**.806
8	.536	*.735	.483	*.659	.498	.371	.500	-	.567	**.831
9	*.760	.584	**.892	**.787	**.775	.522	**.799	.567	-	*.736
10	**.794	.524	*.669	**.832	**.780	*.730	**.806	**.831	*.736	-
11	.555	*.645	.479	.489	.424	**.829	*.752	.278	.379	.590
12	**.781	**.790	*.702	**.827	**.813	*.757	**.839	.600	**.767	**.895
13	.548	.553	*.637	*.703	*.696	*.649	**.866	*.711	**.775	**.856
14	**.864	*.724	*.727	*.753	**.790	*.645	**.791	.336	**.832	*.735
15	*.665	*.694	**.791	**.832	*.754	*.648	**.770	.628	*.649	**.834
16	**.868	.596	**.901	**.837	**.799	*.681	**.860	.594	**.864	**.814
17	**.678	.568	*.712	*.713	*.644	**.834	**.905	*.663	*.666	*.744
18	**.799	*.695	.414	*.736	**.778	*.740	*.679	.528	.510	**.850
19	**.809	**.765	.662	**.794	**.820	*.738	*.645	.499	.566	**.812
20	-.416	.184	-.378	-.559	-.318	.382	.044	.494	-.265	-.281

r value to be significant at 5% 0.632 degree of freedom 8

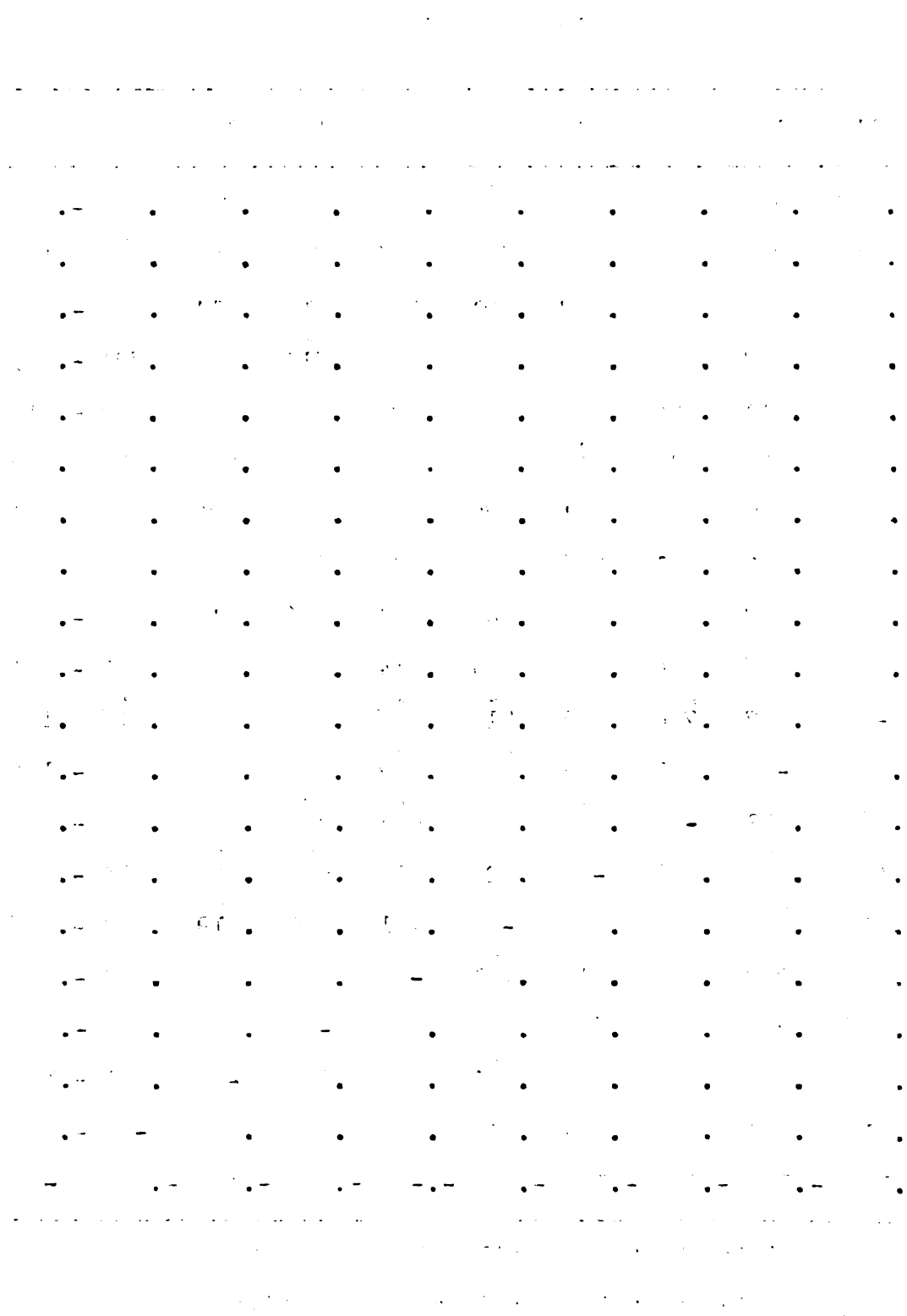
r value to be significant at 1% 0.765 degree of freedom 8

Table 6 (Continued)

11	12	13	14	15	16	17	18	19	20
.555	.781 <sup>**</sup>	.548	.864 <sup>**</sup>	.665 <sup>*</sup>	.868 <sup>**</sup>	.678 <sup>**</sup>	.799 <sup>**</sup>	.809 <sup>**</sup>	-.416
.645 <sup>*</sup>	.790 <sup>**</sup>	.553	.724 <sup>*</sup>	.694 <sup>*</sup>	.596	.568	.695 <sup>*</sup>	.765 <sup>**</sup>	.184
.479	.702 <sup>*</sup>	.637 <sup>*</sup>	.727 <sup>*</sup>	.791 <sup>**</sup>	.901 <sup>**</sup>	.712 <sup>*</sup>	.414	.662 <sup>*</sup>	-.378
.489	.827 <sup>**</sup>	.703 <sup>*</sup>	.753 <sup>*</sup>	.832 <sup>**</sup>	.837 <sup>**</sup>	.713 <sup>*</sup>	.736 <sup>*</sup>	.794 <sup>**</sup>	-.559
.424	.813 <sup>**</sup>	.696 <sup>*</sup>	.790 <sup>**</sup>	.754 <sup>*</sup>	.799 <sup>**</sup>	.644 <sup>*</sup>	.778 <sup>**</sup>	.820 <sup>**</sup>	-.318
.829 <sup>**</sup>	.757 <sup>*</sup>	.649 <sup>*</sup>	.645 <sup>*</sup>	.648 <sup>*</sup>	.681 <sup>*</sup>	.834 <sup>**</sup>	.740 <sup>*</sup>	.738 <sup>*</sup>	.382
.752 <sup>*</sup>	.839 <sup>**</sup>	.866 <sup>**</sup>	.791 <sup>**</sup>	.770 <sup>**</sup>	.860 <sup>*</sup>	.905 <sup>**</sup>	.679 <sup>*</sup>	.645 <sup>*</sup>	.044
.278	.600	.711 <sup>*</sup>	.336	.628	.594	.663 <sup>*</sup>	.528	.499	.494
.379	.767 <sup>**</sup>	.775 <sup>**</sup>	.832 <sup>**</sup>	.649 <sup>*</sup>	.864 <sup>**</sup>	.666 <sup>*</sup>	.510	.566	-.265
.590	.895 <sup>**</sup>	.856 <sup>**</sup>	.735 <sup>*</sup>	.834 <sup>**</sup>	.814 <sup>**</sup>	.744 <sup>*</sup>	.850 <sup>**</sup>	.812 <sup>**</sup>	-.281
-	.647 <sup>*</sup>	.766 <sup>**</sup>	.495	.710 <sup>*</sup>	.695 <sup>*</sup>	.826 <sup>**</sup>	.573	.715 <sup>*</sup>	.138
.647 <sup>*</sup>	-	.833 <sup>**</sup>	.703 <sup>*</sup>	.856 <sup>**</sup>	.727 <sup>*</sup>	.766 <sup>**</sup>	.882 <sup>**</sup>	.864 <sup>**</sup>	-.124
.766 <sup>**</sup>	.833 <sup>**</sup>	-	.637 <sup>*</sup>	.769 <sup>**</sup>	.684 <sup>*</sup>	.775 <sup>**</sup>	.678 <sup>*</sup>	.563 <sup>*</sup>	-.116
.495	.703 <sup>*</sup>	.637 <sup>*</sup>	-	.628	.813 <sup>**</sup>	.683 <sup>*</sup>	.705 <sup>*</sup>	.714 <sup>*</sup>	-.163
.710	.856 <sup>**</sup>	.769 <sup>**</sup>	.628	-	.751 <sup>*</sup>	.870 <sup>**</sup>	.719 <sup>*</sup>	.840 <sup>**</sup>	-.295
.695 <sup>*</sup>	.727 <sup>*</sup>	.684 <sup>*</sup>	.813 <sup>**</sup>	.751 <sup>*</sup>	-	.874 <sup>**</sup>	.589	.712 <sup>*</sup>	-.245
.826 <sup>**</sup>	.766 <sup>**</sup>	.775 <sup>**</sup>	.683 <sup>*</sup>	.870 <sup>**</sup>	.874 <sup>**</sup>	-	.674 <sup>*</sup>	.755 <sup>*</sup>	-.096
.573	.882 <sup>**</sup>	.678 <sup>*</sup>	.705 <sup>*</sup>	.719 <sup>*</sup>	.589	.674 <sup>*</sup>	-	.891 <sup>**</sup>	-.109
.715 <sup>*</sup>	.864 <sup>**</sup>	.563	.714 <sup>*</sup>	.840 <sup>**</sup>	.712 <sup>*</sup>	.755 <sup>*</sup>	.891 <sup>**</sup>	-	-.148
.138	-.124	-.116	-.163	-.295	-.245	-.096	-.109	-.148	-

\* significant at 5%      all values positive

\*\* significant at 1%      all values positive



7. 1. 1971

1. 1. 1971

1. 1. 1971

1. 1. 1971

1. 1. 1971

1. 1. 1971

1. 1. 1971

1. 1. 1971

1. 1. 1971

1. 1. 1971

1. 1. 1971

1. 1. 1971

1. 1. 1971

Table No. 7

Average percentage stalk lodging for test crosses  
at two locations  
(M. S. U. Farm and Saginaw County)

Second cycle lines	Oh 51	Oh 26	Ill. A	W23	Oh 51 X Oh 26
1	27.3	11.8	31.0	40.2	29.9
2	27.3	13.7	40.7	52.0	29.1
3	24.1	9.1	87.5	22.7	17.9
4	30.5	11.6	64.0	40.2	9.0
5	40.6	4.7	60.5	27.0	7.7
6	30.9	14.1	74.1	47.6	19.6
7	37.1	6.5	52.4	43.2	14.4
8	27.6	7.6	40.6	35.2	24.9
9	10.6	2.5	38.3	18.6	7.4
10	16.9	13.3	67.0	40.3	15.5
11	25.2	7.1	41.5	21.0	15.0
12	28.5	19.8	55.2	20.0	28.9
13	24.4	8.8	51.2	34.1	22.5
14	47.4	6.6	60.7	49.7	35.0
15	42.2	7.9	69.3	49.2	22.8
16	28.3	9.5	40.7	27.7	24.9
17	18.9	3.6	45.5	28.9	12.9
18	24.4	13.5	66.6	62.7	33.1
19	42.8	7.3	22.9	48.3	21.5
20	31.4	16.6	32.5	28.4	22.4
Av.	29.3	9.8	52.1	36.9	20.7



Table No. 7 (Continued)

Ill. A X W23	Ohio M15	M14	M14 X WF9	Ia. 4483	Av.
52.7	32.2	2.9	10.1	20.7	25.9
33.6	26.3	4.1	8.6	15.1	25.1
54.2	33.1	7.4	7.4	9.1	27.3
45.5	31.7	2.3	11.9	11.2	25.8
53.0	27.3	16.6	14.5	14.4	21.2
61.4	39.0	11.1	8.6	18.4	32.5
46.2	28.8	5.7	6.0	7.3	24.8
41.9	29.0	11.1	3.9	12.9	23.5
23.9	22.0	2.3	5.9	4.6	13.6
42.3	18.5	5.3	9.9	6.9	23.6
47.5	21.7	0.5	5.7	2.8	18.8
47.9	30.4	16.1	8.5	11.6	26.7
45.1	23.4	4.1	5.3	6.9	22.6
47.8	39.3	14.8	15.0	18.0	33.4
64.3	43.3	6.1	17.4	18.2	34.1
54.9	38.1	15.6	7.8	11.3	25.9
42.0	24.6	10.1	7.2	9.4	20.3
64.2	49.0	10.9	12.6	36.5	27.3
48.3	26.5	4.6	9.6	12.3	24.4
35.5	25.6	19.6	8.3	12.4	23.3
47.6	30.5	8.6	9.2	13.0	

72

ALL INFORMATION CONTAINED HEREIN IS UNCLASSIFIED					
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30
31	32	33	34	35	36
37	38	39	40	41	42
43	44	45	46	47	48
49	50	51	52	53	54
55	56	57	58	59	60
61	62	63	64	65	66
67	68	69	70	71	72
73	74	75	76	77	78
79	80	81	82	83	84
85	86	87	88	89	90
91	92	93	94	95	96
97	98	99	100	101	102
103	104	105	106	107	108
109	110	111	112	113	114
115	116	117	118	119	120
121	122	123	124	125	126
127	128	129	130	131	132
133	134	135	136	137	138
139	140	141	142	143	144
145	146	147	148	149	150
151	152	153	154	155	156
157	158	159	160	161	162
163	164	165	166	167	168
169	170	171	172	173	174
175	176	177	178	179	180
181	182	183	184	185	186
187	188	189	190	191	192
193	194	195	196	197	198
199	200	201	202	203	204
205	206	207	208	209	210
211	212	213	214	215	216
217	218	219	220	221	222
223	224	225	226	227	228
229	230	231	232	233	234
235	236	237	238	239	240
241	242	243	244	245	246
247	248	249	250	251	252
253	254	255	256	257	258
259	260	261	262	263	264
265	266	267	268	269	270
271	272	273	274	275	276
277	278	279	280	281	282
283	284	285	286	287	288
289	290	291	292	293	294
295	296	297	298	299	300
301	302	303	304	305	306
307	308	309	310	311	312
313	314	315	316	317	318
319	320	321	322	323	324
325	326	327	328	329	330
331	332	333	334	335	336
337	338	339	340	341	342
343	344	345	346	347	348
349	350	351	352	353	354
355	356	357	358	359	360
361	362	363	364	365	366
367	368	369	370	371	372
373	374	375	376	377	378
379	380	381	382	383	384
385	386	387	388	389	390
391	392	393	394	395	396
397	398	399	400	401	402
403	404	405	406	407	408
409	410	411	412	413	414
415	416	417	418	419	420
421	422	423	424	425	426
427	428	429	430	431	432
433	434	435	436	437	438
439	440	441	442	443	444
445	446	447	448	449	450
451	452	453	454	455	456
457	458	459	460	461	462
463	464	465	466	467	468
469	470	471	472	473	474
475	476	477	478	479	480
481	482	483	484	485	486
487	488	489	490	491	492
493	494	495	496	497	498
499	500	501	502	503	504
505	506	507	508	509	510
511	512	513	514	515	516
517	518	519	520	521	522
523	524	525	526	527	528
529	530	531	532	533	534
535	536	537	538	539	540
541	542	543	544	545	546
547	548	549	550	551	552
553	554	555	556	557	558
559	560	561	562	563	564
565	566	567	568	569	570
571	572	573	574	575	576
577	578	579	580	581	582
583	584	585	586	587	588
589	590	591	592	593	594
595	596	597	598	599	600
601	602	603	604	605	606
607	608	609	610	611	612
613	614	615	616	617	618
619	620	621	622	623	624
625	626	627	628	629	630
631	632	633	634	635	636
637	638	639	640	641	642
643	644	645	646	647	648
649	650	651	652	653	654
655	656	657	658	659	660
661	662	663	664	665	666
667	668	669	670	671	672
673	674	675	676	677	678
679	680	681	682	683	684
685	686	687	688	689	690
691	692	693	694	695	696
697	698	699	700	701	702
703	704	705	706	707	708
709	710	711	712	713	714
715	716	717	718	719	720
721	722	723	724	725	726
727	728	729	730	731	732
733	734	735	736	737	738
739	740	741	742	743	744
745	746	747	748	749	750
751	752	753	754	755	756
757	758	759	760	761	762
763	764	765	766	767	768
769	770	771	772	773	774
775	776	777	778	779	780
781	782	783	784	785	786
787	788	789	790	791	792
793	794	795	796	797	798
799	800	801	802	803	804
805	806	807	808	809	810
811	812	813	814	815	816
817	818	819	820	821	822
823	824	825	826	827	828
829	830	831	832	833	834
835	836	837	838	839	840
841	842	843	844	845	846
847	848	849	850	851	852
853	854	855	856	857	858
859	860	861	862	863	864
865	866	867	868	869	870
871	872	873	874	875	876
877	878	879	880	881	882
883	884	885	886	887	888
889	890	891	892	893	894
895	896	897	898	899	900
901	902	903	904	905	906
907	908	909	910	911	912
913	914	915	916	917	918
919	920	921	922	923	924
925	926	927	928	929	930
931	932	933	934	935	936
937	938	939	940	941	942
943	944	945	946	947	948
949	950	951	952	953	954
955	956	957	958	959	960
961	962	963	964	965	966
967	968	969	970	971	972
973	974	975	976	977	978
979	980	981	982	983	984
985	986	987	988	989	990
991	992	993	994	995	996
997	998	999	1000	1001	1002

• • •

20. The following table shows the number of people who have been convicted of a crime in the United States since 1970, by race and sex. The data are from the U.S. Department of Justice, Bureau of the Census, and the U.S. Department of Education, Office of Education Statistics.

DATE	TIME	LOCATION	WIND	TEMP	SEA	REMARKS
10/10/54	0800	1000	10	15	1	1000
10/10/54	0900	1000	10	15	1	1000
10/10/54	1000	1000	10	15	1	1000
10/10/54	1100	1000	10	15	1	1000
10/10/54	1200	1000	10	15	1	1000
10/10/54	1300	1000	10	15	1	1000
10/10/54	1400	1000	10	15	1	1000
10/10/54	1500	1000	10	15	1	1000
10/10/54	1600	1000	10	15	1	1000
10/10/54	1700	1000	10	15	1	1000
10/10/54	1800	1000	10	15	1	1000
10/10/54	1900	1000	10	15	1	1000
10/10/54	2000	1000	10	15	1	1000
10/10/54	2100	1000	10	15	1	1000
10/10/54	2200	1000	10	15	1	1000
10/10/54	2300	1000	10	15	1	1000
10/10/54	0000	1000	10	15	1	1000
10/10/54	0100	1000	10	15	1	1000
10/10/54	0200	1000	10	15	1	1000
10/10/54	0300	1000	10	15	1	1000
10/10/54	0400	1000	10	15	1	1000
10/10/54	0500	1000	10	15	1	1000
10/10/54	0600	1000	10	15	1	1000
10/10/54	0700	1000	10	15	1	1000
10/10/54	0800	1000	10	15	1	1000
10/10/54	0900	1000	10	15	1	1000
10/10/54	1000	1000	10	15	1	1000
10/10/54	1100	1000	10	15	1	1000
10/10/54	1200	1000	10	15	1	1000
10/10/54	1300	1000	10	15	1	1000
10/10/54	1400	1000	10	15	1	1000

1. The first step in the process is to identify the problem or issue that needs to be addressed. This involves gathering information and understanding the context of the problem.

...and the ... ..

Table 8

Correlation coefficients for stalk lodging between  
second cycle lines in test crosses

2nd cycle lines	1	2	3	4	5	6	7	8	9	10
1	-	.834**	.601	.726**	.673*	.789**	.814**	.787**	.682*	.657*
2	.834**	-	.620	.802**	.586	.810**	.867**	.770*	.737*	.797**
3	.601	.620	-	.915**	.894**	.933**	.834*	.712*	.954**	.920**
4	.726**	.802**	.915**	-	.908**	.973**	.956**	.765**	.957**	.942**
5	.673*	.586	.894**	.908**	-	.900**	.900**	.719*	.865**	.822**
6	.789**	.810**	.933**	.973**	.900**	-	.949**	.816**	.960**	.948**
7	.814**	.867**	.834*	.956**	.900**	.949**	-	.832**	.889**	.883**
8	.787**	.770*	.712*	.765**	.719*	.816**	.832**	-	.635*	.727*
9	.682*	.737*	.954**	.957**	.865**	.960**	.889**	.635*	-	.926**
10	.657*	.797**	.920**	.942**	.822**	.948**	.883**	.727*	.926**	-
11	.837**	.722*	.887**	.903**	.903**	.927**	.921**	.800**	.739*	.849**
12	.670*	.589	.941**	.824**	.838**	.770**	.810**	.742*	.858**	.830**
13	.839**	.860**	.906**	.938**	.861**	.969**	.953**	.841**	.917**	.938**
14	.801**	.878**	.800**	.885**	.838**	.889**	.955**	.835**	.859**	.819**
15	.846**	.823**	.883**	.967**	.917**	.967**	.974**	.825**	.935**	.887**
16	.861**	.672*	.803**	.727*	.828**	.874**	.859**	.816**	.822**	.723*
17	.793**	.767**	.923**	.945**	.920**	.984**	.940**	.820**	.950**	.921**
18	.875**	.866**	.776**	.859**	.713*	.920**	.852**	.795**	.872**	.842**
19	.882**	.810**	.422	.996**	.624	.660**	.825**	.718*	.530	.536*
20	.604	.752*	.740*	.794**	.816**	.841**	.910**	.818**	.740*	.729*

\* value to be significant at 5% 0.632 degree of freedom 8

\*\* value to be significant at 1% 0.765 degree of freedom 8

Table 8 (Continued)

11	12	13	14	15	16	17	18	19	20
.837*	.670*	.839*	.801*	.846*	.861*	.793*	.875*	.882*	.604
.722*	.589	.860*	.878*	.823*	.672*	.767*	.866*	.810*	.752*
.887*	.941*	.906*	.800*	.883*	.803*	.923*	.776*	.422	.740*
.903*	.824*	.938*	.885*	.967*	.727*	.945*	.859*	.996*	.794*
.903*	.838*	.861*	.838*	.917*	.828*	.920*	.713*	.624	.816*
.927*	.770*	.969*	.889*	.967*	.874*	.984*	.920*	.660*	.841*
.921*	.810*	.953*	.955*	.974*	.859*	.940*	.852*	.825*	.910*
.800*	.742*	.841*	.835*	.825*	.816*	.820*	.795*	.718*	.818*
.739*	.858*	.917*	.859*	.935*	.822*	.950*	.872*	.530	.740*
.849*	.830*	.938*	.819*	.887*	.723*	.921*	.842*	.536	.729*
-	.924*	.955*	.865*	.949*	.936*	.936*	.801*	.738	.883*
.924*	-	.905*	.785*	.838*	.882*	.877*	.696*	.489	.841*
.955*	.905*	-	.927*	.960*	.889*	.961*	.889*	.728	.882*
.865*	.785*	.927*	-	.940*	.835*	.893*	.833*	.799*	.882*
.949*	.838*	.960*	.940*	-	.894*	.967*	.895*	.776*	.848*
.936*	.882*	.889*	.835*	.894*	-	.911*	.812*	.735	.899*
.936*	.877*	.961*	.893*	.967*	.911*	-	.903*	.679	.477
.801*	.696*	.889*	.833*	.895*	.812*	.903*	-	.688	.716*
.738*	.489	.728*	.799*	.776*	.735*	.679*	.688	-	.803*
.883*	.841*	.882*	.882*	.848*	.899*	.477	.716*	.803*	-

\* significant at 5%

All values positive

\*\* significant at 1%

All values positive





Table 9

Average percentage of root lodging for test crosses  
at two locations  
(M. S. U. Farm and Saginaw County)

Second cycle line	Oh 51	Oh 26	Ill. A	W23	Oh 51 X Oh 26
1	5.6	7.5	10.8	-	0.6
2	9.8	3.2	2.8	9.4	3.6
3	13.2	8.0	7.4	4.5	5.8
4	2.9	5.2	1.7	4.0	7.3
5	7.8	5.2	15.7	1.2	5.9
6	2.8	4.5	2.8	-	-
7	-	2.4	1.2	-	2.3
8	-	1.7	2.8	-	1.7
9	2.9	3.3	0.6	2.5	3.2
10	4.1	-	2.2	0.6	1.2
11	5.2	2.6	-	2.3	1.2
12	-	2.4	1.2	-	-
13	7.3	7.2	0.6	4.1	2.3
14	3.4	2.3	-	0.6	2.8
15	5.2	1.7	1.7	6.8	4.5
16	3.9	8.2	10.5	5.4	2.9
17	3.1	1.7	1.7	0.6	0.6
18	18.1	5.7	16.8	3.4	10.3
19	-	-	7.8	2.8	0.6
20	1.3	-	2.4	1.2	3.4
Av.	4.8	3.6	4.5	2.5	3.0



Table 9 (Continued)

Ill. A X W23	Ohio M15	M14	M14 X WF9	Ia. 4483	Av.
1.7	0.6	1.2	-	-	2.8
6.3	2.3	-	2.3	0.6	4.0
3.4	6.5	2.9	4.6	1.2	5.8
2.2	10.1	2.2	-	4.5	4.0
3.0	2.3	2.9	1.7	5.0	5.1
1.8	0.6	2.2	1.2	0.6	1.7
0.6	0.6	-	-	0.6	0.8
0.6	1.2	-	0.6	-	0.8
-	-	1.1	0.6	-	1.4
-	1.2	-	-	-	0.9
-	4.2	-	1.1	1.7	1.8
1.8	-	2.8	-	-	0.8
0.6	-	5.2	-	5.1	3.2
1.7	4.9	1.2	0.6	4.0	2.1
4.0	5.4	3.3	5.8	0.6	3.9
0.6	2.8	1.7	10.6	3.8	5.0
-	0.6	4.6	-	0.6	1.4
0.6	3.4	-	2.8	7.2	6.8
-	-	-	-	-	1.1
-	-	-	-	1.8	1.0
1.4	2.3	1.5	1.5	1.9	



## Performances of Single and Double Crosses of Second Cycle Lines

Single cross performance in all possible combinations, Table 10, indicates that a majority of the second cycle lines crossed with the parental lines yielded as high as the parental line crossed with the unrelated line M 14. Twenty-one single crosses out of 28 crosses of second cycle lines with parental lines, yielded as high as the average yield of two entries of Ohio M 15. These results suggest that a majority of the second cycle lines included in the single crosses were genetically different from the parents and might be used with the parental lines to produce good yielding hybrids.

The twenty-one single crosses (Table 10) among seven second cycle lines indicate that some of the lines were genetically different. The single cross 2 x 3 yielded 105.5 bushels per acre which was better than Ohio M 15 at the 10% level of significance. Fifteen of these single crosses yielded as high as Ohio M 15. This suggests that some second cycle lines were genetically different from the others and might be used in crosses among themselves to produce commercial hybrids.

