THE RELATIONSHIP OF CORN BORER INFESTATION IN MICHIGAN TO SOME CHARACTERS IN CORN

THESIS FOR THE DEGREE OF M. S.

James Tyer

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THESIS

RESPECTFULLY SUBMITTED IN PARTIAL FULFILLMENT
FOR THE DEGREE OF MASTER OF SCIENCE

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THESIS

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INTRODUCTION

The European corn borer (Pyrausta nubilalis Hübner) by 1925 had spread over several counties in southeastern Michigan, causing an estimated loss of from fifty to seventy per cent of the corn crop. This attack constituted the most serious potential menace that had ever confronted the corn crop. It was feared that its spread over the entire corn producing area of Michigan was only a question of time.

An experiment station was established in this infected area near the city of Monroe, in the county of Monroe, by the State Board of Agriculture of Michigan State College in 1926 to study the cultural practices that would aid in controlling this new pest, and to study the feasibility of obtaining corn varieties that were either resistant or tolerant to the ravages of the borer.

Reports by European investigators indicate that there are corn varieties which are more resistant or less subject to the attack of the corn borer than other varieties. Raubaud (4), Pasteur Institute, Paris, reports studies in 1927 which indicate some resistance in the corn variety Hatif d'Auxonne and apparently complete immunity of the

variety Dent de Cheval to infestation by the corn borer. Marston (2) cites Hase of the German Biological Institute of Agriculture, who reports studies which indicate complete immunity of the variety Pferdezahn to the attacks of the corn borer.

Mr. A. R. Marston, who was placed in charge of the agronomy work at the Monroe Station, reported (2) that some strains of corn are more tolerant to borer damage than others, some escape attack, and some are resistant. Maiz Amargo, a variety of corn which had been received from Dr. D. W. Jones of the Federal Corn Borer station at Arlington, Massachusetts, was found most resistant, but is, unfortunately, not adapted to Michigan climatic conditions. Michigan varieties proved to be susceptible.

The data, which were obtained from segregates coming from crosses made between Maiz Amargo and local Michigan varieties, show that resistance seems to be recessive to susceptibility and due to a single factor difference (2).

Since the establishment of a definite relationship of susceptibility to an easily discernable morphological or physological character would be of great value in the selection of resistant segregates, a problem was outlined in 1930 that would make such a study possible. This problem was subdivided as follows:

Fig. 1. Showing damage done to the corn stalk by the corn borer (Pyrausta nubilalis Hubner) used by permission of the Entomological Department of Michigan State College.

1. To obtain the means of the various characters of the different strains and variety of corn used in these investigations and to determine whether or not these means are significantly different from each other.

2. To determine the relationship between the percentage of corn borer infestation at harvest time and,

(a) the height of plant at the time of moth flight,

(b) the area of leaf at the time of moth flight,

(c) the number of internodes,

(d) the height of upper ear,

(e) the height of plant at maximum growth,

(f) the leaf area at maximum growth,

(g) the number of days from planting to date of tasseling,

(h) the number of days from planting to date of silking.

A review of the literature showing some studies upon the different phases of this work will be given before discussing the material used in this investigation.

Fig. 2. A Maiz Amargo plant of the South American corn variety that is resistant to the corn borer (Pyrausta nubilalis Hübner).

LITERATURE CITED

No reports have been found giving any information on work done to determine the relationship of the percentage of corn borer infestation and to the number of internodes, height of upper ear, leaf area at maximum growth, height of corn at maximum growth, and date of tasseling. Some studies have been made on the relationship of corn borer infestation to date of silking and height of plant at moth flight.

Heiswander and Huber (3) showed that there was a marked decrease in egg deposition of the corn borer moth as the average height of plants decreased, irrespective of varieties. "Resistance to survival varies inversely with the silking date of the host whether variety, planting date, or merely rate of development within a given variety or planting date is concerned".

Salter, Thatcher, and McClure (5) reported correlation studies which were made by Meyers and Cutler. They found a significant negative correlation between date of silking and corn borer infestation and a significant positive relationship between height of plant and infestation.

Marston (2) gives a coefficient of correlation of $\pm.654\pm.097$ between the percentage of infestation and the number of days from planting to 50 per cent silk.

MATERIAL

Studies were made in 1930 on the following corns:

Strain and variety	No. strains or plots	No. of generations inbred
Local corn x Maiz Amargo, inbreds	389	3
Local corn x Maiz Amargo, inbreds	196	4
Local corn x local corn, inbreds	123	4
Duncan variety (check)	231	0

Further data were collected in 1931 on the filial generation of the inbred strains used in 1930 and on several other lines.

Strain and variety	No strains or plots	No. of generations inbred
Northwestern Dent x Maiz Amargo, inbreds	100	3
Local corn x Maiz Amargo, inbreds	106	(3,4,or 5)specially resistant strains
Local corn x Maiz Amargo, inbreds	176	4
Local corn x Maiz Amargo, inbreds	234	5
Duncan variety (check	297	0
Local corn x local corn, inbreds	60	3
Local corn x local corn, inbreds	40	4
Local corn x local corn, inbreds	44	5

The data for 1930 were obtained from Mr. A. R. Marston, Agronomist, Michigan State College Corn Borer Sub-Station, Monroe, Michigan, while the 1931 data were obtained by the

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Fig. 3. General view of the corn breeding plots growing at the Monroe Corn Borer Station, at Monroe, Michigan, taken in 1931.

writer on material planted by Mr. Marston.

The inbred strains of local corn crossed with Maiz Amargo and local corn crossed with local corn had been selected every year for resistance to the corn borer, while the sister lines showing comparatively high infestation were discarded.

This experiment was conducted under conditions of natural infestation and was a