Determination of the relative importance of general and specific combining ability in the single cross corn hybrids was made using the method given by Sprague and Tatum (29) with a correction in the formula (24). Estimates of general and specific combining ability obtained by the formulae are relative for the particular group of lines involved in the hybrids under test. For related lines (Table 11), the estimates for specific



THE UNIVERSITY OF CHICAGO PRESS

CHICAGO, ILL. 60607  
U.S.A. AND CANADA  
LONDON, ENGLAND W.C.2  
AND  
MILWAUKEE, WIS. 53233  
U.S.A.

1. The first part of the book is devoted to a general survey of the history of the subject, from the earliest times to the present day. It is written in a clear and concise style, and is well illustrated by numerous examples.	2. The second part of the book is devoted to a detailed study of the various theories and methods which have been proposed for the solution of the problem. It is written in a more technical style, and is well illustrated by numerous examples.	3. The third part of the book is devoted to a detailed study of the various theories and methods which have been proposed for the solution of the problem. It is written in a more technical style, and is well illustrated by numerous examples.	4. The fourth part of the book is devoted to a detailed study of the various theories and methods which have been proposed for the solution of the problem. It is written in a more technical style, and is well illustrated by numerous examples.	5. The fifth part of the book is devoted to a detailed study of the various theories and methods which have been proposed for the solution of the problem. It is written in a more technical style, and is well illustrated by numerous examples.	6. The sixth part of the book is devoted to a detailed study of the various theories and methods which have been proposed for the solution of the problem. It is written in a more technical style, and is well illustrated by numerous examples.	7. The seventh part of the book is devoted to a detailed study of the various theories and methods which have been proposed for the solution of the problem. It is written in a more technical style, and is well illustrated by numerous examples.	8. The eighth part of the book is devoted to a detailed study of the various theories and methods which have been proposed for the solution of the problem. It is written in a more technical style, and is well illustrated by numerous examples.	9. The ninth part of the book is devoted to a detailed study of the various theories and methods which have been proposed for the solution of the problem. It is written in a more technical style, and is well illustrated by numerous examples.	10. The tenth part of the book is devoted to a detailed study of the various theories and methods which have been proposed for the solution of the problem. It is written in a more technical style, and is well illustrated by numerous examples.
---	--	---	--	---	---	---	--	---	--

Table 10

Yield, and percentages of moisture, stalk and root lodging in single crosses

S.N.	Pedigree	Yield in Bu/acre at 15.5% moisture			Moisture in ear %		
		M.S.U. Farm	Saginaw County	Av.	M.S.U. Farm	Saginaw County	Av.
1	Oh51 X Oh26	62.9	84.7	73.5	25.9	17.2	21.6
2	Oh51 X I11.A	76.0	117.1	95.9	26.7	19.5	23.1
3	Oh51 X W23	84.4	103.8	92.8	20.2	18.9	19.6
4	Oh51 X M14	82.3	93.6	87.8	24.3	18.5	21.4
5	Oh51 X 1	69.6	85.7	77.4	21.2	19.0	20.1
6	Oh51 X 2	63.0	83.6	72.7	27.4	23.2	25.3
7	Oh51 X 3	70.6	84.2	77.8	27.1	19.0	23.1
8	Oh51 X 6	71.6	85.3	78.1	22.3	19.8	21.1
9	Oh51 X 9	73.7	84.5	86.3	30.3	20.3	25.3
10	Oh51 X 11	68.6	80.6	75.0	22.1	18.6	20.4
11	Oh51 X 14	54.6	84.6	68.7	25.1	19.4	22.3
12	Oh26 X I11.A	77.6	97.9	87.5	29.1	19.4	24.3
13	Oh26 X W23	68.8	98.2	83.3	23.2	19.0	21.1
14	Oh26 X M14	88.9	94.2	91.1	26.8	17.2	22.0
15	Oh26 X 1	74.9	76.8	76.0	24.4	20.5	22.5
16	Oh26 X 2	67.8	67.0	67.1	28.8	22.0	25.4
17	Oh26 X 3	94.9	105.7	99.0	29.1	22.4	25.8
18	Oh26 X 6	75.9	82.4	80.3	23.1	18.8	21.0
19	Oh26 X 9	67.4	69.9	69.1	26.2	15.9	21.1
20	Oh26 X 11	90.2	100.0	96.2	23.4	20.3	21.9
21	Oh26 X 14	72.0	87.4	76.9	22.5	17.3	19.9
22	I11.A X W23	69.0	95.9	82.7	27.5	22.2	24.9
23	I11.A X M14	80.6	103.7	92.5	30.2	22.7	26.5
24	I11.A X 1	82.5	106.1	89.6	27.4	20.6	24.0
25	I11.A X 2	80.1	96.5	88.7	32.1	29.9	31.0
26	I11.A X 3	87.1	87.8	78.3	27.2	25.7	26.0
27	I11.A X 6	48.1	90.4	67.6	29.5	24.1	26.8
28	I11.A X 9	70.3	95.7	82.9	35.4	23.5	29.0
29	I11.A X 11	67.9	93.0	78.4	28.2	21.9	25.1
30	I11.A X 14	51.4	119.5	84.3	28.6	24.5	26.6
31	W23 X M14	95.9	102.6	99.4	25.0	19.2	22.1
32	W23 X 1	80.5	106.7	90.6	21.9	20.0	21.0
33	W23 X 2	75.5	93.3	84.0	23.1	24.7	23.9
34	W23 X 3	80.0	104.8	92.0	27.5	22.9	25.2
35	W23 X 6	67.5	83.7	75.8	26.8	21.2	24.0
36	W23 X 9	93.1	102.1	97.7	28.3	21.2	24.8
37	W23 X 11	69.0	105.1	87.0	22.7	20.8	21.8
38	W23 X 14	61.9	82.7	72.0	24.1	25.3	24.7
39	M14 X 1	80.3	92.9	86.5	23.4	16.3	19.9

Table 10 (Continued)

Stalk lodging %			Root lodging %		
M.S.U. Farm	Saginaw County	Av.	M.S.U. Farm	Saginaw County	Av.
10.0	8.0	9.0	-	5.8	2.9
48.9	50.8	49.9	1.1	1.4	1.3
6.0	28.9	17.5	4.8	3.3	4.1
-	18.6	9.3	3.4	3.5	3.5
15.7	53.4	34.6	-	-	-
48.3	53.1	50.7	2.2	19.7	11.0
22.4	51.2	36.8	4.5	-	2.3
11.8	33.1	22.5	-	2.3	1.2
9.0	4.0	6.5	2.2	13.7	7.7
22.6	6.8	14.7	-	13.5	6.8
64.0	72.4	68.2	1.2	6.9	4.1
20.9	16.8	18.9	-	-	-
4.9	24.4	14.7	-	-	-
-	2.4	1.2	-	-	-
2.4	17.1	9.8	-	3.7	1.9
21.4	12.1	16.8	1.8	-	0.9
2.4	10.6	6.5	3.6	2.6	3.1
9.4	60.3	34.9	1.2	3.8	2.5
2.9	-	1.5	-	-	-
3.5	2.5	3.0	-	2.5	1.3
3.4	19.7	23.1	-	3.5	1.8
39.1	96.3	67.7	-	-	-
9.4	42.9	26.2	-	-	-
28.0	77.7	42.9	-	4.2	2.1
39.1	65.0	52.1	2.6	1.2	1.9
75.9	81.9	78.9	8.8	-	4.4
50.0	81.3	65.7	3.5	-	1.8
9.6	11.9	10.8	-	4.0	2.0
19.7	30.4	25.1	3.5	4.0	3.8
77.3	62.7	70.0	-	-	-
-	67.5	38.8	-	2.5	1.3
29.1	40.0	34.6	-	-	-
36.0	33.8	34.9	3.5	2.6	3.1
13.7	39.9	26.8	21.7	3.4	12.6
52.9	61.2	57.1	-	3.5	1.8
-	39.9	20.0	-	2.3	1.2
23.2	56.2	39.7	-	1.2	0.6
23.9	40.5	32.2	-	8.1	4.1
25.8	23.8	24.8	1.1	-	0.6





100

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

26

27

28

29

30

31

32

33

34

35

36

37

38

39

40

41

42

43

44

45

46

47

48

49

50

51

52

53

54

55

56

57

58

59

60

61

62

63

64

65

66

67

68

69

70

71

72

73

74

75

76

77

78

79

80

81

82

83

84

85

86

87

88

89

90

91

92

93

94

95

96

97

98

99

100

101

102

103

104

105

106

107

108

109

110

111

112

113

114

115

116

117

118

119

120

121

122

123

124

125

126

127

128

129

130

131

132

133

134

135

136

137

138

139

140

141

142

143

144

145

146

147

148

149

150

151

152

153

154

155

156

157

158

159

160

161

162

163

164

165

166

167

168

169

170

171

172

173

174

175

176

177

178

179

180

181

182

183

184

185

186

187

188

189

190

191

192

193

194

195

196

197

198

199

200

201

202

203

204

205

206

207

208

209

210

211

212

213

214

215

216

217

218

219

220

221

222

223

224

225

226

227

228

229

230

231

232

233

234

235

236

237

238

239

240

241

242

243

244

245

246

247

248

249

250

251

252

253

254

255

256

257

258

259

260

261

262

263

264

265

266

267

268

269

270

271

272

273

274

275

276

277

278

279

280

281

282

283

284

285

286

287

288

289

290

291

292

293

294

295

296

297

298

299

300

301

302

303

304

305

306

307

308

309

310

311

312

313

314

315

316

317

318

319

320

321

322

323

324

325

326

327

328

329

330

331

332

333

334

335

336

337

338

339

340

341

342

343

344

345

346

347

348

349

350

351

352

353

354

355

356

357

358

359

360

361

362

363

364

365

366

367

368

369

370

371

372

373

374

375

376

377

378

379

380

381

382

383

384

385

386

387

388

389

390

391

392

393

394

395

396

397

398

399

400

401

402

403

404

405

406

407

408

409

410

411

412

413

414

415

416

417

418

419

420

421

422

423

424

425

426

427

428

429

430

431

432

433

434

435

436

437

438

439

440

441

442

443

444

445

446

447

448

449

450

451

452

453

454

455

456

457

458

459

460

461

462

463

464

465

466

467

468

469

470

471

472

473

474

475

476

477

478

479

480

481

482

483

484

485

486

487

488

489

490

491

492

493

494

495

496

497

498

499

500

501

502

503

504

505

506

507

508

509

510

511

512

513

514

515

516

517

518

519

520

521

522

523

524

525

52

Table 10 (Continued)

S.N.	Pedigree	Yield in Bu/acre at 15.5% moisture			Moisture in ear %		
		M.S.U. Farm	Saginaw County	Av.	M.S.U. Farm	Saginaw County	Av.
40	M14 X 2	91.5	118.3	104.6	29.4	22.4	25.9
41	M14 X 3	87.9	100.0	92.3	26.4	18.0	22.2
42	M14 X 6	66.4	105.1	84.6	23.9	20.0	22.0
43	M14 X 9	90.4	105.9	97.9	29.1	19.8	24.5
44	M14 X 11	83.9	109.5	96.4	24.6	16.8	20.7
45	M14 X 14	79.1	116.0	96.9	25.2	20.3	22.8
46	1 X 2	83.6	103.9	92.9	27.5	21.6	24.6
47	1 X 3	66.3	74.3	70.0	23.3	19.8	21.6
48	1 X 6	79.0	77.8	77.1	24.7	20.8	22.8
49	1 X 9	89.0	111.4	102.6	27.8	18.5	23.2
50	1 X 11	79.5	94.1	89.7	23.3	18.8	21.1
51	1 X 14	67.4	92.6	82.6	27.1	22.0	24.6
52	2 X 3	94.6	110.6	105.5	29.8	24.4	27.1
53	2 X 6	84.9	87.2	88.6	31.6	27.6	29.6
54	2 X 9	32.9	73.7	51.5	32.8	28.5	30.7
55	2 X 11	47.1	77.0	65.3	33.7	25.3	29.5
56	2 X 14	77.0	107.3	93.4	28.1	24.5	26.3
57	3 X 6	85.8	100.8	94.0	27.1	20.7	23.9
58	3 X 9	102.4	94.4	99.0	30.1	21.9	26.0
59	3 X 11	85.3	110.0	96.9	26.7	20.5	23.6
60	3 X 14	86.2	90.0	87.7	27.0	21.8	24.4
61	6 X 9	82.7	65.1	74.7	29.4	23.9	26.7
62	6 X 11	79.8	85.9	83.1	25.9	20.8	23.4
63	6 X 14	60.3	79.8	68.7	27.1	21.5	24.3
64	9 X 11	87.5	78.0	83.5	29.8	23.2	26.5
65	9 X 14	83.1	101.2	94.2	28.1	23.3	25.7
66	11 X 14	81.0	80.8	79.6	26.4	20.4	23.4
67	Oh M15	82.3	93.5	88.2	21.8	19.2	20.5
68	Oh M15	78.2	102.8	92.5	22.3	19.4	20.9
69	WF9 X M14	79.4	108.0	93.5	28.2	21.4	24.8
70	Mich. 350	80.4	91.1	92.4	21.9	17.2	19.6
71	Mich. 480	107.7	95.1	100.8	22.8	22.2	22.5
72	Mich. 570	94.6	107.9	101.4	24.5	19.4	22.0
	L.S.D. 51	22.3	bu 21.0 bu	15.2 bu	4.3	3.0	2.8

Table 10 (Continued)

Stalk lodging %			Root lodging %		
M.S.U. Farm	Saginaw County	Av.	M.S.U. Farm	Saginaw County	Av.
5.6	8.3	7.0	-	8.3	4.2
2.2	3.3	2.8	18.9	3.3	11.1
2.2	29.0	15.5	-	-	-
-	6.0	3.0	-	3.6	1.8
2.3	2.5	2.4	-	-	-
5.6	19.7	12.7	-	-	-
29.9	47.5	38.7	1.3	7.5	4.4
56.6	47.2	51.9	7.2	1.2	4.2
12.3	41.0	26.7	2.5	-	1.3
5.9	6.1	6.0	-	-	-
13.4	23.4	18.4	4.5	-	2.3
41.4	31.9	36.7	2.2	3.5	2.9
66.7	27.6	47.2	3.4	-	1.7
38.8	22.5	30.7	18.9	11.2	15.1
63.7	-	31.9	16.4	-	8.2
13.9	14.8	14.4	1.2	3.3	2.3
29.6	62.6	46.1	-	-	-
50.0	15.6	32.8	5.6	-	2.8
2.3	20.4	11.4	9.2	1.2	5.2
66.3	9.3	37.8	6.7	8.0	7.4
45.6	40.5	43.1	-	3.7	1.9
10.3	26.4	18.4	1.1	6.0	3.6
28.1	38.4	33.3	3.7	-	1.9
64.0	42.3	53.2	-	-	-
-	7.1	3.6	-	7.1	3.6
9.1	37.8	23.5	-	4.7	2.4
31.9	45.2	38.6	2.3	8.3	5.3
18.2	31.7	25.0	-	7.3	3.7
33.0	28.9	31.0	1.2	-	0.6
-	2.4	1.2	-	-	-
2.4	21.9	12.2	-	-	-
6.2	8.5	7.4	-	-	-
7.7	22.6	15.2	-	-	-



combining ability were higher than those for general combining ability in all cases. Some combinations did relatively better and other poorer than expected on the basis of general combining ability. The data for the single crosses (Table 11) indicate that the related lines produced high yields in certain combinations and low yields in others. This indicates that genes with dominance and epistatic effects were relatively more common than genes for additive effect.

The estimates for general combining ability for M 14 were higher than those for specific combining ability (Table 11). Large values for general combining ability may arise because a particular line does much better or much poorer than the remaining lines with which it is compared (29). The high value for general combining ability for M 14 was due to its high yield in most combinations in which it appeared. The average yield for this line was highest of the lines included.

Variance for general combining ability,  $\sigma^2_G$  for inbred 6 was nearly equal to its variance for specific combining ability,  $\sigma^2_S$ . The average yield of inbred 6 was the lowest of the inbreds compared. A high  $\sigma^2_G$  value is obtained when a line does much better or poorer than the other lines with which it is compared (29). On the other hand, inbred 6 yielded as high as 93.5 bushels per acre in some crosses and as low as 71.8 bushels in others. This variation in yields is due to specific combining ability. The difference between minimum and maximum yield is not as high as it is for other related lines. Therefore the value of  $\sigma^2_S$  is small in comparison to



1. The first part of the document is a list of the names of the persons who have been appointed to the various offices of the Board of Directors of the Corporation.

List of Directors					
					1900
					1901
					1902
					1903
					1904
					1905
					1906
					1907
					1908
					1909
					1910
					1911
					1912
					1913
					1914
					1915
					1916
					1917
					1918
					1919
					1920
					1921
					1922
					1923
					1924
					1925
					1926
					1927
					1928
					1929
					1930
					1931
					1932
					1933
					1934
					1935
					1936
					1937
					1938
					1939
					1940
					1941
					1942
					1943
					1944
					1945
					1946
					1947
					1948
					1949
					1950
					1951
					1952
					1953
					1954
					1955
					1956
					1957
					1958
					1959
					1960
					1961
					1962
					1963
					1964
					1965
					1966
					1967
					1968
					1969
					1970
					1971
					1972
					1973
					1974
					1975
					1976
					1977
					1978
					1979
					1980
					1981
					1982
					1983
					1984
					1985
					1986
					1987
					1988
					1989
					1990
					1991
					1992
					1993
					1994
					1995
					1996
					1997
					1998
					1999
					2000
					2001
					2002
					2003
					2004
					2005
					2006
					2007
					2008
					2009
					2010
					2011
					2012
					2013
					2014
					2015
					2016
					2017
					2018
					2019
					2020
					2021
					2022
					2023
					2024
					2025
					2026
					2027
					2028
					2029
					2030
					2031
					2032
					2033
					2034
					2035
					2036
					2037
					2038
					2039
					2040
					2041
					2042
					2043
					2044
					2045
					2046
					2047
					2048
					2049
					2050
					2051
					2052
					2053
					2054
					2055
					2056
					2057
					2058
					2059
					2060
					2061
					2062
					2063
					2064
					2065
					2066
					2067
					2068
					2069
					2070
					2071
					2072
					2073
					2074
					2075
					2076
					2077
					2078
					2079
					2080
					2081
					2082
					2083
					2084
					2085
					2086
					2087
					2088
					2089
					2090
					2091
					2092
					2093
					2094
					2095
					2096
					2097
					2098
					2099
					2100

The above list of directors is subject to change without notice.

Table 11

Average yields in bushels per acre for single  
crosses at two locations and estimates of  
general ( $\sigma^2_y$ ) and specific ( $\sigma^2_s$ )  
combining ability

Inbred	Oh51	Oh26	I11.A	W23	M14	1
Oh51	-	74.0	96.3	89.3	89.2	79.6
Oh26	74.0	-	89.5	83.0	92.4	75.5
I11.A	96.3	89.5	-	81.7	90.3	93.0
W23	89.3	83.0	81.7	-	99.5	92.4
M14	89.2	92.4	90.3	99.5	-	85.1
1	79.6	75.5	93.0	92.4	85.1	-
2	73.3	69.4	88.9	87.4	104.1	92.0
3	76.4	98.0	81.9	94.2	94.7	66.0
6	77.0	75.7	71.8	74.5	82.6	79.0
9	81.0	67.7	81.1	94.1	95.4	101.4
11	74.4	91.2	79.8	86.1	85.8	85.3
14	71.8	77.0	86.9	73.2	94.0	80.9
General Combining Ability	21.1	5.9	-4.57	1.13	65.75	-5.86
Specific Combining Ability	44.01	57.24	55.98	34.74	28.35	113.22



Table 11 (Continued)

2	3	6	9	11	14	Total	Av.
73.3	76.4	77.0	81.0	74.4	71.8		80.2
69.4	98.0	75.7	67.7	91.2	77.0		81.2
88.9	81.9	71.8	81.1	79.8	86.9		85.6
87.4	94.2	74.5	94.1	86.1	73.2		86.9
104.1	94.7	82.6	95.4	85.8	94.0		92.1
92.0	66.0	79.0	101.4	85.3	80.9		84.6
-	102.3	88.5	50.4	65.1	96.6		83.5
102.3	-	93.5	98.3	98.3	87.4		90.1
88.5	93.5	-	72.7	80.9	74.1		79.1
50.4	98.3	72.7	-	83.5	93.0		83.5
65.1	98.3	80.9	83.5	-	80.1		82.8
96.6	87.4	74.1	93.0	80.1	-		83.2

1.05 33.13 27.33 -5.31 -3.08 -4.48

211.23 120.51 32.94 180.36 53.64 55.35



rest of the related lines.

$\sigma^2S$  was high for inbred 2 because it yielded high in some combinations and low in others. The minimum and maximum yields for this line were 50.4 and 104.1 bushels per acre, respectively, which were the minimum and maximum yields for the experiment. This high variation in yields accounts for the high  $\sigma^2S$  for this line. The high  $\sigma^2S$  for lines 1, 3, and 9 were also due to a wide range in yields for these lines in single crosses. These results suggest that specific combining ability was more important than the general combining ability in influencing the yields of related lines.

In maturity, six single crosses out of twenty-one crosses among the seven second cycle lines (Table 10) were equal to the average of two entries of Ohio M 15. Ten were equal to the early parental single cross (Oh 51 x Oh 26). Sixteen single crosses among second cycle lines, were similar to the late maturing single cross parent (Ill.A x W 23), and three crosses were significantly later, and two were earlier. None of the single crosses among second cycle lines was earlier in maturity than Ohio M 15 or the early maturing single cross parent, Oh 51 x Oh 26. Most of the single crosses among second cycle lines were similar in maturity to the late single cross Ill.A x W 23.

While there is no critical evidence for it, a general trend toward late maturity in the single crosses of second cycle lines could be expected due to closer genetic similarity between two second cycle lines than between two unrelated lines



combined in a single cross. Pressure of inbreeding would be comparatively higher in single crosses of second cycle lines than in crosses of two unrelated inbreds. Since one of the effects of inbreeding is to delay maturity, the single crosses of second cycle lines with relatively higher pressure of inbreeding might be expected to be generally later in maturity.

Single crosses among the seven second cycle lines were generally more resistant to stalk lodging (Table 10) than the lodging susceptible parental single cross, Ill.A x W 23. Only four crosses were as resistant as the lodging resistant parental single cross, Oh 51 x Oh 26. One of the single crosses of second cycle lines (9 x 11) was better than Oh 51 x Oh 26 in lodging resistance.

Root lodging (Table 10) was not high in any of the single crosses, although the cross 2 x 6 had 15.1% root lodging. Nearly 50% of the single crosses among second cycle lines were as resistant to root lodging as the two parental single crosses.

Some of the single crosses of the second cycle lines were used to make double cross hybrids. These double crosses were "guess" combinations made up before any test cross or single cross data were available for prediction. Out of 43 double crosses (Table 12) using only second cycle lines, there were only three double crosses that were significantly below the average of 90.6 bushels for the three entries of Ohio M 15. Five double crosses showed small but not significant increases in yield compared to Ohio M 15. The best double cross, No. 68 (1 x 9)(3 x 14) averaged 96.0 bushels compared to 90.6 average for Ohio M 15.



1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1040 1

the 1990s, the number of people in the United States who are 65 years of age or older is projected to increase from 20 million to 30 million, and the number of people 75 years of age or older is projected to increase from 10 million to 15 million (U.S. Census Bureau, 1996). The number of people 85 years of age or older is projected to increase from 2 million to 4 million (U.S. Census Bureau, 1996). The number of people 90 years of age or older is projected to increase from 500,000 to 1 million (U.S. Census Bureau, 1996). The number of people 95 years of age or older is projected to increase from 100,000 to 200,000 (U.S. Census Bureau, 1996). The number of people 100 years of age or older is projected to increase from 10,000 to 20,000 (U.S. Census Bureau, 1996).

1990

[illegible]

1. *Chlorophyll a* (Chl *a*)

• •

[illegible]

Table 12

Mean yield and percentages of moisture, stalk  
and root lodging for double-cross hybrids

S.N.	Pedigree	Yield in Bu/acre at 15.5% moisture		
		M.S.U. Farm	Saginaw County	Av.
1	(Oh51 X Oh26) (I11.A X W23)	83.5	95.2	89.4
2	(Oh51 X Oh26) (I11.A X M14)	87.6	81.7	84.7
3	(Oh51 X Oh26) (I11.A X 1)	80.7	88.7	84.7
4	(Oh51 X Oh26) (I11.A X 2)	76.4	85.2	80.8
5	(Oh51 X Oh26) (I11.A X 3)	80.7	104.0	92.4
6	(Oh51 X Oh26) (I11.A X 6)	73.6	86.7	80.2
7	(Oh51 X Oh26) (I11.A X 9)	71.0	81.5	76.3
8	(Oh51 X Oh26) (I11.A X 11)	71.0	93.5	82.3
9	(Oh51 X Oh26) (I11.A X 14)	74.5	81.5	78.0
10	(Oh51 X Oh26) (W23 X M14)	70.4	83.2	76.8
11	(Oh51 X Oh26) (W23 X 1)	78.4	83.9	81.2
12	(Oh51 X Oh26) (W23 X 2)	81.9	82.9	82.4
13	(Oh51 X Oh26) (W23 X 3)	87.9	92.0	90.0
14	(Oh51 X Oh26) (W23 X 6)	74.0	89.4	81.7
15	(Oh51 X Oh26) (W23 X 9)	77.2	85.1	81.2
16	(Oh51 X Oh26) (W23 X 11)	68.5	82.4	75.5
17	(Oh51 X Oh26) (W23 X 14)	72.3	82.3	77.3
18	(Oh51 X M14) (I11.A X W23)	83.5	96.9	90.2
19	(Oh51 X 1) (I11.A X W23)	83.7	79.3	81.5
20	(Oh51 X 2) (I11.A X W23)	73.2	80.4	76.8
21	(Oh51 X 3) (I11.A X W23)	64.6	88.4	76.5
22	(Oh51 X 9) (I11.A X W23)	69.4	90.3	79.9
23	(Oh51 X 11) (I11.A X W23)	81.9	77.6	79.8
24	(Oh51 X 14) (I11.A X W23)	77.7	85.2	81.5
25	(Oh26 X M14) (I11.A X W23)	92.1	85.8	89.0
26	(Oh26 X 1) (I11.A X W23)	78.3	81.6	80.0
27	(Oh26 X 2) (I11.A X W23)	73.1	95.3	84.2
28	(Oh26 X 3) (I11.A X W23)	89.4	96.9	93.2
29	(Oh26 X 6) (I11.A X W23)	78.8	85.2	82.0
30	(Oh26 X 9) (I11.A X W23)	83.8	93.5	88.7
31	(Oh26 X 11) (I11.A X W23)	96.4	93.6	95.0
32	(Oh26 X 14) (I11.A X W23)	83.5	87.4	85.5
33	(1 X 2) (3 X 6)	83.8	87.7	85.8
34	(1 X 2) (3 X 9)	78.3	92.6	85.5
35	(1 X 2) (3 X 11)	76.0	95.5	85.8
36	(1 X 2) (3 X 14)	73.8	94.2	84.0
37	(1 X 2) (6 X 9)	77.4	91.9	84.7
38	(1 X 2) (6 X 11)	68.2	89.5	78.9
39	(1 X 2) (6 X 14)	81.8	78.2	80.0



Table 12 (Continued)

Moisture in ear %			Stalk lodging %			Root lodging %		
M.S.U. Farm	Saginaw County	Av.	M.S.U. Farm	Saginaw County	Av.	M.S.U. Farm	Saginaw County	Av.
26.5	18.7	22.6	22.1	52.2	37.2	-	1.2	0.6
27.6	18.2	22.9	13.4	26.2	19.8	2.4	8.3	5.4
26.9	17.3	22.1	14.6	27.1	20.9	-	7.4	3.7
28.1	18.7	23.4	23.9	39.6	31.8	5.0	3.6	4.3
29.9	20.6	25.3	24.3	28.1	26.2	5.1	4.9	5.0
29.6	20.9	25.3	25.2	51.1	38.2	2.5	-	1.3
32.1	19.0	25.6	13.0	36.9	25.0	7.8	4.9	6.4
28.2	18.4	23.3	17.4	27.1	22.3	8.1	4.9	6.5
29.3	19.0	24.2	22.0	46.0	34.0	-	8.0	4.0
27.6	19.3	23.5	6.2	12.5	9.4	-	-	-
24.5	18.0	21.3	34.2	45.5	39.9	3.4	6.5	5.0
27.4	19.6	23.5	15.1	40.2	27.7	1.3	6.9	4.1
25.3	17.4	21.4	8.3	42.9	25.6	1.2	7.0	4.1
25.2	19.1	22.2	28.1	53.5	40.8	-	3.5	1.8
30.5	16.9	23.7	8.3	34.8	21.6	-	7.0	3.5
23.9	18.2	21.2	17.4	31.3	24.4	-	-	-
26.3	18.3	22.3	9.8	38.8	24.3	1.2	6.8	4.0
29.5	18.9	24.2	21.2	63.4	42.3	-	-	-
26.9	18.6	22.8	17.8	70.6	44.0	-	1.2	0.6
30.0	21.4	25.7	38.0	72.4	55.2	12.6	5.8	9.2
30.6	21.7	26.2	24.6	59.5	42.0	13.5	-	6.8
26.2	21.2	23.7	27.0	51.9	39.5	-	5.3	2.7
26.9	20.3	23.6	23.0	47.1	35.1	6.4	-	3.2
30.6	21.7	26.2	47.2	76.7	62.0	3.5	9.3	6.4
27.3	20.0	23.7	20.9	48.3	34.6	1.5	-	0.8
28.0	18.9	23.5	17.2	49.9	33.6	2.5	-	1.3
27.3	20.8	24.1	33.0	38.1	35.6	2.6	2.4	2.5
29.4	20.0	24.7	14.3	42.2	28.3	-	-	-
29.6	21.7	25.7	14.3	37.8	26.1	6.0	1.2	3.6
29.3	19.0	24.2	3.8	50.6	27.2	1.2	-	0.6
28.5	20.0	24.3	12.3	65.2	38.8	2.2	4.5	3.4
29.5	19.7	24.6	13.1	60.0	36.6	1.2	-	0.6
29.3	21.8	25.6	32.9	78.3	55.6	-	3.6	1.8
39.6	24.5	32.1	18.5	44.3	31.4	1.3	8.6	5.0
30.0	22.7	26.4	18.2	54.3	36.3	9.1	4.9	7.0
33.0	22.2	26.6	30.7	39.0	34.9	1.3	3.9	2.6
34.1	23.6	28.9	19.8	34.0	26.9	18.5	2.5	10.5
30.4	23.5	27.0	35.0	46.6	40.8	5.0	-	2.5
30.9	25.3	28.1	31.7	53.2	42.5	6.1	3.8	5.0



*Journal of Management Studies*, 19(6), 701-718.

23.

• •

.....

19

.....

DATE	DESCRIPTION	AMOUNT	BALANCE
1950			
1951			
1952			
1953			
1954			
1955			
1956			
1957			
1958			
1959			
1960			
1961			
1962			
1963			
1964			
1965			
1966			
1967			
1968			
1969			
1970			
1971			
1972			
1973			
1974			
1975			
1976			
1977			
1978			
1979			
1980			
1981			
1982			
1983			
1984			
1985			
1986			
1987			
1988			
1989			
1990			
1991			
1992			
1993			
1994			
1995			
1996			
1997			
1998			
1999			
2000			
2001			
2002			
2003			
2004			
2005			
2006			
2007			
2008			
2009			
2010			
2011			
2012			
2013			
2014			
2015			
2016			
2017			
2018			
2019			
2020			
2021			
2022			
2023			
2024			
2025			
2026			
2027			
2028			
2029			
2030			
2031			
2032			
2033			
2034			
2035			
2036			
2037			
2038			
2039			
2040			
2041			
2042			
2043			
2044			
2045			
2046			
2047			
2048			
2049			
2050			
2051			
2052			
2053			
2054			
2055			
2056			
2057			
2058			
2059			
2060			
2061			
2062			
2063			
2064			
2065			
2066			
2067			
2068			
2069			
2070			
2071			
2072			
2073			
2074			
2075			
2076			

[illegible]

Table 12 (Continued)

S.N.	Pedigree	Yield in Bu/acre at 15.5% moisture		
		M.S.U. Farm	Saginaw County	Av.
40	(1 X 2) (9 X 11)	82.8	91.3	87.1
41	(1 X 2) (9 X 14)	95.6	85.0	90.3
42	(1 X 2) (11 X 14)	70.3	81.1	75.7
43	(1 X 3) (6 X 9)	81.7	83.2	82.5
44	(1 X 3) (6 X 11)	78.3	92.7	85.5
45	(1 X 3) (6 X 14)	72.3	89.6	81.0
46	(1 X 3) (9 X 11)	84.1	87.3	85.7
47	(1 X 3) (9 X 14)	80.2	91.3	85.8
48	(1 X 3) (11 X 14)	81.8	101.7	91.8
49	(1 X 6) (9 X 11)	77.9	100.8	89.4
50	(1 X 6) (9 X 14)	70.2	82.0	76.1
51	(1 X 6) (11 X 14)	74.5	85.8	80.2
52	(1 X 9) (11 X 14)	68.8	86.8	77.8
53	(2 X 3) (6 X 9)	75.8	88.2	82.0
54	(2 X 3) (6 X 11)	83.8	86.9	85.4
55	(2 X 3) (6 X 14)	88.8	82.4	85.6
56	(2 X 3) (9 X 11)	89.1	98.6	93.9
57	(2 X 3) (9 X 14)	76.8	97.6	87.2
58	(2 X 3) (11 X 14)	81.7	101.9	91.8
59	(2 X 6) (9 X 11)	90.0	91.0	90.5
60	(2 X 6) (9 X 14)	76.2	94.7	85.5
61	(2 X 6) (11 X 14)	78.5	98.0	88.3
62	(2 X 9) (11 X 14)	73.3	91.9	82.6
63	(3 X 6) (9 X 11)	87.2	81.0	84.1
64	(3 X 6) (11 X 14)	73.4	89.7	81.6
65	(3 X 9) (11 X 14)	79.7	86.3	83.0
66	(6 X 9) (11 X 14)	80.3	94.4	87.4
67	(1 X 9) (3 X 11)	90.1	87.7	88.9
68	(1 X 9) (3 X 14)	91.0	100.9	96.0
69	(1 X 9) (3 X 6)	83.8	97.9	90.9
70	(1 X 9) (6 X 11)	89.2	78.7	84.0
71	(2 X 9) (6 X 14)	70.2	82.9	76.6
72	(1 X 6) (3 X 11)	82.7	84.6	83.7
73	(1 X 6) (3 X 14)	68.5	91.4	80.0
74	(2 X 6) (3 X 11)	87.7	83.6	85.7
75	(2 X 6) (3 X 14)	80.7	92.0	86.4
76	Oh M15	86.6	93.8	90.2
77	Michigan 350	84.4	88.6	86.5
78	Michigan 480	93.7	109.0	101.4

Table 12 (Continued)

Moisture in ear %			Stalk lodging %			Root lodging %		
M.S.U. Farm	Saginaw County	Av.	M.S.U. Farm	Saginaw County	Av.	M.S.U. Farm	Saginaw County	Av.
32.4	23.0	27.7	17.5	29.3	23.4	10.0	4.9	7.5
33.8	22.5	28.2	23.2	40.6	31.9	3.7	3.7	3.7
33.2	18.8	26.0	39.4	43.9	41.7	4.9	-	2.5
31.9	22.4	27.2	12.0	30.0	21.0	8.4	5.3	6.9
28.5	18.5	23.5	22.8	42.8	32.8	1.1	3.8	2.5
30.3	19.5	24.9	29.5	63.1	46.3	2.5	6.0	4.3
30.9	20.4	25.7	10.4	41.6	26.0	3.4	-	1.7
32.7	20.9	26.8	21.6	41.3	31.5	13.2	2.4	7.8
28.0	18.8	23.4	39.6	21.6	30.6	-	-	-
29.4	21.5	25.5	13.5	16.0	14.8	-	3.7	1.9
32.8	22.9	27.9	35.3	42.2	38.8	1.3	2.6	2.0
25.3	18.7	22.0	23.0	46.4	34.7	1.3	1.2	1.3
29.8	20.8	25.3	26.5	17.1	21.8	2.5	2.4	2.5
33.7	27.1	30.4	15.9	29.0	22.5	17.1	-	8.5
30.7	23.6	27.4	22.0	50.0	36.0	6.1	-	3.1
31.6	24.2	27.9	31.2	53.9	42.6	11.2	-	5.6
33.8	22.7	28.3	22.1	31.2	26.7	2.5	6.0	4.3
33.7	24.9	29.3	26.5	55.3	40.9	12.6	2.4	7.5
31.5	21.2	26.4	27.1	38.0	32.6	7.1	13.8	10.5
31.1	21.1	26.1	19.8	44.4	32.1	13.2	-	6.6
35.1	24.3	29.7	13.2	72.8	42.0	9.6	-	4.8
27.2	22.2	24.7	20.9	72.7	46.8	6.2	2.3	8.5
33.0	24.1	28.6	19.7	44.1	31.9	18.4	11.3	14.9
30.7	22.0	26.4	11.5	47.2	29.4	1.3	2.2	2.3
33.4	22.2	27.8	32.8	40.3	36.6	-	-	-
32.7	21.3	27.0	15.9	34.8	25.4	9.8	9.3	9.6
32.2	23.6	27.9	14.3	60.2	37.3	6.0	9.1	7.6
32.7	21.2	27.0	13.4	35.6	24.5	-	-	-
31.6	22.4	27.0	21.2	29.0	25.1	1.2	2.5	1.9
29.3	21.8	25.6	15.9	56.1	36.0	8.5	3.4	6.0
30.0	20.5	25.3	9.0	36.6	22.8	5.1	2.4	3.8
34.8	27.0	30.9	21.3	59.8	40.6	30.6	10.4	15.5
26.2	20.5	23.4	17.5	43.3	30.4	-	5.7	2.9
29.5	21.3	25.4	13.2	52.4	32.8	9.6	-	4.8
30.7	23.2	27.0	16.5	36.9	26.7	23.6	-	11.8
33.2	23.5	28.4	58.1	67.4	62.8	14.8	11.6	13.2
28.4	17.6	23.0	13.8	35.7	24.8	3.4	9.5	6.5
22.4	16.1	19.3	10.7	18.9	14.8	1.2	-	0.6
27.0	17.3	22.2	14.6	20.7	17.7	3.7	-	1.9



1. **Introduction**  
 2. **Background**  
 3. **Methodology**  
 4. **Results**  
 5. **Discussion**  
 6. **Conclusion**  
 7. **References**  
 8. **Appendix**  
 9. **Figure 1**  
 10. **Figure 2**  
 11. **Figure 3**  
 12. **Figure 4**  
 13. **Figure 5**  
 14. **Figure 6**  
 15. **Figure 7**  
 16. **Figure 8**  
 17. **Figure 9**  
 18. **Figure 10**  
 19. **Figure 11**  
 20. **Figure 12**  
 21. **Figure 13**  
 22. **Figure 14**  
 23. **Figure 15**  
 24. **Figure 16**  
 25. **Figure 17**  
 26. **Figure 18**  
 27. **Figure 19**  
 28. **Figure 20**  
 29. **Figure 21**  
 30. **Figure 22**  
 31. **Figure 23**  
 32. **Figure 24**  
 33. **Figure 25**  
 34. **Figure 26**  
 35. **Figure 27**  
 36. **Figure 28**  
 37. **Figure 29**  
 38. **Figure 30**  
 39. **Figure 31**  
 40. **Figure 32**  
 41. **Figure 33**  
 42. **Figure 34**  
 43. **Figure 35**  
 44. **Figure 36**  
 45. **Figure 37**  
 46. **Figure 38**  
 47. **Figure 39**  
 48. **Figure 40**  
 49. **Figure 41**  
 50. **Figure 42**  
 51. **Figure 43**  
 52. **Figure 44**  
 53. **Figure 45**  
 54. **Figure 46**  
 55. **Figure 47**  
 56. **Figure 48**  
 57. **Figure 49**  
 58. **Figure 50**  
 59. **Figure 51**  
 60. **Figure 52**  
 61. **Figure 53**  
 62. **Figure 54**  
 63. **Figure 55**  
 64. **Figure 56**  
 65. **Figure 57**  
 66. **Figure 58**  
 67. **Figure 59**  
 68. **Figure 60**  
 69. **Figure 61**  
 70. **Figure 62**  
 71. **Figure 63**  
 72. **Figure 64**  
 73. **Figure 65**  
 74. **Figure 66**  
 75. **Figure 67**  
 76. **Figure 68**  
 77. **Figure 69**  
 78. **Figure 70**  
 79. **Figure 71**  
 80. **Figure 72**  
 81. **Figure 73**  
 82. **Figure 74**  
 83. **Figure 75**  
 84. **Figure 76**  
 85. **Figure 77**  
 86. **Figure 78**  
 87. **Figure 79**  
 88. **Figure 80**  
 89. **Figure 81**  
 90. **Figure 82**  
 91. **Figure 83**  
 92. **Figure 84**  
 93. **Figure 85**  
 94. **Figure 86**  
 95. **Figure 87**  
 96. **Figure 88**  
 97. **Figure 89**  
 98. **Figure 90**  
 99. **Figure 91**  
 100. **Figure 92**  
 101. **Figure 93**  
 102. **Figure 94**  
 103. **Figure 95**  
 104. **Figure 96**  
 105. **Figure 97**  
 106. **Figure 98**  
 107. **Figure 99**  
 108. **Figure 100**  
 109. **Figure 101**  
 110. **Figure 102**  
 111. **Figure 103**  
 112. **Figure 104**  
 113. **Figure 105**  
 114. **Figure 106**  
 115. **Figure 107**  
 116. **Figure 108**  
 117. **Figure 109**  
 118. **Figure 110**  
 119. **Figure 111**  
 120. **Figure 112**  
 121. **Figure 113**  
 122. **Figure 114**  
 123. **Figure 115**  
 124. **Figure 116**  
 125. **Figure 117**  
 126. **Figure 118**  
 127. **Figure 119**  
 128. **Figure 120**  
 129. **Figure 121**  
 130. **Figure 122**  
 131. **Figure 123**  
 132. **Figure 124**  
 133. **Figure 125**  
 134. **Figure 126**  
 135. **Figure 127**  
 136. **Figure 128**  
 137. **Figure 129**  
 138. **Figure 130**  
 139. **Figure 131**  
 140. **Figure 132**  
 141. **Figure 133**  
 142. **Figure 134**  
 143. **Figure 135**  
 144. **Figure 136**  
 145. **Figure 137**  
 146. **Figure 138**  
 147. **Figure 139**  
 148. **Figure 140**  
 149. **Figure 141**  
 150. **Figure 142**  
 151. **Figure 143**  
 152. **Figure 144**  
 153. **Figure 145**  
 154. **Figure 146**  
 155. **Figure 147**  
 156. **Figure 148**  
 157. **Figure 149**  
 158. **Figure 150**  
 159. **Figure 151**  
 160. **Figure 152**  
 161. **Figure 153**  
 162. **Figure 154**  
 163. **Figure 155**  
 164. **Figure 156**  
 165. **Figure 157**  
 166. **Figure 158**  
 167. **Figure 159**  
 168. **Figure 160**  
 169. **Figure 161**  
 170. **Figure 162**  
 171. **Figure 163**  
 172. **Figure 164**  
 173. **Figure 165**  
 174. **Figure 166**  
 175. **Figure 167**  
 176. **Figure 168**  
 177. **Figure 169**  
 178. **Figure 170**  
 179. **Figure 171**  
 180. **Figure 172**  
 181. **Figure 173**  
 182. **Figure 174**  
 183. **Figure 175**  
 184. **Figure 176**  
 185. **Figure 177**  
 186. **Figure 178**  
 187. **Figure 179**  
 188. **Figure 180**  
 189. **Figure 181**  
 190. **Figure 182**  
 191. **Figure 183**  
 192. **Figure 184**  
 193. **Figure 185**  
 194. **Figure 186**  
 195. **Figure 187**  
 196. **Figure 188**  
 197. **Figure 189**  
 198. **Figure 190**  
 199. **Figure 191**  
 200. **Figure 192**  
 201. **Figure 193**  
 202. **Figure 194**  
 203. **Figure 195**  
 204. **Figure 196**  
 205. **Figure 197**  
 206. **Figure 198**  
 207. **Figure 199**  
 208. **Figure 200**  
 209. **Figure 201**  
 210. **Figure 202**  
 211. **Figure 203**  
 212. **Figure 204**  
 213. **Figure 205**  
 214. **Figure 206**  
 215. **Figure 207**  
 216. **Figure 208**  
 217. **Figure 209**

[illegible][illegible][illegible]

I.

CA

CA

CC

# PROBLEM 1

Let  $\mathcal{A}$  be a finite alphabet.

Let  $\mathcal{A}^*$  be the set of all strings over  $\mathcal{A}$ .

Let  $\mathcal{A}^+ = \mathcal{A}^* \setminus \{\epsilon\}$ .

Let  $\mathcal{A}^{\dagger} = \mathcal{A}^* \setminus \{\epsilon\}$ .

Let  $\mathcal{A}^{\dagger} = \mathcal{A}^* \setminus \{\epsilon\}$ .

Let  $\mathcal{A}^{\dagger} = \mathcal{A}^* \setminus \{\epsilon\}$ .

$$\mathcal{A}^{\dagger} = \mathcal{A}^* \setminus \{\epsilon\}$$

Let  $\mathcal{A}^{\dagger} = \mathcal{A}^* \setminus \{\epsilon\}$ .

$$\mathcal{A}^{\dagger} = \mathcal{A}^* \setminus \{\epsilon\}$$

Let  $\mathcal{A}^{\dagger} = \mathcal{A}^* \setminus \{\epsilon\}$ .

$$\mathcal{A}^{\dagger} = \mathcal{A}^* \setminus \{\epsilon\}$$

Table 12 (Continued)

S.N.	Pedigree	Yield in Bu/acre at 15.5% moisture		
		M.S.U. Farm	Saginaw County	Av.
79	Oh M15	82.4	102.0	92.2
80	Michigan 430	93.2	89.5	91.4
81	Michigan 570	80.5	110.3	95.4
	L.S.D. at 5%	17.7	18.8	13.0

- (a) Correlation coefficient between actual yield and predicted yield of double crosses  $r = .400^*$
- (b) Correlation coefficient between actual moisture percentage and predicted moisture percentage  $r = .826^{**}$
- (c) Correlation coefficient between actual percentage of stalk lodging and predicted percentages  $r = .628^{**}$



Table 12 (Continued)

Moisture in ear %			Stalk lodging %			Root lodging %		
M.S.U. Farm	Saginaw County	Av.	M.S.U. Farm	Saginaw County	Av.	M.S.U. Farm	Saginaw County	Av.
25.3	16.4	20.9	15.9	36.0	26.0	-	3.6	1.8
29.6	17.2	23.4	7.5	14.8	11.2	-	2.3	1.2
27.6	18.8	23.2	25.3	22.7	24.0	-	1.3	0.7
4.0	3.4	2.5						



In 27 double crosses (Table 12), where second cycle lines were substituted for one of the parents Ohio M 15, five double crosses were lower than Ohio M 15 (90.6 average of three entries) and none was better while the remainder yielded as well as Ohio M 15.

The percentage of moisture (Table 12) indicates that five double crosses of second cycle lines were as early in maturity as the three entries of Ohio M 15 which averaged 22.2% moisture. Thirty-eight double crosses among second cycle lines were later in maturity and none were earlier than Ohio M 15. The early maturing lines from the test cross trials were not included in the single or double crosses.

The percentage of the stalk lodging in one of the better yielding double crosses of second cycle lines, No. 49 (1 x 6) x (9 x 11) was 14.8% compared to the average of 29.3% for Ohio M 15. Several other double crosses were as resistant to stalk lodging as Ohio M 15.

Average root lodging for three entries of Ohio M 15 was 3%. Nineteen double crosses of second cycle lines compared favorably with Ohio M 15 in root lodging resistance.

These results, with "guess" crosses, indicate that a slightly better yielding double cross might be produced by crossing the best second cycle lines among themselves or by substituting in the pedigree of the parental double-cross hybrid.

The predicted yields, moisture percentages, and stalk lodging percentages for the best 44 double crosses (Table 13) predicted from the single cross data show that some high



Table 13

Predicted yield, moisture percentage and stalk  
lodging for 44 best yielding double-crosses  
predicted from single-cross data

S.N.	Pedigree	Yield in Bu/acre at 15.5% moisture	Moisture in ear %	Stalk lodging %
1	(M14 X 3)(2 X 9)	100.0	25.9	17.2
2	(W23 X 2)(M14 X 3)	99.8	25.1	28.7
3	(Oh26 X 2)(M14 X 3)	99.5	23.7	17.0
4	(M14 X 1)(2 X 9)	98.5	24.6	13.7
5	(1 X 3)(2 X 9)	98.5	25.3	25.8
6	(M14 X 3)(2 X 11)	98.0	24.3	23.6
7	(M14 X 3)(2 X 14)	97.6	25.1	27.5
8	(2 X 9)(3 X 14)	97.6	26.3	32.1
9	(M14 X 2)(3 X 14)	97.5	24.6	27.2
10	(M14 X 14)(2 X 9)	97.5	25.6	19.9
11	(W23 X 9)(M14 X 1)	97.2	22.8	19.4
12	(W23 X 3)(M14 X 9)	97.0	23.8	17.0
13	(W23 X 2)(M14 X 1)	96.8	23.4	28.5
14	(W23 X 2)(M14 X 3)	96.4	24.5	18.8
15	(Oh26 X 14)(3 X 9)	96.4	24.3	31.6
16	(W23 X 14)(M14 X 9)	96.3	23.9	22.5
17	(W23 X 9)(1 X 3)	96.3	23.9	19.7
18	(Oh26 X 9)(M14 X 3)	96.1	23.1	7.0
19	(M14 X 3)(2 X 6)	96.0	24.7	25.7
20	(1 X 14)(2 X 9)	96.0	25.0	28.6
21	(M14 X 9)(3 X 14)	95.9	24.2	12.6
22	(Oh26 X W23)(M14 X 3)	95.9	22.3	18.6
23	(W23 X 3)(M14 X 2)	95.9	23.8	29.7
24	(M14 X 14)(2 X 3)	95.8	24.7	24.8
25	(Oh26 X 2)(I11.A X 3)	95.8	25.6	32.7
26	(M14 X 6)(2 X 3)	95.7	25.4	18.3
27	(W23 X M14)(2 X 9)	95.6	24.8	16.2
28	(W23 X M14)(3 X 9)	95.6	24.2	13.2
29	(1 X 3)(9 X 11)	95.6	23.5	18.4
30	(W23 X 3)(2 X 9)	95.6	25.5	28.4
31	(W23 X 2)(1 X 3)	95.4	24.5	36.8
32	(W23 X 1)(M14 X 9)	95.4	22.6	21.2
33	(M14 X 9)(1 X 3)	95.1	22.9	11.3
34	(I11.A X 9)(M14 X 1)	95.0	24.6	19.6
35	(W23 X M14)(2 X 3)	95.0	24.3	17.9
36	(I11.A X 2)(M14 X 1)	94.6	25.3	28.7

34

.....

.....

.....

Table 13 (Continued)

S.N.	Pedigree	Yield in Bu/acre at 15.5% moisture	Moisture in ear %	Stalk lodging %
37	(M14 X 3)(9 X 11)	94.6	23.7	13.7
38	(1 X 3)(2 X 11)	94.6	24.1	35.5
39	(W23 X 2)(M14 X 6)	94.6	25.6	25.5
40	(Oh51 X 2)(I11.A X M14)	94.5	25.4	29.6
41	(Oh51 X M14)(I11.A X W23)	94.4	22.8	31.9
42	(W23 X 11)(M14 X 3)	94.4	22.9	25.2
43	(I11.A X 3)(M14 X 2)	94.4	26.7	32.1
44	(Oh26 X 3)(M14 X 11)	94.4	22.4	11.2
45	Ohio M15	90.9	22.0	25.3

*Journal of Management Education* 36(7) 809-826  
© The Author(s) 2012  
Reprints and permissions: <http://www.sagepub.com/journalsPermissions.nav>

1. The first part of the document is a list of names and their corresponding positions. The names are listed in a column on the left, and the positions are listed in a column on the right. The names are:
 

- 1. The first part of the document is a list of names and their corresponding positions. The names are listed in a column on the left, and the positions are listed in a column on the right. The names are:



yielding double crosses may be produced from some of the second cycle lines. It is evident from the results that most of the high yielding double crosses have two or three second cycle lines as their parents. The predicted yield for Ohio M 15 is the lowest of the double crosses listed in the Table 13. Some of the predicted double crosses, where a second cycle line was one of the parents, were as early in maturity as Ohio M 15. However, none of the double crosses were earlier in maturity than Ohio M 15. The percentages of stalk lodging indicates that some of the predicted double crosses of second cycle lines were better in lodging resistance than Ohio M 15.

Correlations were calculated for the actual yield, moisture percentage, and stalk lodging of the double crosses (Table 12) with the predicted yield, moisture percentage, and stalk lodging. In all cases the correlation coefficients were significant indicating that the predicted data of the double crosses gave a good indication of the actual performance of the double crosses.

#### **Evaluation of Second Cycle Lines By Different Types of Related and Unrelated Testers**

A comparison of different types (inbred, single cross, or double-cross) of related and unrelated tester parents to detect inherent differences in combining ability of 20 second cycle lines was made. The two groups of testers, related and unrelated, differed in vigor as expressed by mean yields

1  
The first of these is the fact that the  
data are not normally distributed. The second is  
that the data are not independent. The third is  
that the data are not stationary.

It is clear that the data are not normally distributed.  
The data are not independent. The data are not stationary.

The data are not normally distributed. The data are not independent.  
The data are not stationary. The data are not normally distributed.

The data are not normally distributed. The data are not independent.  
The data are not stationary. The data are not normally distributed.  
The data are not normally distributed. The data are not independent.

The data are not normally distributed. The data are not independent.  
The data are not stationary. The data are not normally distributed.  
The data are not normally distributed. The data are not independent.

The data are not normally distributed. The data are not independent.  
The data are not stationary. The data are not normally distributed.  
The data are not normally distributed. The data are not independent.

The data are not normally distributed. The data are not independent.  
The data are not stationary. The data are not normally distributed.

The data are not normally distributed. The data are not independent.  
The data are not stationary. The data are not normally distributed.  
The data are not normally distributed. The data are not independent.

The data are not normally distributed. The data are not independent.  
The data are not stationary. The data are not normally distributed.  
The data are not normally distributed. The data are not independent.

in bushels per acre (Table 3). The mean yields of each of the three unrelated tester types was higher than the mean yield of related testers of the same type. This situation could be expected since the related testers had more genetic similarity with the second cycle lines than the unrelated testers.

Correlation coefficients were calculated to determine the rank association between different testers for evaluating yielding ability of the lines. The results (Table 14) indicate that there was little correlation between the inbred testers in their ability to evaluate the lines for yield in similar order. This may be due to differences in specific combining ability of the testers with the tested lines.

Except in one case, yields with inbred testers were significantly correlated with yields of single cross testers in which the inbred tester was one of the parents. Correlations for inbred testers and double cross testers were generally not significant. The broader gene base of the double cross tester reduced the possibilities of inbred testers evaluating the lines in rank similar to that of the double cross tester.

Except in one case, there was no association among single cross testers in their ability to evaluate the lines for yield, Table 14. This indicates that the single cross testers were affected to a great extent by genes for specific combining ability. More than one single cross tester would be needed to evaluate these inbred lines for general combining ability.



# Appendix

Table 1. Summary of the data used in the analysis.

Variable	Unit	Mean	SD	Range
Age	Years	65.2	7.8	55-85
Gender	Male/Female	50/50	0	0-100
Education	Years	12.5	2.1	10-16
Income	\$/month	1500	300	1000-2000
Health	Good/Bad	60/40	0	0-100
Marital	Married/Single	70/30	0	0-100
Religion	Protestant/Catholic	40/60	0	0-100
Occupation	Unemployed/Retired	30/70	0	0-100
Living	Alone/With family	20/80	0	0-100
Smoking	Yes/No	20/80	0	0-100
Drinking	Yes/No	10/90	0	0-100
Exercise	Yes/No	30/70	0	0-100
Stress	High/Low	40/60	0	0-100
Loneliness	Yes/No	30/70	0	0-100
Depression	Yes/No	20/80	0	0-100
Life satisfaction	High/Low	40/60	0	0-100

## Table 2. Descriptive statistics of the variables.

Variable	Mean	SD	Min	Max
Age	65.2	7.8	55	85
Gender	50	0	0	100
Education	12.5	2.1	10	16
Income	1500	300	1000	2000
Health	60	0	0	100
Marital	70	0	0	100
Religion	40	0	0	100
Occupation	30	0	0	100
Living	20	0	0	100
Smoking	20	0	0	100
Drinking	10	0	0	100
Exercise	30	0	0	100
Stress	40	0	0	100
Loneliness	30	0	0	100
Depression	20	0	0	100
Life satisfaction	40	0	0	100

Table 14

Correlation coefficients for yield between  
testers in the test crosses

S.N.	Testers	Oh51	Oh26	I11.A	W23
1	Oh51	-	+.31	-.24	+.38
2	Oh26	+.31	-	-.05	+.19
3	I11.A	-.24	-.05	-	+.12
4	W23	+.38	+.19	+.12	-
5	Oh51 X Oh26	+.53 <sup>*</sup>	+.61 <sup>*</sup>	-.405	.56 <sup>*</sup>
6	I11.A X W23	+.05	+.17	+.50 <sup>*</sup>	+.39
7	Ohio M15	+.46 <sup>*</sup>	+.01	+.10	+.30
8	M14	+.17	+.20	+.35	+.25
9	M14 X WF9	+.40	+.12	-.10	+.40
10	Ia. 4483	+.34	+.08	+.33	+.53 <sup>*</sup>

Correlation coefficients between -

- (a) Average of four related inbred testers and M14  
the unrelated inbred tester .453<sup>\*</sup>
- (b) Average of four related inbred testers and average  
of two related single crosses .783<sup>\*\*</sup>
- (c) Average of four related inbred testers and OhioM15 .400
- (d) Average of two related single cross tester and  
Ohio M15 .349
- (e) Average of two related single cross tester and  
M14 X WF9, the unrelated single cross .578<sup>\*\*</sup>
- (f) Average of all related testers and average of  
unrelated testers .623<sup>\*\*</sup>

Table 14 (Continued)

Oh51 X Oh26	Ill.A X W23	Oh10 M15	M14	M14 X WF9	Ia. 4483
$r = .53^*$	$r = .05$	$r = .46^*$	$r = .17$	$r = .40$	$r = .34$
$r = .61^*$	$r = .17$	$r = .01$	$r = .20$	$r = .12$	$r = .08$
$r = -.405$	$r = .50^*$	$r = .10$	$r = .35$	$r = -.10$	$r = .33$
$r = .56^*$	$r = .39$	$r = .30$	$r = .25$	$r = .40$	$r = .53^*$
$r = -$	$r = .01$	$r = .28$	$r = .26$	$r = .62^{**}$	$r = .32$
$r = .01$	$r = -$	$r = .34$	$r = .20$	$r = .16$	$r = .40$
$r = .28$	$r = .34$	$r = -$	$r = .38$	$r = .29$	$r = .46^*$
$r = .26$	$r = .20$	$r = .38$	$r = -$	$r = .54^*$	$r = .602^{**}$
$r = .62^{**}$	$r = .16$	$r = .29$	$r = .54^*$	$r = -$	$r = .447^*$
$r = .32$	$r = .40$	$r = .46^*$	$r = .602^{**}$	$r = .447^*$	$r = -$

\* Significant at 5%

\*\* Significant at 1%

r value to be significant at 5% 0.444 degree of freedom 18

r value to be significant at 1% 0.561 degree of freedom 18





Except in one case, single cross testers also did not show any rank association with the double-cross testers. Differences in rank association may be attributed largely to differences in specific combining ability of the testers with the line being tested.

Correlation between the two double cross testers, one parental and the other nonparental, was .46, which was significant at the 5% level but low for much predictive value. As pointed out by Sprague and Tatum (29), a broad gene base tester, in addition to effecting general combining ability, probably contains factors with strong dominance and epistatic effects. Thus, the evaluation of the tested lines for general combining ability might be more greatly influenced by dominant and epistatic factors than would be desirable for evaluating general combining ability.

A high 'r' value (.783\*\*) for the means of the four parental inbred testers with the means of the two related single crosses (Table 14) suggests that either four inbreds or their two single crosses may be used as testers to evaluate the lines for yield. These results indicate that the average yield obtained from crosses with two or more tester parents tends to reduce the effects due to specific combining ability. The 'r' value, .623, for the two tester groups (related and unrelated) indicates that, either related testers or unrelated testers, as a group, were reliable for estimating general combining ability.

the 1990s, the number of people in the world who are undernourished has declined from 1.1 billion to 800 million. The number of people who are malnourished has declined from 1.5 billion to 1 billion. The number of people who are obese has increased from 100 million to 300 million. The number of people who are overweight has increased from 100 million to 300 million. The number of people who are obese and overweight has increased from 100 million to 300 million. The number of people who are obese and overweight has increased from 100 million to 300 million.

the following table, the results of the analysis of variance are given for the different factors.

Analysis of Variance				
Source of Variation	Sum of Squares	Mean Square	D.F.	F-Value
Between Groups	1.2345	0.2469	4	1.23
Within Groups	1.5678	0.0314	16	
Total	2.8023		20	
Factorial Analysis of Variance				
Factor A	0.5678	0.1136	2	0.56
Factor B	0.3456	0.0691	2	0.34
Factor C	0.2345	0.0469	2	0.23
Factor D	0.1234	0.0247	2	0.12
Factor E	0.0123	0.0025	2	0.01
Factor F	0.0012	0.0002	2	0.00
Factor G	0.0001	0.0000	2	0.00
Factor H	0.0000	0.0000	2	0.00
Factor I	0.0000	0.0000	2	0.00
Factor J	0.0000	0.0000	2	0.00
Factor K	0.0000	0.0000	2	0.00
Factor L	0.0000	0.0000	2	0.00
Factor M	0.0000	0.0000	2	0.00
Factor N	0.0000	0.0000	2	0.00
Factor O	0.0000	0.0000	2	0.00
Factor P	0.0000	0.0000	2	0.00
Factor Q	0.0000	0.0000	2	0.00
Factor R	0.0000	0.0000	2	0.00
Factor S	0.0000	0.0000	2	0.00
Factor T	0.0000	0.0000	2	0.00
Factor U	0.0000	0.0000	2	0.00
Factor V	0.0000	0.0000	2	0.00
Factor W	0.0000	0.0000	2	0.00
Factor X	0.0000	0.0000	2	0.00
Factor Y	0.0000	0.0000	2	0.00
Factor Z	0.0000	0.0000	2	0.00

The following table shows the results of the analysis of variance for the different factors.

Source of Variation	Sum of Squares	Mean Square	D.F.	F-Value
Between Groups	1.2345	0.2469	4	1.23
Within Groups	1.5678	0.0314	16	
Total	2.8023		20	
Factorial Analysis of Variance				
Factor A	0.5678	0.1136	2	0.56
Factor B	0.3456	0.0691	2	0.34
Factor C	0.2345	0.0469	2	0.23
Factor D	0.1234	0.0247	2	0.12
Factor E	0.0123	0.0025	2	0.01
Factor F	0.0012	0.0002	2	0.00
Factor G	0.0001	0.0000	2	0.00
Factor H	0.0000	0.0000	2	0.00
Factor I	0.0000	0.0000	2	0.00
Factor J	0.0000	0.0000	2	0.00
Factor K	0.0000	0.0000	2	0.00
Factor L	0.0000	0.0000	2	0.00
Factor M	0.0000	0.0000	2	0.00
Factor N	0.0000	0.0000	2	0.00
Factor O	0.0000	0.0000	2	0.00
Factor P	0.0000	0.0000	2	0.00
Factor Q	0.0000	0.0000	2	0.00
Factor R	0.0000	0.0000	2	0.00
Factor S	0.0000	0.0000	2	0.00
Factor T	0.0000	0.0000	2	0.00
Factor U	0.0000	0.0000	2	0.00
Factor V	0.0000	0.0000	2	0.00
Factor W	0.0000	0.0000	2	0.00
Factor X	0.0000	0.0000	2	0.00
Factor Y	0.0000	0.0000	2	0.00
Factor Z	0.0000	0.0000	2	0.00

Table 15

Correlation coefficients for percentage of  
moisture between testers in test crosses

S.N.	Testers	Oh51	Oh26	I11.A	W23
1	Oh51	-	.785**	.828**	.612**
2	Oh26	.785**	-	.771**	.776**
3	I11.A	.828**	.771**	-	.674**
4	W23	.612**	.776**	.674**	-
5	Oh51 X Oh26	.905**	.859**	.828**	.720**
6	I11.A X W23	.786**	.879**	.860**	.839**
7	Oh10 M15	.773**	.768**	.727**	.815**
8	M14	.713**	.810**	.677**	.800**
9	M14 X WF9	.853**	.763**	.693**	.720**
10	Ia. 4483	.674**	.632**	.723**	.606**

Correlation coefficients between -

- (a) Average of four related inbred testers and M14, the unrelated inbred tester r = .831\*\*
- (b) Average of four related inbred testers and average of two related single crosses .970\*\*
- (c) Average of four related inbred testers and Oh M15 .859\*\*
- (d) Average of two related single cross tester and Oh M15 .828\*\*
- (e) Average of two related single cross tester and M14 X WF9, the unrelated single cross .869\*\*
- (f) Average of all related testers and average of unrelated testers .879\*\*

Table 15 (Continued)

Oh51 X Oh26	Ill.A X W23	Ohio M15	M14	M14 X WF9	Ia. 4483
.905**	.786**	.773**	.713**	.853**	.674*
.859**	.879**	.768**	.810**	.763**	.632**
.828**	.860**	.727**	.677**	.693**	.723**
.720**	.839**	.815**	.800**	.720**	.606**
-	.861**	.829**	.775**	.873**	.667**
.861**	-	.770**	.798**	.804**	.640**
.829**	.770**	-	.807**	.769**	.514*
.775**	.798**	.807**	-	.661**	.547*
.873**	.804**	.769**	.661	-	.669**
.667**	.640**	.514*	.547*	.669**	-

\* significant at 5%

\*\* significant at 1%

r value significant at 5% 0.444 degree of freedom 18

r value significant at 1% 0.561 degree of freedom 18



Correlations were calculated for moisture percentage in the test crosses to assess the ability of different testers to evaluate maturity (Table 15). All the testers, irrespective of type and relationship with the lines under test, showed significant rank association for evaluating maturity of the lines.

Correlations among testers for evaluating maturity (Table 15) were generally high in contrast to those for yield (Table 14). This suggests that fewer testers would be needed to evaluate maturity than for yield.

Correlations between inbred testers for stalk lodging were low (Table 16) showing that inbred testers did not rank the lines in the same order. This failure of inbred testers to give the same evaluation may be attributed to differences in specific combining ability for lodging resistance of the testers (19).

Except in one case, where the significant 'r' value, .471, was rather low, single cross testers also did not evaluate the lines alike for stalk lodging. Single cross testers were also specific in action for lodging resistance and the evaluation with any one of them did not apply for other testers. Evaluation with single cross testers correlated significantly with that obtained with double cross testers.

Related and unrelated double cross testers showed good association, .805\*\*, for evaluating stalk lodging resistance, suggesting that a double cross tester might be best for evaluating stalk lodging. A high 'r' value, .924\*\*, between

The first two steps are the most important. The first step is to identify the problem. The second step is to define the problem. The third step is to identify the causes of the problem. The fourth step is to identify the effects of the problem. The fifth step is to identify the stakeholders involved in the problem. The sixth step is to identify the resources available to solve the problem. The seventh step is to identify the constraints on the problem. The eighth step is to identify the risks associated with the problem. The ninth step is to identify the opportunities associated with the problem. The tenth step is to identify the solutions to the problem. The eleventh step is to implement the solutions. The twelfth step is to evaluate the results of the solutions. The thirteenth step is to monitor the results of the solutions. The fourteenth step is to report the results of the solutions. The fifteenth step is to conclude the problem-solving process.



Year	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099
1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	

— *Journal of the American Medical Association*, 1997

Table 16

Correlation coefficients for percentage of stalk  
lodging between testers in test crosses

S.N.	Testers	Oh51	Oh26	Ill.A	W23
1	Oh51	-	-.043	+.04	+.41
2	Oh26	-.043	-	+.127	+.171
3	Ill.A	+.04	+.127	-	+.149
4	W23	+.41	+.171	+.149	-
5	Oh51 X Oh26	+.279	+.480*	-.092	+.490*
6	Ill.A X W23	+.205	+.277	+.518*	+.399
7	Oh10 M15	+.411	+.190	+.430	+.550*
8	M14	+.315	+.286	+.086	-.110
9	M14 X WF9	+.561**	+.051	+.376	+.484*
10	Ia. 4483	+.279	+.322	+.203	+.710**

Correlation coefficients between -

(a)	Average of four related inbred testers and M14, the unrelated inbred tester	+.143
(b)	Average of four related inbred testers and average of two related single crosses	+.724**
(c)	Average of four related inbred testers and Oh M15	+.712**
(d)	Average of two related single cross tester and Oh M15	+.924**
(e)	Average of two related single cross tester and M14 X WF9 the unrelated single cross	+.561*
(f)	Average of all related testers and average of unrelated testers	+.723**

Table 16 (Continued)

Oh51 X Oh26	Ill.A X W23	Ohio M15	M14	M14 X WF9	Ia. 4483
+.279	+.205	+.411	+.315	+.561 <sup>**</sup>	+.279
+.480 <sup>*</sup>	+.277	+.190	+.286	+.051	+.322
-.092	+.518 <sup>*</sup>	+.430	+.086	.376	+.203
+.490 <sup>*</sup>	+.399	+.550 <sup>*</sup>	-.110	+.484 <sup>*</sup>	+.710 <sup>**</sup>
-	+.304	+.535 <sup>*</sup>	+.288	+.176	+.617 <sup>**</sup>
+.304	-	+.764 <sup>**</sup>	+.178	+.471 <sup>*</sup>	+.588 <sup>**</sup>
+.535 <sup>*</sup>	+.764 <sup>**</sup>	-	+.309	+.520 <sup>*</sup>	+.805 <sup>**</sup>
+.288	+.178	+.309	-	+.190	+.288
+.176	+.471 <sup>*</sup>	+.520 <sup>*</sup>	+.190	-	+.534 <sup>*</sup>
+.617 <sup>**</sup>	+.588 <sup>**</sup>	+.805 <sup>**</sup>	+.288	+.534 <sup>*</sup>	-

\* significant at 5%

\*\* significant at 1%

r value to be significant at 5% 0.444 degree of freedom 18

r value to be significant at 1% 0.561 degree of freedom 18

...and the other is the fact that the ...

[illegible][illegible]

*Journal of Management Education* 30(6)p.789-804  
© The Author(s) 2006

1. The first step in the process is to identify the problem or issue that needs to be addressed. This involves gathering information and understanding the context of the problem.

For the purpose of this study, the following hypotheses were formulated:

the mean performance of the two related single crosses with their double cross, Ohio M 15 indicated that either a double cross tester or the two single crosses of the double-cross may be used to evaluate general combining ability of the lines for stalk lodging. Correlations for the mean of the four related inbred testers with the mean of their two single crosses, .724\*\*, with the related double cross, .712\*\*, indicated that the four inbred testers could be replaced with their two single crosses or the double cross in evaluating general combining ability for resistance to stalk lodging.

Mean performances of the related and unrelated testers showed high association, .723\*\*, in evaluating lines for stalk lodging. This suggests that either related or unrelated testers provided valid information on resistance to stalk lodging.

Four out of ten correlations among inbred testers for root lodging, Table 17, were significant. In general, inbred testers were not very effective in evaluating the lines in similar order. Likewise, correlations among single cross and double cross testers were low, indicating specific reactions between tester and tested lines. It was apparent, that inbred and single testers could not be depended upon to provide evaluation applicable to other testers. However, the amount of root lodging was generally low and may not present a true picture of the situation if the incidence of the root lodging had been higher.





Table 17

Correlation coefficients for percentage of root  
lodging between testers in test crosses

S.N.	Testers	Oh51	Oh26	I11.A	W23
1	Oh51	-	$\sqrt{.665}^{**}$	$\sqrt{.553}^*$	$\sqrt{.471}^*$
2	Oh26	$\sqrt{.665}^{**}$	-	$\sqrt{.485}^*$	$\sqrt{.263}^*$
3	I11.A	$\sqrt{.553}^*$	$\sqrt{.485}^*$	-	$\sqrt{.09}^*$
4	W23	$\sqrt{.471}^*$	$\sqrt{.263}^*$	$\sqrt{.09}^*$	-
5	Oh51 X Oh26	$\sqrt{.702}^{**}$	$\sqrt{.357}^*$	$\sqrt{.497}^*$	$\sqrt{.433}^*$
6	I11.A X W23	$\sqrt{.375}^*$	$\sqrt{.238}^*$	$\sqrt{.085}^*$	$\sqrt{.618}^{**}$
7	Oh M15	$\sqrt{.337}^*$	$\sqrt{.286}^*$	$\sqrt{.029}^*$	$\sqrt{.414}^*$
8	M14	$\sqrt{.069}^*$	$\sqrt{.392}^*$	$\sqrt{.084}^*$	$\sqrt{.088}^*$
9	M14 X WF9	$\sqrt{.334}^*$	$\sqrt{.460}^*$	$\sqrt{.364}^*$	$\sqrt{.572}^*$
10	Ia. 4483	$\sqrt{.549}^*$	$\sqrt{.480}^*$	$\sqrt{.461}^*$	$\sqrt{.198}^*$

Correlation coefficients between -

- (a) Average of four related inbred testers and M14, the unrelated inbred tester  $\sqrt{.101}$
- (b) Average of four related inbred testers and average of two related single crosses  $\sqrt{.694}^{**}$
- (c) Average of four related inbred testers and Oh M15  $\sqrt{.341}$
- (d) Average of two related single cross tester and Oh M15  $\sqrt{.665}^{**}$
- (e) Average of two related single cross tester and M14 X WF9, the unrelated single cross  $\sqrt{.368}$
- (f) Average of all related testers and average of unrelated testers  $\sqrt{.600}^{**}$



Table 17 (Continued)

Oh51 X Oh26	Ill.A X W23	Ohio M15	M14	M14 X WF9	Ia. 4483
.702**	+.375	+.337	+.069	+.334	.549*
+.357	+.238	+.286	+.392	.460*	+.480*
+.497*	+.085	+.029	+.084	+.364	+.461*
+.433	.618**	+.414	+.088	+.572*	+.198
-	+.289	+.612**	+.025	+.299	+.71**
+.289	-	+.404	+.167	+.397	-.011
+.612*	+.404	-	+.093	+.32	+.395
+.025	+.167	+.093	-	+.114	+.195
+.299	+.397	+.32	+.114	-	+.310
+.710**	-.011	+.395	+.195	+.310	-

\* Significant at 5%

\*\* Significant at 1%

r value to be significant at 5% 0.444 degree of freedom 18

r value to be significant at 1% 0.561 degree of freedom 18



TABLE 1. Summary of data for the 1990-1991 season.

1990-1991					
Station	1990	1991	1992	1993	1994
1	1.2	1.5	1.8	2.1	2.4
2	1.5	1.8	2.1	2.4	2.7
3	1.8	2.1	2.4	2.7	3.0
4	2.1	2.4	2.7	3.0	3.3
5	2.4	2.7	3.0	3.3	3.6
6	2.7	3.0	3.3	3.6	3.9
7	3.0	3.3	3.6	3.9	4.2
8	3.3	3.6	3.9	4.2	4.5
9	3.6	3.9	4.2	4.5	4.8
10	3.9	4.2	4.5	4.8	5.1
11	4.2	4.5	4.8	5.1	5.4
12	4.5	4.8	5.1	5.4	5.7
13	4.8	5.1	5.4	5.7	6.0
14	5.1	5.4	5.7	6.0	6.3
15	5.4	5.7	6.0	6.3	6.6
16	5.7	6.0	6.3	6.6	6.9
17	6.0	6.3	6.6	6.9	7.2
18	6.3	6.6	6.9	7.2	7.5
19	6.6	6.9	7.2	7.5	7.8
20	6.9	7.2	7.5	7.8	8.1
21	7.2	7.5	7.8	8.1	8.4
22	7.5	7.8	8.1	8.4	8.7
23	7.8	8.1	8.4	8.7	9.0
24	8.1	8.4	8.7	9.0	9.3
25	8.4	8.7	9.0	9.3	9.6
26	8.7	9.0	9.3	9.6	9.9
27	9.0	9.3	9.6	9.9	10.2
28	9.3	9.6	9.9	10.2	10.5
29	9.6	9.9	10.2	10.5	10.8
30	9.9	10.2	10.5	10.8	11.1
31	10.2	10.5	10.8	11.1	11.4
32	10.5	10.8	11.1	11.4	11.7
33	10.8	11.1	11.4	11.7	12.0
34	11.1	11.4	11.7	12.0	12.3
35	11.4	11.7	12.0	12.3	12.6
36	11.7	12.0	12.3	12.6	12.9
37	12.0	12.3	12.6	12.9	13.2
38	12.3	12.6	12.9	13.2	13.5
39	12.6	12.9	13.2	13.5	13.8
40	12.9	13.2	13.5	13.8	14.1
41	13.2	13.5	13.8	14.1	14.4
42	13.5	13.8	14.1	14.4	14.7
43	13.8	14.1	14.4	14.7	15.0
44	14.1	14.4	14.7	15.0	15.3
45	14.4	14.7	15.0	15.3	15.6
46	14.7	15.0	15.3	15.6	15.9
47	15.0	15.3	15.6	15.9	16.2
48	15.3	15.6	15.9	16.2	16.5
49	15.6	15.9	16.2	16.5	16.8
50	15.9	16.2	16.5	16.8	17.1
51	16.2	16.5	16.8	17.1	17.4
52	16.5	16.8	17.1	17.4	17.7
53	16.8	17.1	17.4	17.7	18.0
54	17.1	17.4	17.7	18.0	18.3
55	17.4	17.7	18.0	18.3	18.6
56	17.7	18.0	18.3	18.6	18.9
57	18.0	18.3	18.6	18.9	19.2
58	18.3	18.6	18.9	19.2	19.5
59	18.6	18.9	19.2	19.5	19.8
60	18.9	19.2	19.5	19.8	20.1
61	19.2	19.5	19.8	20.1	20.4
62	19.5	19.8	20.1	20.4	20.7
63	19.8	20.1	20.4	20.7	21.0
64	20.1	20.4	20.7	21.0	21.3
65	20.4	20.7	21.0	21.3	21.6
66	20.7	21.0	21.3	21.6	21.9
67	21.0	21.3	21.6	21.9	22.2
68	21.3	21.6	21.9	22.2	22.5
69	21.6	21.9	22.2	22.5	22.8
70	21.9	22.2	22.5	22.8	23.1
71	22.2	22.5	22.8	23.1	23.4
72	22.5	22.8	23.1	23.4	23.7
73	22.8	23.1	23.4	23.7	24.0
74	23.1	23.4	23.7	24.0	24.3
75	23.4	23.7	24.0	24.3	24.6
76	23.7	24.0	24.3	24.6	24.9
77	24.0	24.3	24.6	24.9	25.2
78	24.3	24.6	24.9	25.2	25.5
79	24.6	24.9	25.2	25.5	25.8
80	24.9	25.2	25.5	25.8	26.1
81	25.2	25.5	25.8	26.1	26.4
82	25.5	25.8	26.1	26.4	26.7
83	25.8	26.1	26.4	26.7	27.0
84	26.1	26.4	26.7	27.0	27.3
85	26.4	26.7	27.0	27.3	27.6
86	26.7	27.0	27.3	27.6	27.9
87	27.0	27.3	27.6	27.9	28.2
88	27.3	27.6	27.9	28.2	28.5
89	27.6	27.9	28.2	28.5	28.8
90	27.9	28.2	28.5	28.8	29.1
91	28.2	28.5	28.8	29.1	29.4
92	28.5	28.8	29.1	29.4	29.7
93	28.8	29.1	29.4	29.7	30.0
94	29.1	29.4	29.7	30.0	30.3
95	29.4	29.7	30.0	30.3	30.6
96	29.7	30.0	30.3	30.6	30.9
97	30.0	30.3	30.6	30.9	31.2
98	30.3	30.6	30.9	31.2	31.5
99	30.6	30.9	31.2	31.5	31.8
100	30.9	31.2	31.5	31.8	32.1

TABLE 2. Summary of data for the 1992-1993 season.

TABLE 3. Summary of data for the 1993-1994 season.

TABLE 4. Summary of data for the 1994-1995 season.

TABLE 5. Summary of data for the 1995-1996 season.

Correlation of average root lodging scores of the four related inbred testers with the averages from the two related single cross testers and with the double cross Ohio M 15, were significant, suggesting that either four inbred testers, or their two single crosses, or the double cross made up from the four tester inbreds would be effective in evaluating root lodging. Correlating the averages for the related and unrelated testers showed a significant association, suggesting that either related or unrelated testers could be effective for root lodging evaluation.

#### Variance Components

Variance components for "testers" and "tester x line" interaction were compared for yield and maturity percentage. The method of calculating the components of variance is presented in Table 18, 19, 20, 21, 22 and the results are given in Table 23.

The mean yields for inbred, single and double cross testers in test crosses were 81.7, 83.6 and 83.7 bushels per acre, respectively. These three means were quite similar. There was no significant tester type x line interaction Table 22 and the variance component was .01 (Table 23), related and unrelated testers evaluated the lines similarly for yield.

The differences among the five inbred testers, three single cross and two double cross testers were significant as

...the ... of ...

...the ... of ...

...the ... of ...

### ...the ... of ...

...the ... of ...

...the ... of ...

...the ... of ...

...the ... of ...

Table 18

Mean square expectations for yield and moisture  
percentage comparing inbred single cross  
and double cross testers

Source of Variation	Value of Mean Squares
Tester Type	$\sigma^2_{aT_y} \neq 194.4 \sigma^2_{l.T_y} \neq 372 \sigma^2_{T_y}$
Line X Tester Type	$\sigma^2_{bT_y} \neq 9.8 \sigma^2_{l.T_y.L} \neq 19.9 \sigma^2_{T_y.L}$
Inbred Testers	$\sigma^2_{a_1} \neq 60 \sigma^2_{l.T_1} \neq 120 \sigma^2_{T_1}$
(a) Error	$\sigma^2_{a_1}$
Inbred Tester X Line	$\sigma^2_{b_1} \neq 3 \sigma^2_{l.T_1.L} \neq 6 \sigma^2_{T_1.L}$
(b) Error	$\sigma^2_{b_1}$
Single Cross Testers	$\sigma^2_{a_s} \neq 60 \sigma^2_{l.T_s} \neq 120 \sigma^2_{T_s}$
(a) Error	$\sigma^2_{a_s}$
Tester X Line	$\sigma^2_{b_s} \neq 3 \sigma^2_{l.T_s.L} \neq 6 \sigma^2_{T_s.L}$
(b) Error	$\sigma^2_{b_s}$
Double Cross Tester	$\sigma^2_{a_d} \neq 60 \sigma^2_{l.T_d} \neq 120 \sigma^2_{T_d}$
(a) Error	$\sigma^2_{a_d}$
Double Cross Tester X Line	$\sigma^2_{b_d} \neq 3 \sigma^2_{l.T_d.L} \neq 6 \sigma^2_{T_d.L}$
(b) Error	$\sigma^2_{b_d}$

the 1990s, the number of people in the world who are under 15 years of age is expected to increase from 1.1 billion to 1.5 billion. The number of people aged 65 and over is expected to increase from 200 million to 400 million. The number of people aged 15 and over is expected to increase from 3.5 billion to 4.5 billion. The number of people aged 15 and over is expected to increase from 3.5 billion to 4.5 billion. The number of people aged 15 and over is expected to increase from 3.5 billion to 4.5 billion.

[illegible]

Table 19

## Component of Variance for inbred testers

	D.F.	M.S.S. Yield	M.S.S. Mois- ture	
Total	599			
Replica- tions	4	53.92	46.3	
Tester	4	125.72*	847.17*	$\sigma^2_{a1} \neq 60 \sigma^2_{1.T1} \neq 120 \sigma^2_{T1}$
Location	1	130.8	1753.8	$\sigma^2_{a1} \neq 60 \sigma^2_{1.T1} \neq 300 \sigma^2_1$
Location X Tester	4	9.67	40.3	$\sigma^2_{a1} \neq 60 \sigma^2_{1.T1}$
(a) Error	16	15.34	19.77	$\sigma^2_{a1}$
Line	19	3.72	205.2	$\sigma^2_{b1} \neq 3 \sigma^2_{1.T1.L} \neq 6 \sigma^2_{T1.L} \neq 30 \sigma^2_{1.L} \neq 60 \sigma^2_L$
Line X Location	19	11.12	30.78	$\sigma^2_{b1} \neq 3 \sigma^2_{1.T1.L} \neq 30 \sigma^2_{1.L}$
Tester X Line	76	12.71*	15.77*	$\sigma^2_{b1} \neq 3 \sigma^2_{1.T1.L} \neq 6 \sigma^2_{T.L}$
Line X Tester X Location	76	5.42	5.31	$\sigma^2_{b1} \neq 3 \sigma^2_{1.T1.L}$
Error	380	3.90	4.25	$\sigma^2_{b1}$

Note: 1 = Location

L = Line

T1 = Tester inbred

\* significance at 5%

THE UNIVERSITY OF CHICAGO

CHICAGO, ILL.

TO THE PRESIDENT OF THE UNIVERSITY OF CHICAGO  
FROM THE DEAN OF THE FACULTY  
SIR:  
I have the honor to acknowledge the receipt of your letter of the 10th inst. and in reply to inform you that the same has been forwarded to the proper authorities for their consideration. I am, Sir, very respectfully,  
Yours, Sir, very respectfully,  
J. H. COOPER, Dean of the Faculty

THE UNIVERSITY OF CHICAGO  
CHICAGO, ILL.



Table 20

## Component of Variance for single cross testers

	D.F.	M.S.S. Yield	M.S.S. Mois- ture %	
Total	359			
Replica- tion	4	26.8	62.5	
Tester	2	353.5*	328.3*	$\sigma^2_{a_s} \neq 60 \sigma^2_{1.Ts.} \neq 120 \sigma^2_{Ts.}$
Location	1	120.5	1039.3	$\sigma^2_{a_s} \neq 60 \sigma^2_{1.Ts.} \neq 180 \sigma^2_1$
Location X Tester	2	9.7	78.9	$\sigma^2_{a_s} \neq 60 \sigma^2_{1.Ts.}$
(a) Error	8	19.51	7.74	$\sigma^2_{a_s}$
Line	19	23.3	11.77	$\sigma^2_{b_s} \neq 3 \sigma^2_{1.TsL.} \neq 6 \sigma^2_{TsL.} \neq 30 \sigma^2_{1.L} \neq 60 \sigma^2_{L.}$
Line X Location	19	8.35	17.85	$\sigma^2_{b_s} \neq 3 \sigma^2_{1.Ts.L} \neq 30 \sigma^2_{1.L.}$
Line X Tester	38	5.88*	6.98	$\sigma^2_{b_s} \neq 3 \sigma^2_{1.TsL.} \neq 6 \sigma^2_{TsL}$
Line X Location X Tester	38	3.12	5.41	$\sigma^2_{b_s} \neq 3 \sigma^2_{1.Ts.L.}$
(b) Error	228	3.72	4.11	$\sigma^2_{b_s}$

L = Line

l = Location

Ts = Tester single cross

\* significance at 5%

... ..

... ..

... ..

... ..

... ..

... ..

... ..

... ..

... ..

... ..

... ..

... ..

... ..

... ..

... ..

... ..

... ..

... ..

Table 21

## Components of Variance of double cross testers

	D.F.	M.S.S. Yield	M.S.S. Mois- ture	
Total	239			
Replica- tion	4	22.95	34.55	
Tester	1	264.8	22.6	$\sigma^2_{a_d} \neq 60$ 1.Td. $\neq 120$ $\sigma^2_{Td}$ .
Location	1	51.0	709.3	$\sigma^2_{a_d} \neq 60$ $\sigma^2_{1.Td.} \neq 120$ $\sigma^2_1$
Location X Tester	1	86.0	22.8	$\sigma^2_{a_d} \neq 60$ $\sigma^2_{1.Td.}$
(a) Error	4	8.05	4.88	$\sigma^2_{a_d}$
Line	19	15.70	63.89	$\sigma^2_{b_d} \neq 3$ $\sigma^2_{1.Td.L.} \neq 6$ $\sigma^2_{Td.L.} \neq$ 30 $\sigma^2_{1.L} \neq 60$ $\sigma^2_L$
Line X Location	19	3.40	47.5	$\sigma^2_{b_d} \neq 3$ $\sigma^2_{1.Td.L.} \neq 30$ 1.L
Line X Tester	19	2.35	16.98	$\sigma^2_{b_d} \neq 3$ $\sigma^2_{1.Td.L.} \neq 6$ $\sigma^2_{Td.L}$
Line X Tester X Location	19	8.26	8.67	$\sigma^2_{b_d} \neq 3$ $\sigma^2_{1.Td.L}$
(b) Error	152	3.76	5.12	$\sigma^2_{b_d}$

1 = Location

L = Line

Td = Tester double cross

\* significance at 5%

1. The first group of people who are not in the labor force are those who are not in the labor force because they are not in the labor force. This group is the largest group of people who are not in the labor force.

[illegible]

Table 22

## Components of Variance of type of testers

	D.F.	M.S.S. for Yield	M.S.S. for Mois- ture	
Total	359			
Replica- tion	4			
Location	1			
Type	2	11.2	12.8	$\sigma^2_{aTy} \neq 194.4 \sigma^2_{l.Ty} \neq 372 \sigma^2_{Ty}$
Location X Type	2	2.95	0.05	$\sigma^2_{aTy} \neq 194.4 \sigma^2_{l.Ty}$
(a) Error	8	13.71	10.85	$\sigma^2_{aTy}$
Line	19	66.9	39.4	$\sigma^2_{bTy} \neq 9.8 \sigma^2_{l.TyL} \neq 19.9 \sigma^2_{TyL} \neq 30 \sigma^2_{l.L} \neq 60 \sigma^2_L$
Line X Location	19	19.9	57.7	$\sigma^2_{bTy} \neq 9.8 \sigma^2_{l.TyL} \neq 30 \sigma^2_{l.L}$
Line X Type	38	4.39	9.46	$\sigma^2_{bTy} \neq 9.8 \sigma^2_{l.Ty.L} \neq 19.9 \sigma^2_{Ty.L}$
Line X Type X Location	38	1.75	9.06	$\sigma^2_{bTy} \neq 9.8 \sigma^2_{l.Ty.L}$
(b) Error	228	4.08	5.22	$\sigma^2_{bTy}$

L = Line

l = Location

Ty = Type



Page 10

10/10/10

10/10/10

10/10/10

10/10/10

10/10/10

10/10/10

10/10/10

10/10/10

10/10/10

10/10/10

10/10/10

10/10/10

10/10/10

10/10/10

10/10/10

10/10/10

10/10/10

10/10/10

10/10/10

10/10/10

10/10/10

10/10/10

10/10/10

10/10/10

10/10/10

10/10/10

10/10/10

10/10/10

10/10/10

Table 23

## Variance components for yield and moisture

Source of Variation	D.F.	Mean Square		Variance Components	Variance components estimate	
		Yield	Moisture		Yield	Moisture
Tester types	2	11.2	12.8	$\sigma^2_T$	.022	.005
(a) Error	8	13.71	10.85	$\sigma^2_{a.T}$	13.71	10.85
Line X Tester type	38	4.39	9.46	$\sigma^2_{bT.L}$	0.01	.02
(b) Error	228	4.08	5.22	$\sigma^2_{bT}$	4.08	5.22
Inbred Tester	4	125.72	847.17	$\sigma^2_1$	.93	6.72
(a) Error	16	15.34	19.77	$\sigma^2_{a_1}$	15.34	19.77
Inbred Tester X Line	76	12.71	15.77	$\sigma^2_{b_1L}$	1.22	1.74
(b) Error	380	3.90	4.25	$\sigma^2_{b_1}$	3.90	4.25
Single Cross Tester	2	353.5	328.3	$\sigma^2_s$	2.86	2.1
(a) Error	8	19.51	7.74	$\sigma^2_{as}$	19.51	7.74
Single Cross Tester X Line	38	5.88	6.98	$\sigma^2_{s.L}$	.46	0.26
(b) Error	228	3.72	4.11	$\sigma^2_{bs}$	3.72	4.11
Double Cross Tester	1	264.8	22.6	$\sigma^2_d$	1.49	.002
(a) Error	4	8.05	4.88	$\sigma^2_{ad}$	8.05	4.88
Double Cross Tester X Line	19	2.35	16.98	$\sigma^2_{d.L.}$	-.23	1.58
(b) Error	152	3.76	5.12	$\sigma^2_{bd}$	3.76	5.12

Correlation between inbred and single cross testers		.698
Degree of freedom	18	
Correlation between inbred and double cross testers		.624
Degree of freedom	18	
Correlation between single and double testers		.529
Degree of freedom	18	





judged by the 'F' test, (Table 19, 20, and 21). The difference in the yield due to the different testers within a group may be due to the variation in the amount of genetic similarity of the testers with the lines being tested. Testers more similar genetically to the tested lines would be expected to give lower average yields than testers which were different genetically from the tested lines.

Correlation coefficients showed that the three groups of testers ranked the lines for the yield similarly, Table 23. Interactions for inbred tester x lines and single cross tester x lines were significant but not for the double cross tester x line, Table 19, 20 and 21. Components of variance estimates for the interactions inbred testers x lines, single-cross testers x lines and double - cross testers x lines were 1.22, .46 and -.23 respectively. The decrease in relative size of these interaction components indicate that performances with inbred and single cross testers were more specific than those with double cross testers. The relative size of the interaction component for tester x line decreased as the gene base became broader. This same relationship for tester types was shown by Matzinger (21).

Mean moisture percentages for inbred, single and double cross testers were 21.9, 21.5 and 21.6 respectively. There were no differences for type of testers or for line x type interactions as judged by 'F' tests (Table 22). The component of variance for line x type interaction was .02 again indicating no interaction.



...the ... of ...  
...the ... of ...  
...the ... of ...

...the ... of ...  
...the ... of ...  
...the ... of ...

...the ... of ...  
...the ... of ...  
...the ... of ...

...the ... of ...  
...the ... of ...  
...the ... of ...

...the ... of ...  
...the ... of ...  
...the ... of ...

...the ... of ...  
...the ... of ...  
...the ... of ...

...the ... of ...  
...the ... of ...  
...the ... of ...

...the ... of ...  
...the ... of ...  
...the ... of ...

...the ... of ...  
...the ... of ...  
...the ... of ...

...the ... of ...  
...the ... of ...  
...the ... of ...

The data for different testers x line interaction indicate that there was no significant line x single cross tester interaction for moisture (Table 22). This suggests that the three single cross testers were evaluating the lines similarly for maturity. Interactions for inbred testers x lines and double cross testers x lines were significant as judged by 'F' test (Tables 19 and 21) and the components of variance were 1.74 and 1.58 respectively. Like yield, these interactions components were small compared to the error components indicating that factors contributing to error components were more effective than the components for interactions.



## Discussion

The results reported in this investigation have indicated that some second cycle lines, more vigorous and better in combining ability than the parental lines, were produced by inbreeding and selection in a double cross corn hybrid. Since only the better lines were used to produce the initial double cross hybrid, Ohio M 15, the desirable factors from each of the parental inbreds were concentrated in one variety. Thus the chances of obtaining a higher percentage of usable lines from such sources are likely to be better than from the older open pollinated varieties. The isolation of some superior lines from double cross hybrids may be due to the cumulative effect of large number of factors affecting yield (28). Similar results were reported by Wu (30), Hayes and Johnson (12) and Johnson and Hayes (18) who worked with single cross hybrids. Sprague (26) suggests that continued cycles of isolating new lines may be repeated as long as improved lines are obtained. The production of vigorous lines is an economic factor in production of hybrid seed corn from inbred lines whereas lines superior in combining ability lead to better hybrids.

Through inbreeding and selection in a double-cross hybrid, second cycle lines genetically different from the parents and with each other were produced. The results from single and double cross tests among second cycle lines indicated that selected lines produced some hybrids equal or



slightly better yielding than Ohio M 15, from which they were extracted. Since yield is controlled by a large number of genetic factors, there is little possibility of similar yield factors recombining in second cycle lines to produce lines similar to the parental lines. The chances of recombining all of the parental characters in one recovered line exactly or even close to the parental genotype are relatively remote. Thus, recovered lines varying in genetic relationship with each other and also with the four parental inbreds were produced.

Several hybrids using second cycle lines were superior to the parental double cross, Ohio M 15, in lodging resistance. Resistance to lodging is very important from the standpoint of ease and thoroughness of mechanical harvest. Any improvement in lodging resistance represents an important contribution to corn production and increases corn yields by reducing harvest losses.

These results show that lines from the same genetic background can be used to produce good hybrids, if they were extracted from a wide genetic base equivalent at least to a double-cross hybrid as source material for extraction. Close genetic similarity with the parents and among the second cycle lines has been reported (30, 12) for lines isolated from single crosses. In addition to improving combining ability, lines earlier or later in maturity than the parents and equal to the best parent and better than the other parents in root and stalk lodging resistance were isolated.

The results were encouraging in that some lines genetically different from the parent and with each other were produced. Previous workers, using single crosses as source material, isolated some superior lines, but closer genetic relationship largely precluded the use of the second cycle lines with their parental lines in double cross combinations. These results have shown that there are chances to isolate genetically divergent lines in second cycle selection from a double cross.

As a feature of routine corn breeding program, the extensive evaluation of a group of second cycle lines from the same source as was done here would probably be less effective in developing improved hybrids than the same effort devoted to evaluating a group of lines from several sources. However, the present study does serve to point out the possibilities of improvement where it is desired to improve a highly popular double-cross hybrid using it as inbreeding source material.

Evaluation of second cycle lines for yield, maturity and lodging using different types of related and unrelated testers was compared. Inbred testers irrespective of the relationship with the lines under test were specific in evaluating the lines for yield. Also single and double cross testers (related and unrelated) either showed little or no similarity in evaluating yield. These results support the view of Sprague and Tatum (29) who suggest more than one single or double cross tester for evaluating lines for general combining ability.





The specific action of these testers for yield has been indicated by the analyses of components of variance. The line x tester interaction for yield indicated that as genetic variation within testers increased (inbred to single cross to double cross), the line x tester interaction component decreased. These results concur with the findings of Matzinger (21) and suggest that the inbred or single cross testers be selected according to the use which is to be made of the new lines. For example if the new lines were to be used as a substitute for one of the parents in the pedigree of a double cross the best tester will be the opposite single cross.

There was no interaction for the yields due to line x double cross testers and the correlation was significant .46. While the correlation between the two double cross testers was not high, they did identify most of the same inbreds as being high in general combining ability.

The comparison between the two tester groups (related and unrelated) indicated that either related testers or unrelated testers, as a group were reliable for estimating general combining ability. The two groups of testers showed significant association for all the characteristics under study indicating that the relationship of the tester parents to the tested lines did not affect the ranking of the lines.

The analyses for types of testers suggests that the evaluation of the lines for general combining ability can be



done most economically with two or more double cross testers irrespective of relationship with the lines under test. If other types of testers (inbreds and single crosses) are to be used, the number of testers should be increased.

Correlations of the mean performances of four inbred testers with the means of their two single crosses suggest that the two types of testers within a group ranked the lines similarly for all the characters under study. This suggests either four parental inbreds or their two single crosses as testers for approximately equal precision.

Correlations among testers for maturity were generally high, suggesting fewer testers would be needed for evaluating maturity. Closer association among testers in the evaluation of maturity might be due to fewer genes affecting the expression of maturity than yield and stalk lodging resistance. Yield is highly multi-genic. Resistance to stalk lodging is determined by resistance to both corn borer and stalk rotting fungi coupled with stiffness of stalk and, as such, becomes relatively multi-genic.

The results for stalk and root lodging showed that inbred and single cross testers, regardless of relationship with the tested lines, did not evaluate the lines in similar order. The two double cross testers did evaluate the lines for stalk lodging in similar order but not for root lodging where the use of more than one double cross tester was needed. The amount of root lodging was relatively low and these results



may not apply in tests where root lodging is high.

It should be emphasized that in a corn breeding program, the evaluation for maturity and lodging is done in conjunction with yield. The results have suggested the use of more than one tester irrespective of the relation for evaluating the lines for yield. On the other hand, for all characters under study, the use of more than one tester has produced a high precision. This suggests that with the evaluation of lines for yield, other characters will also be evaluated with a relatively high degree of accuracy.

• The first of these is the fact that the  
• system is not a simple one, and that it is  
• not a simple one, and that it is not a simple one.  
• The second is the fact that the system is not a simple one,  
• and that it is not a simple one, and that it is not a simple one.  
• The third is the fact that the system is not a simple one,  
• and that it is not a simple one, and that it is not a simple one.  
• The fourth is the fact that the system is not a simple one,  
• and that it is not a simple one, and that it is not a simple one.  
• The fifth is the fact that the system is not a simple one,  
• and that it is not a simple one, and that it is not a simple one.  
• The sixth is the fact that the system is not a simple one,  
• and that it is not a simple one, and that it is not a simple one.  
• The seventh is the fact that the system is not a simple one,  
• and that it is not a simple one, and that it is not a simple one.  
• The eighth is the fact that the system is not a simple one,  
• and that it is not a simple one, and that it is not a simple one.  
• The ninth is the fact that the system is not a simple one,  
• and that it is not a simple one, and that it is not a simple one.  
• The tenth is the fact that the system is not a simple one,  
• and that it is not a simple one, and that it is not a simple one.

## Summary

Twenty  $S_6$  second cycle lines developed by inbreeding and selection in the double cross Ohio M 15 (Oh 51 x Oh 26) x (Ill.A x W 23) were used to study the degree of relationship with the four parental lines and among themselves. These lines were crossed on ten testers, seven related (four parental inbreds, two single crosses and the double cross Ohio M 15) and three unrelated testers (inbred M 14, single cross M 14 x W F 9 and double cross Ia. 4483 (M 14 x W F 9) x (B<sub>8</sub> x B16)).

Seven of the second cycle lines, four parental lines and one unrelated line, M 14 were used to produce, 66, single crosses. Actual and predicted performance of double crosses were compared with the parental Ohio M 15.

1. A few of the second cycle lines were more vigorous than and superior to the parental inbreds in combining ability.
2. Second cycle lines were genetically different from some of the parents and from each other.
3. A few double crosses equal to or slightly better than Ohio M 15 were produced by crossing four second cycle lines or by substituting them with one or more of the parental lines in the pedigree of Ohio M 15.
4. Predicted yield, percentage of moisture and stalk lodging of the double crosses from the single cross data showed significant correlation with the actual yield, percentage of moisture and stalk lodging.

These results indicate that, even the lines of the same





origin can be used to produce good hybrids, if they were extracted from a wide genetic base.

5. Inbred and single-cross testers were very specific in evaluating the lines for yield and lodging. This suggests the use of more than one of these as testers for general combining ability. The 'r' value between the two double cross testers was a significant (.46) but low enough to suggest the use of more than one tester for evaluating the lines for general combining ability for yield. A high 'r' value for the mean of the four parental inbred testers with the mean of their two single crosses suggested that either four inbreds or their two single crosses may be used for evaluating general combining ability of the lines for yield.

6. Either the four inbred testers or their two single crosses, or the double cross of the four inbreds could be used to evaluate the lines for resistance to stalk lodging. A similar situation was indicated for resistance to root lodging.

7. Correlation for the two tester groups (related and unrelated) indicates that either related or unrelated testers, as a group, were reliable for estimating relative general combining ability for yield, maturity, and stalk lodging resistance.

8. The correlation coefficients for maturity were significant in all cases and were generally high, suggesting fewer testers would be needed to evaluate maturity than yield or lodging resistance.



9. For related lines, genes conditioning specific combining ability were relatively more important in influencing yield than genes for general combining ability.

10. Analysis of components of variance shows that for yield, line x tester interaction decreased with increased genetic variation in the tester. This same relationship did not exist for maturity.



### Literature Cited

1. Anderson, D. C. The relation between single and double cross yields in corn. Jour. Amer. Soc. Agron., 30:209-211. 1938.
2. Beard, D. F. Relative values of unrelated single crosses and an open pollinated variety as testers of inbred lines of corn. Doctoral Dissertations No. 33; 9-16. Ohio State University Press: Abs. 1940.
3. Brown, Sr. C. E. and Rossman, E. C. A. Machine for the ear corn moisture samples. Jour. Amer. Soc. Agron., 46:40. 1954.
4. Combs, J. B. and Zuber, M. S. Further use of punch card equipment in predicting the performance of double-cross hybrids. Agron. Jour., 41:485-485. 1949.
5. Cowan, J. R. The value of double cross hybrids involving inbreds of similar and diverse genetic origin. Sci. Agri. 287-296. 1943.
6. Davis, R. L. Report of the plant breeder. Rep. Puerto Rico Agric. Ext. Sta. (1927) p. 14.
7. Dextator, C. W. and Johnson, I. J. Prediction of double cross yields in corn. Jour. Amer. Soc. Agron., 28:460-462, 1936.
8. Eckhardt, Robert C. and Bryan, A. A. Effect of method of combining the four inbred lines of a double cross of maize upon the yield and variability of the resulting hybrid. Jour. Amer. Soc. Agron., 32:347-353. 1940.
9. Eckhardt, Robert C. and Bryan, A. A. Effect of the method of combining two early and two late inbred lines of corn upon the yield and variability of the resulting double crosses. Jour. Amer. Soc. Agron., 32:645-656. 1940.
10. Federer, W. T. and Sprague, G. F. A comparison of variance components in corn yield trials: I Error, tester x line, and line components in top-cross experiments. Jour. Amer. Soc. Agron., 39:453-463. 1947.
11. Green, G. M. The inheritance of combining ability in maize hybrids. Jour. Amer. Soc. Agron., 58-63. 1948.
12. Hayes, H. K. and Johnson, I. J. The breeding of improved selfed lines of corn. Jour. Amer. Soc. Agron., 31: 710-724. 1939.



1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes that proper record-keeping is essential for transparency and accountability, particularly in financial matters.

2. The second part outlines the various methods and tools used to collect and analyze data. This includes the use of surveys, interviews, and statistical software to ensure that the information gathered is reliable and valid.

3. The third part focuses on the ethical considerations surrounding data collection and analysis. It highlights the need to protect individual privacy and to use data responsibly, ensuring that it is not misused or shared without proper authorization.

4. The fourth part discusses the challenges faced in conducting research, particularly in terms of resource limitations and the complexity of the subject matter. It offers strategies to overcome these challenges, such as seeking external funding and collaborating with experts in the field.

5. The fifth part provides a summary of the findings and conclusions drawn from the research. It reiterates the key points made throughout the document and offers recommendations for future research and practice.

6. The final part of the document is a conclusion that ties all the elements together, reinforcing the overall message of the importance of rigorous and ethical research practices.

13. Hayes, H. K., Murphy, R. P. and Rinke, E. H. A comparison of the actual yield of double crosses of maize with their predicted yield from single crosses. Jour. Amer. Soc. Agron., 35:60-65. 1943.
14. Jenkins, M. T. Methods of estimating the performance of double crosses in corn. Jour. Amer. Soc. Agron., 26:199-204. 1934.
15. Jenkins, M. T. The effect of inbreeding and selection within inbred lines of maize upon the hybrids made after successive generations of selfing. Iowa State College Jour. Sci., 9:429-450. 1935.
16. Jenkins, M. T. and Brunson, A. M. Methods of testing inbred lines of maize in cross bred combinations. Jour. Amer. Soc. Agron., 24:523-530. 1932.
17. Johnson, I. J. and Hayes, H. K. The combining ability of inbred lines of Golden Bantam sweet corn. Jour. Amer. Soc. Agron., 28:246-252. 1936.
18. Johnson, I. J. and Hayes, H. K. The value in hybrid combinations of inbred lines of corn selected from single crosses by the pedigree method of breeding. Jour. Amer. Soc. Agron., 32:479-485. 1940.
19. Jones, D. R. The productiveness of single and double first generation corn hybrids. Jour. Amer. Soc. Agron., 14, 241-252. 1922.
20. Keller, K. R. A comparison involving the number of and relationship between testers in evaluating inbred lines of maize. Agron. Jour. 41:323-331. 1949.
21. Matzinger, D. F. Comparison of three types of testers for the evaluation of inbred lines of corn. Agron. Jour., 45:493-495. 1953.
22. Millang, Amy and Sprague, G. F. The use of punch card equipment in predicting the performance of corn double crosses. Jour. Amer. Soc. Agron., 32:815-816. 1940.
23. Richey, F. D. Isolating better foundation inbreds for use in corn hybrids. Genetics 30:455-471. 1945.
24. Rojas, Basilio A. and Sprague, G. F. A comparison of variance components in corn yield trials: III. General and specific combining ability and their interaction with locations and years. Jour. Amer. Soc. Agron., 44:462-466. 1952.



the first of these is the fact that the  
the second is the fact that the  
the third is the fact that the  
the fourth is the fact that the  
the fifth is the fact that the  
the sixth is the fact that the  
the seventh is the fact that the  
the eighth is the fact that the  
the ninth is the fact that the  
the tenth is the fact that the  
the eleventh is the fact that the  
the twelfth is the fact that the  
the thirteenth is the fact that the  
the fourteenth is the fact that the  
the fifteenth is the fact that the  
the sixteenth is the fact that the  
the seventeenth is the fact that the  
the eighteenth is the fact that the  
the nineteenth is the fact that the  
the twentieth is the fact that the  
the twenty-first is the fact that the  
the twenty-second is the fact that the  
the twenty-third is the fact that the  
the twenty-fourth is the fact that the  
the twenty-fifth is the fact that the  
the twenty-sixth is the fact that the  
the twenty-seventh is the fact that the  
the twenty-eighth is the fact that the  
the twenty-ninth is the fact that the  
the thirtieth is the fact that the  
the thirty-first is the fact that the  
the thirty-second is the fact that the  
the thirty-third is the fact that the  
the thirty-fourth is the fact that the  
the thirty-fifth is the fact that the  
the thirty-sixth is the fact that the  
the thirty-seventh is the fact that the  
the thirty-eighth is the fact that the  
the thirty-ninth is the fact that the  
the fortieth is the fact that the  
the forty-first is the fact that the  
the forty-second is the fact that the  
the forty-third is the fact that the  
the forty-fourth is the fact that the  
the forty-fifth is the fact that the  
the forty-sixth is the fact that the  
the forty-seventh is the fact that the  
the forty-eighth is the fact that the  
the forty-ninth is the fact that the  
the fiftieth is the fact that the  
the fifty-first is the fact that the  
the fifty-second is the fact that the  
the fifty-third is the fact that the  
the fifty-fourth is the fact that the  
the fifty-fifth is the fact that the  
the fifty-sixth is the fact that the  
the fifty-seventh is the fact that the  
the fifty-eighth is the fact that the  
the fifty-ninth is the fact that the  
the sixtieth is the fact that the  
the sixty-first is the fact that the  
the sixty-second is the fact that the  
the sixty-third is the fact that the  
the sixty-fourth is the fact that the  
the sixty-fifth is the fact that the  
the sixty-sixth is the fact that the  
the sixty-seventh is the fact that the  
the sixty-eighth is the fact that the  
the sixty-ninth is the fact that the  
the seventieth is the fact that the  
the seventy-first is the fact that the  
the seventy-second is the fact that the  
the seventy-third is the fact that the  
the seventy-fourth is the fact that the  
the seventy-fifth is the fact that the  
the seventy-sixth is the fact that the  
the seventy-seventh is the fact that the  
the seventy-eighth is the fact that the  
the seventy-ninth is the fact that the  
the eightieth is the fact that the  
the eighty-first is the fact that the  
the eighty-second is the fact that the  
the eighty-third is the fact that the  
the eighty-fourth is the fact that the  
the eighty-fifth is the fact that the  
the eighty-sixth is the fact that the  
the eighty-seventh is the fact that the  
the eighty-eighth is the fact that the  
the eighty-ninth is the fact that the  
the ninetieth is the fact that the  
the ninety-first is the fact that the  
the ninety-second is the fact that the  
the ninety-third is the fact that the  
the ninety-fourth is the fact that the  
the ninety-fifth is the fact that the  
the ninety-sixth is the fact that the  
the ninety-seventh is the fact that the  
the ninety-eighth is the fact that the  
the ninety-ninth is the fact that the  
the hundredth is the fact that the

25. Shull, G. H. Methods of plant breeding by Hayes and Immer. pp. 192-193. First Edition, 9th impression. McGraw-Hill Book Company, Inc., New York.
26. Singleton, W. Ralph. Hybrid vigour and its utilization in sweet corn breeding. Amer. Nat., 75:48-60. 1941.
27. Sprague, G. F. Early testing of inbred lines of corn. Jour. Amer. Soc. Agron. 38:108-117. 1946.
28. Sprague, G. F. The experimental basis for hybrid maize. Biological reviews, Vol. 21, 101-120. 1946.
29. Sprague, G. F. and Tatum, L. A. General vs. specific combining ability in single crosses of corn. Jour. Amer. Soc. Agron., 34:923-932. 1942.
30. Wu, Shao-Kwei. The relationship between the origin of selfed lines of corn and their value in hybrid combination. Jour. Amer. Soc. Agron., 31:131-140. 1939.

100

Appendix Table I

Yield and percentage of moisture in the inbred lines  
at one location in 1954 and two locations in 1955

Inbred lines	Yields of grain in lbs. per plot			Moisture in ear %		
	M.S.U.	M.S.U.	Saginaw	M.S.U.	M.S.U.	Saginaw
	Farm 1954	Farm 1955	County 1955	Farm 1954	Farm 1955	County 1955
1	3.04	3.37	3.36	32.8	23.5	19.5
2	1.37	-	1.71	60.6	-	31.0
3	2.47	2.17	2.1	39.7	33.6	21.7
4	2.12	2.46	2.15	41.7	35.6	20.5
5	2.67	2.50	2.06	40.5	30.2	18.9
6	2.84	2.97	2.71	33.7	24.4	17.2
7	1.82	2.29	2.03	35.6	23.8	24.0
8	2.11	2.86	2.81	37.7	25.1	14.9
9	1.99	1.82	2.05	45.3	45.0	21.0
10	1.74	1.30	1.27	29.6	18.2	14.7
11	2.07	2.57	2.17	42.4	21.3	20.6
12	1.58	2.68	2.47	37.8	21.7	15.0
13	2.51	2.51	2.78	26.5	25.4	17.0
14	2.12	2.67	2.92	39.2	32.7	23.3
15	1.68	2.14	2.25	31.8	25.6	15.0
16	1.85	2.22	2.36	29.5	23.6	14.1
17	2.36	2.96	2.69	30.3	24.3	19.3
18	1.8	2.27	2.72	37.3	29.1	16.5
19	2.31	2.89	3.17	41.5	21.5	14.2
20	2.03	1.68	1.76	28.2	18.4	12.6
21	2.62	2.03	2.60	30.0	29.3	18.3
22	1.48	2.37	1.91	40.7	20.4	14.9
23	1.65	2.15	2.07	46.7	40.3	27.5
24	2.63	2.49	2.69	34.1	26.6	18.1
25	2.29	2.59	2.77	41.4	33.3	17.2
L.S.D. 5%	.58	0.44	0.42	4.4	4.6	2.8

1. The first part of the document is a list of names and addresses of the members of the committee.

2. The second part of the document is a list of names and addresses of the members of the committee.

3. The third part of the document is a list of names and addresses of the members of the committee.

4. The fourth part of the document is a list of names and addresses of the members of the committee.

5. The fifth part of the document is a list of names and addresses of the members of the committee.

Appendix Table II

Percentage of stalk and root lodging in the inbred lines  
at one location in 1954 and at two locations in 1955

Inbred lines	Stalk lodging %			Root lodging %		
	M.S.U. Farm	M.S.U. Farm	Saginaw County	M.S.U. Farm	M.S.U. Farm	Saginaw County
	1954	1955	1955	1954	1955	1955
1	6.7	2.0	1.8	1.7	2.0	-
2	-	-	2.9	-	13.7	-
3	10.0	16.1	9.4	11.6	23.2	1.9
4	10.0	9.6	6.7	10.0	13.5	10.0
5	16.7	13.0	10.9	16.7	22.2	5.5
6	8.6	16.7	15.5	3.4	-	-
7	1.7	2.1	9.1	3.4	-	-
8	12.3	14.8	8.8	-	-	3.5
9	-	1.8	2.1	-	5.4	-
10	10.3	3.8	26.9	1.7	7.5	-
11	1.8	-	-	-	-	-
12	3.3	4.1	17.6	3.3	-	3.9
13	11.6	7.0	6.7	3.3	1.9	-
14	10.0	5.5	30.5	3.3	1.8	10.2
15	16.7	49.0	31.7	-	-	1.7
16	31.6	7.0	10.0	5.0	1.8	-
17	5.1	7.4	-	-	-	-
18	15.3	27.8	15.9	13.6	20.4	20.5
19	-	7.8	13.4	-	-	-
20	-	12.1	1.7	-	-	-
21	6.7	8.6	5.0	15.0	10.3	3.3
22	-	-	-	-	-	5.3
23	8.3	3.8	19.6	1.7	5.2	-
24	63.3	15.7	41.2	-	5.9	-
25	1.7	3.7	-	3.3	5.7	-



## Appendix III

Yield, percentage of moisture, stalk and root lodging  
in tester crosses at two locations (1955)

S. N.	Pedigree	Yield in bu. per acre at 15.5% moisture	
		University Farm	Saginaw Farm
1	Oh26 X Ill.A	93.7	87.3
2	Oh26 X W23	73.5	90.3
3	Oh26 X (Oh51 X Oh26)	50.0	54.9
4	Oh26 X (Ill.A X W23)	79.8	73.4
5	Oh26 X Ohio M15	66.7	76.3
6	Oh26 X M14	85.2	89.8
7	Oh26 X (M14 X WF9)	89.5	104.9
8	Oh26 X Ia. 4483	78.2	89.6
9	Ill.A X W23	99.2	82.0
10	Ill.A X (Oh51 X Oh26)	80.6	80.9
11	Ill.A X (Ill.A X W23)	55.7	73.7
12	Ill.A X Ohio M15	96.7	77.8
13	Ill.A X M14	80.5	94.7
14	Ill.A X (M14 X WF9)	114.3	97.2
15	Ill.A X Ia. 4483	102.6	93.0
16	M14 X (Oh51 X Oh26)	80.7	93.6
17	M14 X (Ill.A X W23)	88.9	79.6
18	M14 X Ohio M15	83.6	90.6
19	M14 X (M14 X WF9)	64.0	72.6
20	M14 X Ia. 4483	82.6	69.4
21	Oh51 X Oh26	72.6	72.5
22	Oh51 X Ill.A	96.4	89.8
23	Oh51 X W23	84.0	85.4
24	Oh51 X (Oh51 X Oh26)	45.0	55.7
25	Oh51 X (Ill.A X W23)	89.7	84.7
26	Oh51 X Ohio M15	72.7	83.7
27	Oh51 X M14	90.5	93.4
28	Oh51 X (M14 X WF9)	95.0	99.5
29	Oh51 X Ia. 4483	81.9	99.3
30	W23 X (Oh51 X Oh26)	80.9	99.4
31	W23 X (Ill.A X W23)	69.2	68.1
32	W23 X Ohio M15	70.2	81.8
33	W23 X M14	100.7	89.5
34	W23 X (M14 X WF9)	97.1	104.0
35	W23 X Ia. 4483	94.1	89.9
36	Oh51 X Oh26	47.8	76.6
37	Ill.A X W23	67.4	82.5
38	Ohio M15	71.2	87.7
39	M14 X WF9	99.0	95.4
40	Ia. 4483	82.7	105.0
	L. S. D. at 5%	20.3	20.7



## Appendix (Continued)

<u>Percentage of moisture in ear</u>		<u>Percentage of stalk lodging</u>		<u>Percentage of root lodging</u>	
University Farm	Saginaw	University Farm	Saginaw	University Farm	Saginaw
29.6	17.3	6.7	16.1	1.1	12.6
21.2	15.2	7.8	10.0	1.1	1.1
18.5	11.9	6.9	6.4	1.2	-
22.6	13.9	14.6	48.7	-	4.8
21.6	13.0	14.6	17.2	3.4	6.9
25.0	13.7	6.8	1.2	-	-
23.5	15.7	2.2	2.3	-	-
23.5	16.5	8.1	1.2	-	-
26.9	19.9	11.2	38.0	-	-
31.0	20.9	15.9	46.8	3.7	-
29.7	22.3	24.7	61.1	9.1	-
29.1	22.7	10.4	20.1	-	-
32.0	23.8	17.7	25.5	4.7	2.3
29.0	19.2	9.1	6.8	1.1	1.1
24.9	17.7	11.1	5.8	-	2.3
21.1	13.4	2.6	-	-	-
24.5	16.2	10.4	6.7	1.2	-
25.4	16.2	9.0	10.4	1.1	3.5
28.8	19.4	11.9	1.1	1.2	-
25.2	16.9	7.1	8.0	-	3.4
21.5	15.7	9.4	16.2	1.2	8.0
25.8	20.5	25.5	50.0	1.1	-
21.6	16.6	8.3	16.5	1.2	-
20.2	17.0	8.6	47.1	1.2	23.0
23.8	17.9	23.2	50.0	4.6	-
20.7	14.8	12.6	8.3	-	-
23.7	15.5	4.9	-	1.2	2.4
26.9	20.0	4.7	11.5	1.2	6.9
21.2	14.0	17.2	15.0	-	-
20.3	15.1	4.6	17.8	-	-
27.0	18.5	9.2	33.8	-	-
25.3	19.4	24.0	24.6	-	-
27.1	17.8	9.8	1.2	-	-
28.4	22.0	4.8	10.1	-	-
24.3	17.4	2.5	42.9	-	-
20.0	15.0	20.5	-	-	-
26.4	20.0	15.3	62.6	2.8	-
22.3	16.3	11.1	15.1	1.6	-
31.5	18.5	7.5	1.2	-	-
23.4	17.8	1.4	4.0	-	-
3.94	3.66				

1. The first part of the document is a list of names and addresses. The names are written in a cursive script, and the addresses are written in a more formal, printed style. The list is organized into two columns, with names on the left and addresses on the right. The names are: John Doe, Jane Smith, and Robert Brown. The addresses are: 123 Main Street, New York, NY 10001; 456 Elm Street, New York, NY 10002; and 789 Oak Street, New York, NY 10003.

1. The first part of the document is a list of names and addresses. The names are written in a cursive script, and the addresses are written in a more formal, printed style. The list is organized into two columns, with names on the left and addresses on the right. The names are: John Doe, Jane Smith, and Robert Brown. The addresses are: 123 Main Street, New York, NY 10001; 456 Elm Street, New York, NY 10002; and 789 Oak Street, New York, NY 10003.	2. The second part of the document is a list of names and addresses. The names are written in a cursive script, and the addresses are written in a more formal, printed style. The list is organized into two columns, with names on the left and addresses on the right. The names are: John Doe, Jane Smith, and Robert Brown. The addresses are: 123 Main Street, New York, NY 10001; 456 Elm Street, New York, NY 10002; and 789 Oak Street, New York, NY 10003.	3. The third part of the document is a list of names and addresses. The names are written in a cursive script, and the addresses are written in a more formal, printed style. The list is organized into two columns, with names on the left and addresses on the right. The names are: John Doe, Jane Smith, and Robert Brown. The addresses are: 123 Main Street, New York, NY 10001; 456 Elm Street, New York, NY 10002; and 789 Oak Street, New York, NY 10003.	4. The fourth part of the document is a list of names and addresses. The names are written in a cursive script, and the addresses are written in a more formal, printed style. The list is organized into two columns, with names on the left and addresses on the right. The names are: John Doe, Jane Smith, and Robert Brown. The addresses are: 123 Main Street, New York, NY 10001; 456 Elm Street, New York, NY 10002; and 789 Oak Street, New York, NY 10003.	5. The fifth part of the document is a list of names and addresses. The names are written in a cursive script, and the addresses are written in a more formal, printed style. The list is organized into two columns, with names on the left and addresses on the right. The names are: John Doe, Jane Smith, and Robert Brown. The addresses are: 123 Main Street, New York, NY 10001; 456 Elm Street, New York, NY 10002; and 789 Oak Street, New York, NY 10003.	6. The sixth part of the document is a list of names and addresses. The names are written in a cursive script, and the addresses are written in a more formal, printed style. The list is organized into two columns, with names on the left and addresses on the right. The names are: John Doe, Jane Smith, and Robert Brown. The addresses are: 123 Main Street, New York, NY 10001; 456 Elm Street, New York, NY 10002; and 789 Oak Street, New York, NY 10003.
---	--	---	--	---	---

1. The first part of the document is a list of the names of the persons who were present at the meeting. The names are listed in alphabetical order.

Name	Address	City	State	Zip
Mr. John Doe	123 Main St.	New York	NY	10001
Mrs. Jane Smith	456 Elm St.	Los Angeles	CA	90001
Mr. Robert Brown	789 Oak St.	Chicago	IL	60601
Ms. Susan White	101 Pine St.	Houston	TX	77001
Mr. David Green	202 Cedar St.	Phoenix	AZ	85001
Mrs. Emily Black	303 Birch St.	San Francisco	CA	94101
Mr. Michael Lee	404 Maple St.	Dallas	TX	75201

2. The second part of the document is a list of the names of the persons who were present at the meeting. The names are listed in alphabetical order.

- Mr. John Doe
- Mrs. Jane Smith
- Mr. Robert Brown
- Ms. Susan White
- Mr. David Green
- Mrs. Emily Black
- Mr. Michael Lee

## Appendix IV

Average yield of test crosses at University Farm  
(yield in bu per acre at 15.5% moisture)

	Oh51	Oh26	Ill.A	W23	Oh51 X Oh26
1	87.9	80.5	84.2	84.8	76.8
2	70.3	90.1	88.1	65.1	76.5
3	99.9	94.4	64.3	105.7	96.9
4	101.5	101.5	86.3	92.9	97.6
5	83.1	100.1	73.1	90.9	92.0
6	84.5	73.2	71.4	72.9	80.5
7	79.9	77.3	90.8	90.8	76.5
8	91.0	80.8	95.1	80.5	73.2
9	85.4	72.4	70.9	101.0	84.4
10	72.6	65.1	74.5	73.6	61.9
11	78.1	70.9	101.2	94.8	68.4
12	87.8	70.7	79.4	77.4	68.7
13	50.0	56.5	93.8	79.6	53.2
14	60.6	84.2	85.8	84.2	65.2
15	63.7	85.3	83.3	75.0	71.8
16	68.4	58.6	82.4	83.9	64.8
17	71.6	73.5	86.2	84.0	67.1
18	79.6	85.7	55.2	82.4	85.5
19	70.5	51.4	70.1	90.6	79.4
20	71.2	86.8	71.9	88.9	82.6
	77.9	78.0	80.4	85.0	76.2

L. S. D. at 5%

Mean of testers

11.4 bu.

Mean of inbreds

6.2 bu.

Two inbreds at one level of tester

19.6 bu.

Two tester at one level of inbred

20.8 bu.

To test diagonally

20.8 bu.

## Appendix (Continued)

I11.A X W23	M15	M14	M14 X WF9	Ia. 4483	Average
75.5	87.5	89.0	82.4	91.3	84.0
90.8	86.4	116.8	99.2	102.1	88.5
78.2	84.4	97.5	110.3	97.3	92.9
102.2	92.3	99.9	118.5	87.8	98.1
94.3	97.9	103.9	107.5	91.4	93.4
67.3	76.6	81.5	96.9	81.0	78.6
88.8	89.0	84.6	95.7	94.4	86.8
71.4	80.8	96.0	111.9	83.7	86.4
80.9	85.9	105.0	99.6	90.9	87.6
85.3	78.7	80.2	84.3	79.6	75.6
88.6	71.8	95.5	92.9	99.9	86.2
80.8	77.2	88.1	86.0	94.8	81.1
81.8	70.5	95.5	99.2	83.8	76.4
93.2	70.0	84.1	96.3	82.7	79.6
78.6	76.5	85.6	86.9	75.1	78.2
81.0	83.4	81.6	98.1	86.8	78.9
95.2	75.6	83.3	88.9	91.0	81.4
64.0	75.3	84.5	87.8	76.9	77.7
75.7	75.3	86.8	110.7	90.5	80.1
85.2	88.1	94.7	87.4	83.9	84.1
82.4	81.2	91.7	97.0	88.2	

.....

.....

.....

.....

4-68

.....



## Appendix V

Average yield of test crosses at Saginaw County  
(yield in bu per acre)

	Oh51	Oh26	Il1.A	W23	Oh51 X Oh26
1	91.7	89.0	83.3	82.3	63.9
2	71.5	97.8	86.0	99.9	86.5
3	88.4	86.4	69.4	86.4	86.5
4	70.8	82.3	66.7	88.8	75.8
5	80.6	90.3	44.0	75.3	73.0
6	71.0	85.4	81.8	74.3	78.0
7	76.1	62.1	92.2	85.6	77.8
8	80.9	83.5	49.2	93.4	79.8
9	90.7	87.7	77.7	91.0	83.2
10	56.2	68.7	62.7	72.8	63.2
11	74.0	61.9	86.9	99.8	73.8
12	74.3	67.0	88.9	87.0	67.9
13	54.8	77.2	86.7	77.2	70.2
14	65.2	80.0	90.9	87.1	74.5
15	76.4	98.0	83.4	98.1	76.6
16	65.3	61.6	74.7	82.9	66.8
17	56.2	83.7	70.3	82.5	74.4
18	60.6	91.1	52.0	81.6	74.1
19	71.3	72.8	84.7	86.4	87.6
20	48.0	95.4	83.3	100.5	85.5
Av.	71.2	81.1	75.7	86.6	76.0

L. S. D. at 5%

Mean of testers 6.5 bu

Mean of inbreds 7.3 bu

Two inbreds at one level of tester 21.5 bu.

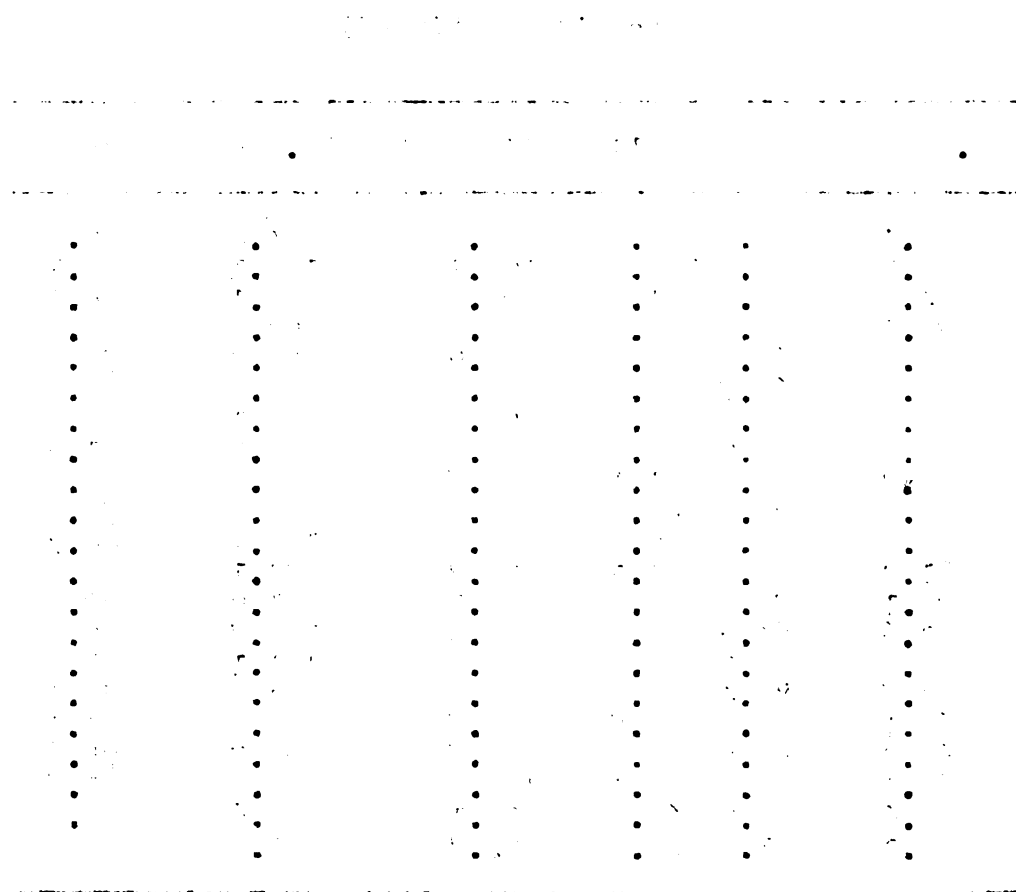
Two tester at one level of inbreds 21.7 bu.

To test diagonally 21.7 bu.



## Appendix (Continued)

Il1.A X W23	M15	M14	M14 X WF9	Ia. 4483	Average
80.4	73.2	86.5	94.5	84.4	82.9
83.5	85.4	104.6	104.3	103.1	92.3
74.9	81.6	91.9	93.3	103.1	86.2
79.7	57.2	95.2	99.8	90.3	80.7
71.8	62.0	82.9	88.9	96.9	76.6
73.9	68.7	90.3	90.5	88.2	80.2
76.1	77.5	95.2	92.5	93.1	82.8
80.2	75.9	99.4	86.5	89.9	81.9
88.7	80.0	81.1	107.5	95.4	88.3
73.6	70.8	68.5	87.4	78.2	70.2
87.3	82.8	99.7	97.6	102.7	86.7
81.2	65.4	84.2	92.7	94.1	80.3
76.1	72.7	96.2	95.3	91.9	79.8
83.6	64.9	87.9	92.0	101.7	82.8
82.4	78.3	96.6	80.8	101.1	87.2
73.5	87.4	92.2	85.2	94.8	78.4
68.1	54.2	80.5	87.5	86.5	74.4
61.2	62.6	91.2	97.5	93.7	75.6
65.4	76.6	96.4	100.3	93.4	83.5
83.6	58.0	69.3	90.1	86.6	80.0
77.3	71.8	89.5	92.7	93.5	



• • •

the 1990s, the number of people in the world who are illiterate has increased from 750 million to 850 million. The number of illiterate people in the world is expected to increase to 900 million by the year 2015. The number of illiterate people in the world is expected to increase to 950 million by the year 2020. The number of illiterate people in the world is expected to increase to 1 billion by the year 2025. The number of illiterate people in the world is expected to increase to 1.1 billion by the year 2030. The number of illiterate people in the world is expected to increase to 1.2 billion by the year 2035. The number of illiterate people in the world is expected to increase to 1.3 billion by the year 2040. The number of illiterate people in the world is expected to increase to 1.4 billion by the year 2045. The number of illiterate people in the world is expected to increase to 1.5 billion by the year 2050. The number of illiterate people in the world is expected to increase to 1.6 billion by the year 2055. The number of illiterate people in the world is expected to increase to 1.7 billion by the year 2060. The number of illiterate people in the world is expected to increase to 1.8 billion by the year 2065. The number of illiterate people in the world is expected to increase to 1.9 billion by the year 2070. The number of illiterate people in the world is expected to increase to 2 billion by the year 2075. The number of illiterate people in the world is expected to increase to 2.1 billion by the year 2080. The number of illiterate people in the world is expected to increase to 2.2 billion by the year 2085. The number of illiterate people in the world is expected to increase to 2.3 billion by the year 2090. The number of illiterate people in the world is expected to increase to 2.4 billion by the year 2095. The number of illiterate people in the world is expected to increase to 2.5 billion by the year 2100.

•v

• • •

• • •

• - 1000

• • • • •

• —

1000

## Appendix VI

Average percentage of moisture for  
test crosses at University Farm

	T1	T2	T3	T4	T5	T6
1	21.6	22.5	31.3	20.9	23.0	24.9
2	23.9	28.4	33.0	27.6	24.0	30.5
3	27.7	26.6	31.5	24.4	25.9	27.5
4	27.2	26.5	33.1	25.7	25.4	28.5
5	25.8	27.1	31.7	26.8	24.0	27.9
6	23.5	22.2	26.0	25.7	20.7	23.1
7	18.7	15.0	26.9	21.3	20.1	22.5
8	20.6	21.0	27.7	22.5	21.5	22.7
9	27.9	26.8	32.7	25.1	26.3	28.3
10	15.6	15.4	24.1	19.0	16.0	19.2
11	19.8	16.0	25.0	24.7	21.1	20.4
12	14.9	17.7	23.6	20.5	15.3	21.0
13	18.6	17.9	24.5	21.5	17.8	22.5
14	24.4	24.8	30.4	22.6	23.3	26.8
15	22.9	25.5	29.2	26.6	23.7	27.7
16	24.6	17.8	30.4	22.3	20.0	20.8
17	21.2	16.1	23.6	22.8	16.5	19.8
18	19.6	20.7	27.4	25.9	19.0	24.7
19	21.7	25.1	29.7	25.1	21.7	25.3
20	14.8	15.9	13.3	16.5	15.2	14.7
Av.	21.8	21.4	27.8	23.4	21.0	23.9

L. S. D.

Tester 1% - 2.16  
5% - 1.57

L. S. D.

Inbred 1% - 1.68  
5% - 1.28

Mean of the expt. = 23.4

## Appendix (Continued)

T7	T8	T9	T10	Total	Av.
24.1	24.9	21.3	20.9	80.9	23.5
29.5	29.9	28.6	28.6		28.4
29.2	23.6	28.6	24.7		27.0
28.5	25.5	27.5	25.4		27.3
22.8	24.8	25.7	22.4		25.9
26.2	26.7	26.4	23.2		24.4
21.2	20.5	24.0	18.2		20.8
21.0	20.7	25.6	29.8		23.3
27.0	28.2	32.6	27.3		28.2
19.2	17.7	19.5	20.9		18.7
29.7	23.7	21.7	20.7		22.3
18.7	18.5	22.1	19.6		19.2
19.5	19.5	27.3	20.6		21.0
25.5	27.0	25.9	22.2		25.3
29.1	23.6	26.7	25.9		26.1
23.3	23.8	25.0	21.4		22.9
20.4	19.9	22.9	20.0		20.3
23.3	27.2	22.8	23.6		23.4
26.9	26.3	23.5	25.2		25.0
13.3	18.0	17.9	13.2		15.3
23.9	23.5	24.8	22.7		

T1 - Oh 51

T2 - Oh 26

T3 - I11.A

T4 - W23

T5 - Oh 51 x Oh 26

T6 - I11.A x W23

T7 - Ohio M15

T8 - M14

T9 - M14 x WF9

T10 - Ia. 4483



1. The first part of the document is a list of names and addresses.

Name	Address	City	State
J. A. Smith	123 Main St.	New York	NY
J. B. Jones	456 Elm St.	New York	NY
J. C. Brown	789 Oak St.	New York	NY
J. D. White	101 Pine St.	New York	NY
J. E. Black	202 Cedar St.	New York	NY
J. F. Green	303 Birch St.	New York	NY
J. G. Hall	404 Spruce St.	New York	NY
J. H. King	505 Ash St.	New York	NY
J. I. Lee	606 Hickory St.	New York	NY
J. J. Scott	707 Walnut St.	New York	NY
J. K. Adams	808 Maple St.	New York	NY
J. L. Baker	909 Cherry St.	New York	NY
J. M. Carter	1010 Peach St.	New York	NY
J. N. Evans	1111 Apple St.	New York	NY
J. O. Fisher	1212 Orange St.	New York	NY

The second part of the document is a list of names and addresses.

## Appendix VII

Average percentage of moisture for test  
crosses at Saginaw County

	T1	T2	T3	T4	T5	T6
1	20.5	16.4	28.2	19.6	17.8	20.8
2	22.0	21.4	27.9	24.6	22.3	26.5
3	21.1	18.8	28.0	18.3	18.7	21.1
4	19.9	19.6	30.8	20.8	20.2	23.9
5	19.9	20.0	30.0	20.0	18.9	22.3
6	19.7	18.5	24.2	23.0	19.9	22.8
7	19.2	15.7	21.7	20.2	17.4	21.2
8	20.3	17.1	24.8	21.3	18.1	20.3
9	21.9	18.8	26.3	20.0	21.2	23.6
10	18.2	15.3	21.8	18.4	14.3	19.7
11	17.8	16.9	23.0	19.8	17.3	19.8
12	17.5	17.3	22.9	18.2	19.5	20.6
13	18.4	15.8	22.1	20.1	17.6	21.8
14	24.1	17.9	24.4	21.7	19.5	24.8
15	20.9	18.0	25.5	21.1	18.6	22.5
16	20.2	16.4	27.5	18.3	18.4	21.2
17	17.3	15.5	23.3	18.7	17.4	20.0
18	16.9	19.3	27.5	21.5	17.7	24.4
19	19.3	19.1	24.9	20.6	17.1	21.6
20	16.2	15.6	15.9	17.6	15.1	15.6
	19.6	17.7	25.0	20.2	18.3	21.7

L. S. D.

Testers 1% - 1.66  
5% - 1.2

L. S. D.

Inbreds 1% - 1.09  
5% - .829

Average moisture = 20.0



## Appendix (Continued)

T7	T8	T9	T10	Av.
18.7	19.9	18.1	21.2	20.1
25.9	22.0	24.1	25.4	24.2
20.9	18.6	21.9	19.8	20.7
19.6	17.5	18.7	22.8	21.4
21.9	19.0	20.1	20.5	21.2
20.8	21.2	21.6	20.2	21.2
19.1	16.3	18.7	17.6	18.7
18.0	17.4	19.9	23.1	20.0
20.5	19.4	21.8	20.2	21.4
15.3	16.4	17.2	17.7	17.4
19.1	18.3	19.4	18.0	18.9
19.3	18.4	17.9	17.3	18.9
16.2	14.9	16.9	18.1	18.2
20.7	21.6	20.8	21.3	21.7
21.6	18.1	21.0	21.3	20.9
20.9	16.6	19.9	19.0	19.8
21.2	16.7	17.8	19.3	18.7
17.8	18.1	17.3	19.4	20.0
21.3	19.3	20.4	19.6	20.3
18.5	16.2	16.0	15.4	16.2
19.9	18.3	19.5	19.9	

T1 - Oh 51

T2 - Oh 26

T3 - I11.A

T4 - W23

T5 - Oh 51 x Oh 26

T6 - I11.A x W23

T7 - Oh10 M15

T8 - M14

T9 - M14 x WF9

T10 - Ia. 4483

TABLE 1				
Summary of the results of the tests of the null hypothesis of no trend				
Test	Number of tests	Number of tests with significant results	Number of tests with significant results (at 5% level)	Number of tests with significant results (at 1% level)
1. Mann-Whitney U-test	10	10	10	10
2. Wilcoxon signed-rank test	10	10	10	10
3. Sign test	10	10	10	10
4. Spearman's rank correlation coefficient	10	10	10	10
5. Kendall's tau	10	10	10	10
6. Fisher's exact test	10	10	10	10
7. McNemar's test	10	10	10	10
8. Cochran's Q test	10	10	10	10
9. Chi-square test	10	10	10	10
10. Fisher's permutation test	10	10	10	10

The results of the tests of the null hypothesis of no trend are summarized in Table 1. The tests were performed on the data from the 10 sites. The results show that all the tests gave significant results at the 5% level and at the 1% level. This indicates that there is a significant trend in the data from all the sites.

• • •

1. The first group of authors (e.g., *Wallerstein, 1986*) has argued that the family structure in which a child is raised is the most important factor in determining the child's sexual orientation.



•

•

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. 62. 63. 64. 65. 66. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97. 98. 99. 100. 101. 102. 103. 104. 105. 106. 107. 108. 109. 110. 111. 112. 113. 114. 115. 116. 117. 118. 119. 120. 121. 122. 123. 124. 125. 126. 127. 128. 129. 130. 131. 132. 133. 134. 135. 136. 137. 138. 139. 140. 141. 142. 143. 144. 145. 146. 147. 148. 149. 150. 151. 152. 153. 154. 155. 156. 157. 158. 159. 160. 161. 162. 163. 164. 165. 166. 167. 168. 169. 170. 171. 172. 173. 174. 175. 176. 177. 178. 179. 180. 181. 182. 183. 184. 185. 186. 187. 188. 189. 190. 191. 192. 193. 194. 195. 196. 197. 198. 199. 200. 201. 202. 203. 204. 205. 206. 207. 208. 209. 210. 211. 212. 213. 214. 215. 216. 217. 218. 219. 220. 221. 222. 223. 224. 225. 226. 227. 228. 229. 230. 231. 232. 233. 234. 235. 236. 237. 238. 239. 240. 241. 242. 243. 244. 245. 246. 247. 248. 249. 250. 251. 252. 253. 254. 255. 256. 257. 258. 259. 260. 261. 262. 263. 264. 265. 266. 267. 268. 269. 270. 271. 272. 273. 274. 275. 276. 277. 278. 279. 280. 281. 282. 283. 284. 285. 286. 287. 288. 289. 290. 291. 292. 293. 294. 295. 296. 297. 298. 299. 300. 301. 302. 303. 304. 305. 306. 307. 308. 309. 310. 311. 312. 313. 314. 315. 316. 317. 318. 319. 320. 321. 322. 323. 324. 325. 326. 327. 328. 329. 330. 331. 332. 333. 334. 335. 336. 337. 338. 339. 340. 341. 342. 343. 344. 345. 346. 347. 348. 349. 350. 351. 352. 353. 354. 355. 356. 357. 358. 359. 360. 361. 362. 363. 364. 365. 366. 367. 368. 369. 370. 371. 372. 373. 374. 375. 376. 377. 378. 379. 380. 381. 382. 383. 384. 385. 386. 387. 388. 389. 390. 391. 392. 393. 394. 395. 396. 397. 398. 399. 400. 401. 402. 403. 404. 405. 406. 407. 408. 409. 410. 411. 412. 413. 414. 415. 416. 417. 418. 419. 420. 421. 422. 423. 424. 425. 426. 427. 428. 429. 430. 431. 432. 433. 434. 435. 436. 437. 438. 439. 440. 441. 442. 443. 444. 445. 446. 447. 448. 449. 450. 451. 452. 453. 454. 455. 456. 457. 458. 459. 460. 461. 462. 463. 464. 465. 466. 467. 468. 469. 470. 471. 472. 473. 474. 475. 476. 477. 478. 479. 480. 481. 482. 483. 484. 485. 486. 487. 488. 489. 490. 491. 492. 493. 494. 495. 496. 497. 498. 499. 500. 501. 502. 503. 504. 505. 506. 507. 508. 509. 510. 511. 512. 513. 514. 515. 516. 517. 518. 519. 520. 521. 522. 523. 524. 525. 526. 527. 528. 529. 530. 531. 532. 533. 534. 535. 536. 537. 538. 539. 540. 541. 542. 543. 544. 545. 546. 547. 548. 549. 550. 551. 552. 553. 554. 555. 556. 557. 558. 559. 560. 561. 562. 563. 564. 565. 566. 567. 568. 569. 570. 571. 572. 573. 574. 575. 576. 577. 578. 579. 580. 581. 582. 583. 584. 585. 586. 587. 588. 589. 590. 591. 592. 593. 594. 595. 596. 597. 598. 599. 600. 601. 602. 603. 604. 605. 606. 607. 608. 609. 610. 611. 612. 613. 614. 615. 616. 617. 618. 619. 620. 621. 622. 623. 624. 625. 626. 627. 628. 629. 630. 631. 632. 633. 634. 635. 636. 637. 638. 639. 640. 641. 642. 643. 644. 645. 646. 647. 648. 649. 650. 651. 652. 653. 654. 655. 656. 657. 658. 659. 660. 661. 662. 663. 664. 665. 666. 667. 668. 669. 670. 671. 672. 673. 674. 675. 676. 677. 678. 679. 680. 681. 682. 683. 684. 685. 686. 687. 688. 689. 690. 691. 692. 693. 694. 695. 696. 697. 698. 699. 700. 701. 702. 703. 704. 705. 706. 707. 708. 709. 710. 711. 712. 713. 714. 715. 716. 717. 718. 719. 720. 721. 722. 723. 724. 725. 726. 727. 728. 729. 730. 731. 732. 733. 734. 735. 736. 737. 738. 739. 740. 741. 742. 743. 744. 745. 746. 747. 748. 749. 750. 751. 752. 753. 754. 755. 756. 757. 758. 759. 760. 761. 762. 763. 764. 765. 766. 767. 768. 769. 770. 771. 772. 773. 774. 775. 776. 777. 778. 779. 780. 781. 782. 783. 784. 785. 786. 787. 788. 789. 790. 791. 792. 793. 794. 795. 796. 797. 798. 799. 800. 801. 802. 803. 804. 805. 806. 807. 808. 809. 810. 811. 812. 813. 814. 815. 816. 817. 818. 819. 820. 821. 822. 823. 824. 825. 826. 827. 828. 829. 830. 831. 832. 833. 834. 835. 836. 837. 838. 839. 840. 84

.....

.....

.....

.....

.....

1. The first group of people who are not in the labor force are those who are not in the labor force because they are not in the labor force.



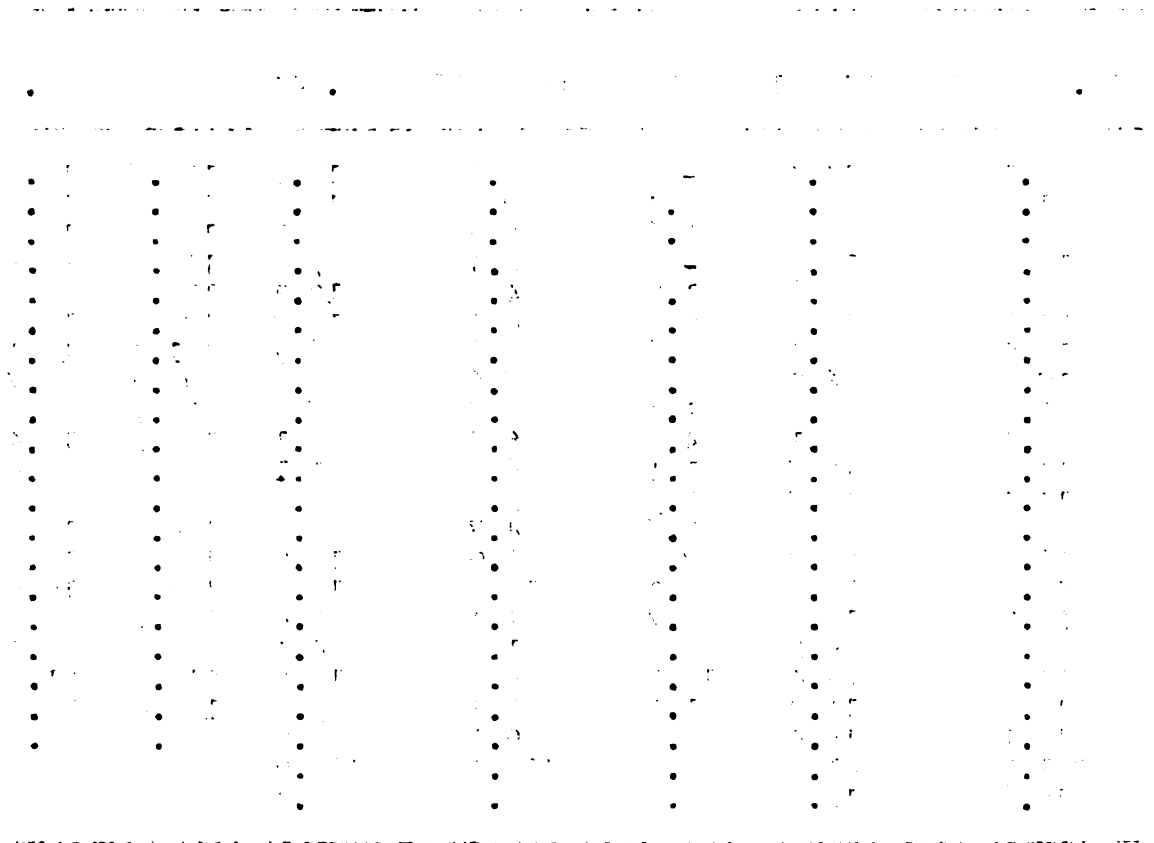
## Appendix VIII

Percentage stalk lodging in test  
crosses at M. S. U. Farm

| Second<br>cycle lines | Oh51  | Oh26  | Il1.A | W23   | Oh51 X Oh26 |
|-----------------------|-------|-------|-------|-------|-------------|
| 1                     | 16.8  | 9.8   | 9.0   | 16.2  | 20.7        |
| 2                     | 20.7  | 3.4   | 12.3  | 45.2  | 20.1        |
| 3                     | 6.7   | 6.7   | 78.4  | 11.1  | 9.1         |
| 4                     | 4.6   | 8.1   | 39.9  | 10.1  | 9.0         |
| 5                     | 26.2  | 4.8   | 26.7  | 21.8  | 9.4         |
| 6                     | 19.6  | 4.6   | 50.6  | 13.4  | 14.6        |
| 7                     | 12.6  | 5.7   | 23.0  | 12.6  | 5.6         |
| 8                     | 7.8   | 6.0   | 7.2   | 10.3  | 18.6        |
| 9                     | 9.6   | 4.9   | 7.8   | 8.9   | 7.8         |
| 10                    | 8.3   | 8.8   | 42.2  | 12.0  | 15.0        |
| 11                    | 10.4  | 12.8  | 6.7   | 6.7   | 13.4        |
| 12                    | 9.5   | 3.6   | 16.0  | 4.4   | 10.1        |
| 13                    | 41.4  | 13.1  | 4.6   | 6.9   | 29.8        |
| 14                    | 30.7  | 8.5   | 21.3  | 21.1  | 23.3        |
| 15                    | 11.6  | 8.9   | 46.0  | 37.0  | 10.1        |
| 16                    | 15.1  | 7.5   | 10.4  | 9.0   | 15.5        |
| 17                    | 10.1  | 3.7   | 8.0   | 5.6   | 9.1         |
| 18                    | 14.6  | 9.1   | 39.9  | 35.3  | 23.2        |
| 19                    | 12.6  | 6.8   | 21.3  | 15.5  | 11.1        |
| 20                    | 11.9  | 9.1   | 10.7  | 8.0   | 12.5        |
| Tester                | 300.8 | 145.9 | 482.2 | 311.1 | 288.0       |
| Average               | 15.0  | 7.3   | 24.1  | 15.6  | 14.4        |

## Appendix (Continued)

| Ill.A X W23 | Ohio M15 | M14  | M14 X WF9 | Ia. 4483 | Av.   |      |
|-------------|----------|------|-----------|----------|-------|------|
| 33.1        | 14.4     | -    | 9.4       | 10.1     | 139.5 | 14.0 |
| 11.5        | 8.0      | 3.4  | 9.1       | 10.6     | 144.3 | 14.4 |
| 33.6        | 13.2     | 5.6  | 6.7       | 7.1      | 178.2 | 17.8 |
| 16.6        | 14.4     | -    | 2.4       | 7.8      | 112.9 | 11.3 |
| 25.3        | 7.8      | 1.2  | 4.5       | 10.3     | 138.0 | 13.8 |
| 34.5        | 17.8     | 7.8  | 4.4       | 12.2     | 179.5 | 18.0 |
| 17.9        | 8.1      | 4.6  | 4.6       | 6.7      | 101.4 | 10.1 |
| 17.4        | 6.9      | 8.9  | 5.6       | 8.0      | 96.7  | 9.7  |
| 3.6         | 2.3      | 3.3  | 4.7       | 5.8      | 58.7  | 5.9  |
| 8.4         | 9.1      | 4.4  | 6.8       | 9.1      | 124.1 | 12.4 |
| 14.8        | 12.5     | 1.1  | 6.7       | 1.1      | 86.2  | 8.6  |
| 14.4        | 10.7     | 3.3  | 2.2       | 8.3      | 82.5  | 8.3  |
| 7.8         | 8.0      | 3.5  | 4.7       | 7.0      | 126.8 | 12.7 |
| 21.1        | 20.7     | 7.8  | 7.0       | 15.7     | 177.2 | 17.7 |
| 41.0        | 11.6     | 3.3  | 11.5      | 13.8     | 194.8 | 19.5 |
| 20.2        | 13.3     | 6.7  | 3.4       | 5.6      | 106.7 | 10.7 |
| 8.0         | 9.2      | 4.6  | 1.2       | 4.4      | 63.9  | 6.4  |
| 34.2        | 27.4     | 10.3 | 9.0       | 12.2     | 215.2 | 21.5 |
| 17.4        | 11.2     | 1.1  | 3.4       | 3.4      | 103.8 | 10.4 |
| 11.1        | 14.4     | 5.8  | 9.1       | 6.7      | 99.3  | 9.9  |
| 391.9       | 241.0    | 86.7 | 116.4     | 165.9    |       |      |
| 19.6        | 12.0     | 4.3  | 5.8       | 8.3      |       |      |



| DATE     | TIME | LOCATION | WIND | TEMP | SEA | REMARKS |
|----------|------|----------|------|------|-----|---------|
| 10/10/54 | 0800 | 1000     | 10   | 18   | 1   | 1000    |
| 10/10/54 | 0900 | 1000     | 10   | 18   | 1   | 1000    |
| 10/10/54 | 1000 | 1000     | 10   | 18   | 1   | 1000    |
| 10/10/54 | 1100 | 1000     | 10   | 18   | 1   | 1000    |
| 10/10/54 | 1200 | 1000     | 10   | 18   | 1   | 1000    |
| 10/10/54 | 1300 | 1000     | 10   | 18   | 1   | 1000    |
| 10/10/54 | 1400 | 1000     | 10   | 18   | 1   | 1000    |
| 10/10/54 | 1500 | 1000     | 10   | 18   | 1   | 1000    |
| 10/10/54 | 1600 | 1000     | 10   | 18   | 1   | 1000    |
| 10/10/54 | 1700 | 1000     | 10   | 18   | 1   | 1000    |
| 10/10/54 | 1800 | 1000     | 10   | 18   | 1   | 1000    |
| 10/10/54 | 1900 | 1000     | 10   | 18   | 1   | 1000    |
| 10/10/54 | 2000 | 1000     | 10   | 18   | 1   | 1000    |
| 10/10/54 | 2100 | 1000     | 10   | 18   | 1   | 1000    |
| 10/10/54 | 2200 | 1000     | 10   | 18   | 1   | 1000    |
| 10/10/54 | 2300 | 1000     | 10   | 18   | 1   | 1000    |
| 10/10/54 | 0000 | 1000     | 10   | 18   | 1   | 1000    |
| 10/10/54 | 0100 | 1000     | 10   | 18   | 1   | 1000    |
| 10/10/54 | 0200 | 1000     | 10   | 18   | 1   | 1000    |
| 10/10/54 | 0300 | 1000     | 10   | 18   | 1   | 1000    |
| 10/10/54 | 0400 | 1000     | 10   | 18   | 1   | 1000    |
| 10/10/54 | 0500 | 1000     | 10   | 18   | 1   | 1000    |
| 10/10/54 | 0600 | 1000     | 10   | 18   | 1   | 1000    |
| 10/10/54 | 0700 | 1000     | 10   | 18   | 1   | 1000    |

## Appendix IX

Percentage stalk lodging in test  
crosses at Saginaw County

| Second<br>cycle lines | Oh51  | Oh26  | Il1.A  | W23    | Oh51 X Oh26 |
|-----------------------|-------|-------|--------|--------|-------------|
| 1                     | 37.7  | 13.7  | 53.0   | 64.1   | 39.1        |
| 2                     | 62.7  | 23.9  | 69.1   | 58.8   | 38.1        |
| 3                     | 41.4  | 11.4  | 96.6   | 34.2   | 26.7        |
| 4                     | 56.3  | 15.0  | 88.0   | 70.2   | 8.9         |
| 5                     | 55.0  | 4.6   | 94.3   | 32.2   | 5.9         |
| 6                     | 42.2  | 23.5  | 97.6   | 81.8   | 24.6        |
| 7                     | 61.6  | 7.2   | 81.8   | 73.8   | 23.2        |
| 8                     | 47.3  | 9.2   | 73.9   | 60.0   | 31.1        |
| 9                     | 11.6  | -     | 68.7   | 28.3   | 7.0         |
| 10                    | 25.5  | 17.8  | 9.18   | 68.6   | 16.0        |
| 11                    | 39.9  | 1.3   | 76.3   | 35.3   | 16.5        |
| 12                    | 47.5  | 36.0  | 94.4   | 35.5   | 47.7        |
| 13                    | 7.3   | 4.4   | 97.8   | 61.2   | 15.1        |
| 14                    | 64.0  | 4.6   | 100.0  | 78.2   | 46.6        |
| 15                    | 72.7  | 6.9   | 92.6   | 61.4   | 35.5        |
| 16                    | 41.4  | 11.5  | 70.9   | 46.4   | 34.2        |
| 17                    | 27.7  | 3.4   | 83.0   | 52.2   | 16.6        |
| 18                    | 34.2  | 17.9  | 93.3   | 90.0   | 43.0        |
| 19                    | 73.0  | 7.7   | 24.4   | 81.1   | 31.9        |
| 20                    | 50.8  | 24.0  | 54.3   | 48.8   | 12.2        |
|                       | 899.8 | 244.0 | 1601.8 | 1162.1 | 519.9       |



## Appendix (Continued)

---

 Ill.A X W23    Ohio M15    M14    M14 X WF9    Ia. 4483
 

---

|        |       |       |       |       |       |      |
|--------|-------|-------|-------|-------|-------|------|
| 72.2   | 50.0  | 5.8   | 10.7  | 31.3  | 377.6 | 37.8 |
| 55.7   | 44.5  | 4.7   | 8.0   | 19.6  | 385.1 | 38.5 |
| 74.7   | 52.9  | 9.2   | 8.0   | 11.1  | 366.2 | 36.6 |
| 74.4   | 48.9  | 4.5   | 21.3  | 14.6  | 402.1 | 40.2 |
| 80.7   | 46.8  | 31.9  | 24.4  | 18.5  | 394.3 | 39.4 |
| 88.2   | 60.2  | 14.4  | 12.8  | 24.6  | 469.9 | 46.9 |
| 74.4   | 49.4  | 6.7   | 7.3   | 7.8   | 393.2 | 39.3 |
| 66.3   | 51.1  | 13.3  | 2.2   | 17.7  | 372.1 | 37.2 |
| 44.1   | 41.6  | 1.2   | 7.1   | 3.4   | 213.0 | 21.3 |
| 76.1   | 27.8  | 10.1  | 13.0  | 4.6   | 351.3 | 35.1 |
| 80.2   | 30.8  | -     | 4.6   | 4.4   | 289.3 | 28.9 |
| 71.4   | 50.0  | 28.9  | 14.8  | 14.8  | 441.0 | 44.1 |
| 82.4   | 38.8  | 4.6   | 5.8   | 6.7   | 324.1 | 32.4 |
| 74.4   | 57.8  | 21.7  | 23.0  | 20.2  | 490.5 | 49.0 |
| 87.5   | 75.0  | 8.9   | 23.2  | 22.6  | 486.3 | 48.0 |
| 89.5   | 62.8  | 24.4  | 12.2  | 16.9  | 410.2 | 41.0 |
| 75.9   | 39.9  | 15.5  | 13.1  | 14.4  | 341.7 | 34.2 |
| 94.2   | 70.5  | 11.5  | 16.1  | 60.7  | 531.4 | 53.1 |
| 79.1   | 41.8  | 8.0   | 15.7  | 21.1  | 383.8 | 38.4 |
| 59.8   | 36.8  | 33.3  | 7.5   | 18.0  | 345.5 | 34.6 |
| 1501.2 | 977.4 | 258.6 | 250.8 | 353.0 |       |      |
| 75.1   | 48.9  | 12.9  | 12.5  | 17.7  |       |      |

---

| TABLE 1. - SUMMARY OF DATA FOR THE 1960-1961 FLOODING OF THE MISSISSIPPI RIVER |           |               |           |               |           |                |
|--|-----------|---------------|-----------|---------------|-----------|----------------|
| STATION  | DATE      | STATION       | DATE      | STATION       | DATE      | STATION        |
| 1. ST. LOUIS   | 1960-1961 | 2. ST. LOUIS  | 1960-1961 | 3. ST. LOUIS  | 1960-1961 | 4. ST. LOUIS   |
| 5. ST. LOUIS   | 1960-1961 | 6. ST. LOUIS  | 1960-1961 | 7. ST. LOUIS  | 1960-1961 | 8. ST. LOUIS   |
| 9. ST. LOUIS   | 1960-1961 | 10. ST. LOUIS | 1960-1961 | 11. ST. LOUIS | 1960-1961 | 12. ST. LOUIS  |
| 13. ST. LOUIS  | 1960-1961 | 14. ST. LOUIS | 1960-1961 | 15. ST. LOUIS | 1960-1961 | 16. ST. LOUIS  |
| 17. ST. LOUIS  | 1960-1961 | 18. ST. LOUIS | 1960-1961 | 19. ST. LOUIS | 1960-1961 | 20. ST. LOUIS  |
| 21. ST. LOUIS  | 1960-1961 | 22. ST. LOUIS | 1960-1961 | 23. ST. LOUIS | 1960-1961 | 24. ST. LOUIS  |
| 25. ST. LOUIS  | 1960-1961 | 26. ST. LOUIS | 1960-1961 | 27. ST. LOUIS | 1960-1961 | 28. ST. LOUIS  |
| 29. ST. LOUIS  | 1960-1961 | 30. ST. LOUIS | 1960-1961 | 31. ST. LOUIS | 1960-1961 | 32. ST. LOUIS  |
| 33. ST. LOUIS  | 1960-1961 | 34. ST. LOUIS | 1960-1961 | 35. ST. LOUIS | 1960-1961 | 36. ST. LOUIS  |
| 37. ST. LOUIS  | 1960-1961 | 38. ST. LOUIS | 1960-1961 | 39. ST. LOUIS | 1960-1961 | 40. ST. LOUIS  |
| 41. ST. LOUIS  | 1960-1961 | 42. ST. LOUIS | 1960-1961 | 43. ST. LOUIS | 1960-1961 | 44. ST. LOUIS  |
| 45. ST. LOUIS  | 1960-1961 | 46. ST. LOUIS | 1960-1961 | 47. ST. LOUIS | 1960-1961 | 48. ST. LOUIS  |
| 49. ST. LOUIS  | 1960-1961 | 50. ST. LOUIS | 1960-1961 | 51. ST. LOUIS | 1960-1961 | 52. ST. LOUIS  |
| 53. ST. LOUIS  | 1960-1961 | 54. ST. LOUIS | 1960-1961 | 55. ST. LOUIS | 1960-1961 | 56. ST. LOUIS  |
| 57. ST. LOUIS  | 1960-1961 | 58. ST. LOUIS | 1960-1961 | 59. ST. LOUIS | 1960-1961 | 60. ST. LOUIS  |
| 61. ST. LOUIS  | 1960-1961 | 62. ST. LOUIS | 1960-1961 | 63. ST. LOUIS | 1960-1961 | 64. ST. LOUIS  |
| 65. ST. LOUIS  | 1960-1961 | 66. ST. LOUIS | 1960-1961 | 67. ST. LOUIS | 1960-1961 | 68. ST. LOUIS  |
| 69. ST. LOUIS  | 1960-1961 | 70. ST. LOUIS | 1960-1961 | 71. ST. LOUIS | 1960-1961 | 72. ST. LOUIS  |
| 73. ST. LOUIS  | 1960-1961 | 74. ST. LOUIS | 1960-1961 | 75. ST. LOUIS | 1960-1961 | 76. ST. LOUIS  |
| 77. ST. LOUIS  | 1960-1961 | 78. ST. LOUIS | 1960-1961 | 79. ST. LOUIS | 1960-1961 | 80. ST. LOUIS  |
| 81. ST. LOUIS  | 1960-1961 | 82. ST. LOUIS | 1960-1961 | 83. ST. LOUIS | 1960-1961 | 84. ST. LOUIS  |
| 85. ST. LOUIS  | 1960-1961 | 86. ST. LOUIS | 1960-1961 | 87. ST. LOUIS | 1960-1961 | 88. ST. LOUIS  |
| 89. ST. LOUIS  | 1960-1961 | 90. ST. LOUIS | 1960-1961 | 91. ST. LOUIS | 1960-1961 | 92. ST. LOUIS  |
| 93. ST. LOUIS  | 1960-1961 | 94. ST. LOUIS | 1960-1961 | 95. ST. LOUIS | 1960-1961 | 96. ST. LOUIS  |
| 97. ST. LOUIS  | 1960-1961 | 98. ST. LOUIS | 1960-1961 | 99. ST. LOUIS | 1960-1961 | 100. ST. LOUIS |

THE UNIVERSITY OF CHICAGO  
LIBRARY

THE UNIVERSITY OF CHICAGO LIBRARY

THE UNIVERSITY OF CHICAGO LIBRARY  
THE UNIVERSITY OF CHICAGO LIBRARY  
THE UNIVERSITY OF CHICAGO LIBRARY  
THE UNIVERSITY OF CHICAGO LIBRARY  
THE UNIVERSITY OF CHICAGO LIBRARY  
THE UNIVERSITY OF CHICAGO LIBRARY

## Appendix X

Percentage of root ledging for  
test crosses at M.S.U. Farm

| Second<br>cycle lines | Oh51 | Oh26 | Il1.A | W23  | Oh51 X 26 |
|-----------------------|------|------|-------|------|-----------|
| 1                     | 1.2  | 1.2  | 6.7   | -    | 1.2       |
| 2                     | 9.2  | 2.3  | 5.6   | 11.6 | 3.5       |
| 3                     | 2.2  | 3.4  | 14.8  | 2.2  | -         |
| 4                     | 1.1  | -    | 3.4   | 5.6  | 5.6       |
| 5                     | 1.1  | -    | 31.3  | 2.3  | 7.1       |
| 6                     | -    | 1.2  | 5.6   | -    | -         |
| 7                     | -    | -    | 2.3   | -    | -         |
| 8                     | -    | -    | 1.2   | -    | 1.2       |
| 9                     | -    | 2.4  | 1.1   | -    | 2.2       |
| 10                    | 7.1  | -    | 4.4   | 1.2  | -         |
| 11                    | 10.4 | -    | -     | 1.1  | -         |
| 12                    | -    | -    | 2.3   | -    | -         |
| 13                    | -    | -    | 1.1   | 5.8  | -         |
| 14                    | 1.2  | -    | -     | 1.1  | -         |
| 15                    | 5.8  | -    | 3.4   | 6.7  | 2.2       |
| 16                    | -    | 2.5  | 1.2   | -    | -         |
| 17                    | 1.1  | -    | 3.4   | -    | 1.1       |
| 18                    | 20.2 | 8.0  | 30.8  | 6.8  | 4.6       |
| 19                    | -    | -    | 5.6   | 1.1  | 1.1       |
| 20                    | 1.2  | -    | 4.8   | 2.3  | 1.1       |
|                       | 61.8 | 21.0 | 129.0 | 47.8 | 30.9      |
|                       | 3.1  | 1.0  | 6.5   | 2.4  | 1.5       |

## Appendix (Continued)

| Ill.A X W23 | Ohio M15 | M14  | M14 X WF9 | Ia. 4483 |      |     |
|-------------|----------|------|-----------|----------|------|-----|
| 2.3         | -        | -    | -         | -        | 12.6 | 1.3 |
| 1.2         | 4.6      | -    | 1.1       | 1.2      | 40.3 | 4.0 |
| 3.4         | 6.0      | 1.1  | 1.1       | 2.4      | 36.6 | 3.7 |
| 4.4         | 13.3     | 2.2  | -         | 2.2      | 37.8 | 3.8 |
| 1.2         | 2.2      | 1.2  | -         | 3.4      | 49.8 | 5.0 |
| 3.6         | 1.1      | 1.1  | -         | -        | 12.6 | 1.3 |
| 1.1         | 1.2      | -    | -         | -        | 4.6  | .4  |
| 1.2         | 2.3      | -    | 1.1       | -        | 7.0  | .7  |
| -           | -        | 2.2  | 1.2       | -        | 9.1  | .9  |
| -           | 2.3      | -    | -         | -        | 15.0 | 1.5 |
| -           | 5.7      | -    | 2.2       | 1.1      | 20.5 | 2.1 |
| -           | -        | -    | -         | -        | 2.3  | .2  |
| 1.1         | -        | -    | -         | -        | 8.0  | .8  |
| 1.1         | 6.1      | -    | 1.2       | 5.6      | 16.3 | 1.6 |
| 5.7         | 10.8     | 3.3  | 2.3       | 1.2      | 41.4 | 4.1 |
| 1.1         | 3.3      | -    | 1.1       | 1.1      | 10.3 | 1.0 |
| -           | 1.2      | 9.1  | -         | 1.1      | 17.0 | 1.7 |
| 1.1         | 5.7      | -    | 5.6       | 12.2     | 95.0 | 9.5 |
| -           | -        | -    | -         | -        | 7.8  | .78 |
| -           | -        | -    | -         | -        | 9.4  | .94 |
| 28.5        | 65.8     | 20.2 | 16.9      | 31.5     |      |     |
| 1.4         | 3.3      | 1.0  | 0.8       | 1.6      |      |     |

| TABLE 1  |                 |                |                |                |                |                |
|--|-----------------|----------------|----------------|----------------|----------------|----------------|
| Summary of the results of the tests of the null hypothesis of no difference in the distribution of the number of successes in the two groups |                 |                |                |                |                |                |
| Test   | Null hypothesis | Test statistic | Test statistic | Test statistic | Test statistic | Test statistic |
| 1  | 1               | 2              | 3              | 4              | 5              | 6              |
| 2  | 1               | 2              | 3              | 4              | 5              | 6              |
| 3  | 1               | 2              | 3              | 4              | 5              | 6              |
| 4  | 1               | 2              | 3              | 4              | 5              | 6              |
| 5  | 1               | 2              | 3              | 4              | 5              | 6              |
| 6  | 1               | 2              | 3              | 4              | 5              | 6              |
| 7  | 1               | 2              | 3              | 4              | 5              | 6              |
| 8  | 1               | 2              | 3              | 4              | 5              | 6              |
| 9  | 1               | 2              | 3              | 4              | 5              | 6              |
| 10   | 1               | 2              | 3              | 4              | 5              | 6              |
| 11   | 1               | 2              | 3              | 4              | 5              | 6              |
| 12   | 1               | 2              | 3              | 4              | 5              | 6              |
| 13   | 1               | 2              | 3              | 4              | 5              | 6              |
| 14   | 1               | 2              | 3              | 4              | 5              | 6              |
| 15   | 1               | 2              | 3              | 4              | 5              | 6              |
| 16   | 1               | 2              | 3              | 4              | 5              | 6              |
| 17   | 1               | 2              | 3              | 4              | 5              | 6              |
| 18   | 1               | 2              | 3              | 4              | 5              | 6              |
| 19   | 1               | 2              | 3              | 4              | 5              | 6              |
| 20   | 1               | 2              | 3              | 4              | 5              | 6              |
| 21   | 1               | 2              | 3              | 4              | 5              | 6              |
| 22   | 1               | 2              | 3              | 4              | 5              | 6              |
| 23   | 1               | 2              | 3              | 4              | 5              | 6              |
| 24   | 1               | 2              | 3              | 4              | 5              | 6              |
| 25   | 1               | 2              | 3              | 4              | 5              | 6              |
| 26   | 1               | 2              | 3              | 4              | 5              | 6              |
| 27   | 1               | 2              | 3              | 4              | 5              | 6              |
| 28   | 1               | 2              | 3              | 4              | 5              | 6              |
| 29   | 1               | 2              | 3              | 4              | 5              | 6              |
| 30   | 1               | 2              | 3              | 4              | 5              | 6              |
| 31   | 1               | 2              | 3              | 4              | 5              | 6              |
| 32   | 1               | 2              | 3              | 4              | 5              | 6              |
| 33   | 1               | 2              | 3              | 4              | 5              | 6              |
| 34   | 1               | 2              | 3              | 4              | 5              | 6              |
| 35   | 1               | 2              | 3              | 4              | 5              | 6              |
| 36   | 1               | 2              | 3              | 4              | 5              | 6              |
| 37   | 1               | 2              | 3              | 4              | 5              | 6              |
| 38   | 1               | 2              | 3              | 4              | 5              | 6              |
| 39   | 1               | 2              | 3              | 4              | 5              | 6              |
| 40   | 1               | 2              | 3              | 4              | 5              | 6              |
| 41   | 1               | 2              | 3              | 4              | 5              | 6              |
| 42   | 1               | 2              | 3              | 4              | 5              | 6              |
| 43   | 1               | 2              | 3              | 4              | 5              | 6              |
| 44   | 1               | 2              | 3              | 4              | 5              | 6              |
| 45   | 1               | 2              | 3              | 4              | 5              | 6              |
| 46   | 1               | 2              | 3              | 4              | 5              | 6              |
| 47   | 1               | 2              | 3              | 4              | 5              | 6              |
| 48   | 1               | 2              | 3              | 4              | 5              | 6              |
| 49   | 1               | 2              | 3              | 4              | 5              | 6              |
| 50   | 1               | 2              | 3              | 4              | 5              | 6              |
| 51   | 1               | 2              | 3              | 4              | 5              | 6              |
| 52   | 1               | 2              | 3              | 4              | 5              | 6              |
| 53   | 1               | 2              | 3              | 4              | 5              | 6              |
| 54   | 1               | 2              | 3              | 4              | 5              | 6              |
| 55   | 1               | 2              | 3              | 4              | 5              | 6              |
| 56   | 1               | 2              | 3              | 4              | 5              | 6              |
| 57   | 1               | 2              | 3              | 4              | 5              | 6              |
| 58   | 1               | 2              | 3              | 4              | 5              | 6              |
| 59   | 1               | 2              | 3              | 4              | 5              | 6              |
| 60   | 1               | 2              | 3              | 4              | 5              | 6              |
| 61   | 1               | 2              | 3              | 4              | 5              | 6              |
| 62   | 1               | 2              | 3              | 4              | 5              | 6              |
| 63   | 1               | 2              | 3              | 4              | 5              | 6              |
| 64   | 1               | 2              | 3              | 4              | 5              | 6              |
| 65   | 1               | 2              | 3              | 4              | 5              | 6              |
| 66   | 1               | 2              | 3              | 4              | 5              | 6              |
| 67   | 1               | 2              | 3              | 4              | 5              | 6              |
| 68   | 1               | 2              | 3              | 4              | 5              | 6              |
| 69   | 1               | 2              | 3              | 4              | 5              | 6              |
| 70   | 1               | 2              | 3              | 4              | 5              | 6              |
| 71   | 1               | 2              | 3              | 4              | 5              | 6              |
| 72   | 1               | 2              | 3              | 4              | 5              | 6              |
| 73   | 1               | 2              | 3              | 4              | 5              | 6              |
| 74   | 1               | 2              | 3              | 4              | 5              | 6              |
| 75   | 1               | 2              | 3              | 4              | 5              | 6              |
| 76   | 1               | 2              | 3              | 4              | 5              | 6              |
| 77   | 1               | 2              | 3              | 4              | 5              | 6              |
| 78   | 1               | 2              | 3              | 4              | 5              | 6              |
| 79   | 1               | 2              | 3              | 4              | 5              | 6              |
| 80   | 1               | 2              | 3              | 4              | 5              | 6              |
| 81   | 1               | 2              | 3              | 4              | 5              | 6              |
| 82   | 1               | 2              | 3              | 4              | 5              | 6              |
| 83   | 1               | 2              | 3              | 4              | 5              | 6              |
| 84   | 1               | 2              | 3              | 4              | 5              | 6              |
| 85   | 1               | 2              | 3              | 4              | 5              | 6              |
| 86   | 1               | 2              | 3              | 4              | 5              | 6              |
| 87   | 1               | 2              | 3              | 4              | 5              | 6              |
| 88   | 1               | 2              | 3              | 4              | 5              | 6              |
| 89   | 1               | 2              | 3              | 4              | 5              | 6              |
| 90   | 1               | 2              | 3              | 4              | 5              | 6              |
| 91   | 1               | 2              | 3              | 4              | 5              | 6              |
| 92   | 1               | 2              | 3              | 4              | 5              | 6              |
| 93   | 1               | 2              | 3              | 4              | 5              | 6              |
| 94   | 1               | 2              | 3              | 4              | 5              | 6              |
| 95   | 1               | 2              | 3              | 4              | 5              | 6              |
| 96   | 1               | 2              | 3              | 4              | 5              | 6              |
| 97   | 1               | 2              | 3              | 4              | 5              | 6              |
| 98   | 1               | 2              | 3              | 4              | 5              | 6              |
| 99   | 1               | 2              | 3              | 4              | 5              | 6              |
| 100  | 1               | 2              | 3              | 4              | 5              | 6              |

1. The first part of the document is a list of names and addresses.

| Name             | Address         | City          | State | Zip   | Phone        |
|------------------|-----------------|---------------|-------|-------|--------------|
| Mr. J. H. Smith  | 123 Main St.    | New York      | NY    | 10001 | 212-555-1234 |
| Mrs. A. B. Jones | 456 Elm St.     | Los Angeles   | CA    | 90001 | 213-555-5678 |
| Mr. C. D. Brown  | 789 Oak St.     | Chicago       | IL    | 60601 | 312-555-9012 |
| Mrs. E. F. Green | 101 Pine St.    | Houston       | TX    | 77001 | 713-555-3456 |
| Mr. G. H. White  | 202 Cedar St.   | Phoenix       | AZ    | 85001 | 602-555-7890 |
| Mrs. I. J. Black | 303 Birch St.   | San Francisco | CA    | 94101 | 415-555-2345 |
| Mr. K. L. Gray   | 404 Spruce St.  | Seattle       | WA    | 98101 | 206-555-6789 |
| Mrs. M. N. Hall  | 505 Ash St.     | Portland      | OR    | 97201 | 503-555-0123 |
| Mr. O. P. Young  | 606 Hickory St. | Denver        | CO    | 80201 | 303-555-4567 |
| Mrs. Q. R. King  | 707 Walnut St.  | Boston        | MA    | 02101 | 617-555-8901 |
| Mr. S. T. Lee    | 808 Maple St.   | San Diego     | CA    | 92101 | 619-555-2345 |
| Mrs. U. V. Scott | 909 Elm St.     | Dallas        | TX    | 75201 | 214-555-6789 |
| Mr. W. X. Adams  | 1010 Oak St.    | San Jose      | CA    | 95101 | 408-555-0123 |
| Mrs. Y. Z. Baker | 1111 Pine St.   | Austin        | TX    | 78701 | 512-555-4567 |

## Appendix XI

Percentage of root lodging for test  
crosses at Saginaw County

| Second<br>cycle lines | Oh51  | Oh26  | Il1.A | W23  | Oh51 X 26 |
|-----------------------|-------|-------|-------|------|-----------|
| 1                     | 10.0  | 13.7  | 14.8  | -    | -         |
| 2                     | 10.4  | 4.0   | -     | 7.1  | 3.6       |
| 3                     | 24.2  | 12.5  | -     | 6.8  | 11.6      |
| 4                     | 4.6   | 10.4  | -     | 2.4  | 8.9       |
| 5                     | 14.4  | 10.4  | -     | -    | 4.7       |
| 6                     | 5.6   | 7.8   | -     | -    | -         |
| 7                     | -     | 4.8   | -     | -    | 4.6       |
| 8                     | -     | 3.4   | 4.4   | -    | 2.2       |
| 9                     | 5.8   | 4.1   | -     | 4.9  | 4.2       |
| 10                    | 1.1   | -     | -     | -    | 2.3       |
| 11                    | -     | 5.2   | -     | 3.4  | 2.4       |
| 12                    | -     | 4.8   | -     | -    | -         |
| 13                    | 14.6  | 14.4  | -     | 2.4  | 4.6       |
| 14                    | 5.6   | 4.6   | -     | -    | 5.6       |
| 15                    | 4.6   | 3.4   | -     | 6.8  | 6.7       |
| 16                    | 7.8   | 13.8  | 19.7  | 10.7 | 5.7       |
| 17                    | 5.0   | 3.4   | -     | 1.1  | -         |
| 18                    | 16.0  | 3.4   | 2.7   | -    | 16.0      |
| 19                    | -     | -     | 10.0  | 4.4  | -         |
| 20                    | 1.4   | -     | -     | -    | 5.6       |
|                       | 131.5 | 204.1 | 51.6  | 50.0 | 88.7      |
|                       | 6.6   | 10.2  | 2.6   | 2.5  | 4.4       |



## Appendix (Continued)

| I11.A X W23 | Ohio M15 | M14  | M14 X WF9 | Ia. 4483 |       |      |
|-------------|----------|------|-----------|----------|-------|------|
| 1.1         | 1.2      | 2.3  | -         | -        | 43.1  | 4.3  |
| 11.3        | -        | -    | 3.4       | -        | 39.8  | 4.0  |
| 3.4         | 6.9      | 4.6  | 8.0       | -        | 78.0  | 7.8  |
| -           | 6.8      | 2.2  | -         | 6.7      | 42.0  | 4.2  |
| 4.8         | 2.4      | 4.6  | 3.3       | 6.6      | 131.2 | 13.1 |
| -           | -        | 3.3  | 2.3       | 1.1      | 20.1  | 2.0  |
| -           | -        | -    | -         | 1.1      | 10.5  | 1.1  |
| -           | -        | -    | -         | -        | 10.0  | 1.0  |
| -           | -        | -    | -         | -        | 19.0  | 1.9  |
| -           | -        | -    | -         | -        | 3.4   | .3   |
| -           | 2.5      | -    | -         | 2.2      | 15.7  | 1.6  |
| 3.6         | -        | 5.6  | -         | -        | 14.0  | 1.4  |
| -           | -        | 10.4 | -         | 10.1     | 56.5  | 5.7  |
| 2.2         | 3.6      | 2.3  | -         | 2.4      | 26.3  | 2.6  |
| 2.3         | -        | 3.3  | 9.3       | -        | 36.4  | 3.1  |
| -           | 2.3      | 3.3  | 20.0      | 6.5      | 89.8  | 9.0  |
| -           | -        | -    | -         | -        | 9.5   | .9   |
| -           | 1.1      | -    | -         | 2.2      | 41.4  | 4.1  |
| -           | -        | -    | -         | -        | 14.4  | 1.4  |
| -           | -        | -    | -         | 3.6      | 10.6  | 1.1  |
| 28.7        | 26.8     | 41.9 | 46.3      | 42.5     |       |      |
| 1.4         | 1.3      | 2.1  | 2.3       | 2.1      |       |      |



| TABLE 1. SUMMARY OF DATA FOR THE 1970-1971 SEASON |          |       |      |      |       |        |
|---|----------|-------|------|------|-------|--------|
| STATION   | DATE     | TIME  | WIND | TEMP | HUMID | PRECIP |
| 1   | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 2   | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 3   | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 4   | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 5   | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 6   | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 7   | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 8   | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 9   | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 10  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 11  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 12  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 13  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 14  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 15  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 16  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 17  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 18  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 19  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 20  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 21  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 22  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 23  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 24  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 25  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 26  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 27  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 28  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 29  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 30  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 31  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 32  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 33  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 34  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 35  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 36  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 37  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 38  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 39  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 40  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 41  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 42  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 43  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 44  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 45  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 46  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 47  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 48  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 49  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 50  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 51  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 52  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 53  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 54  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 55  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 56  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 57  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 58  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 59  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 60  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 61  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 62  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 63  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 64  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 65  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 66  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 67  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 68  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 69  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 70  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 71  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 72  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 73  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 74  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 75  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 76  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 77  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 78  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 79  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 80  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 81  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 82  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 83  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 84  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 85  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 86  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 87  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 88  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 89  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 90  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 91  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 92  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 93  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 94  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 95  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 96  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 97  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 98  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 99  | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |
| 100   | 10/10/70 | 12:00 | 10   | 65   | 75    | 0.0    |

ROOM USE ONLY

9 AUG 1964

MICHIGAN STATE UNIVERSITY LIBRARIES



3 1293 03174 9348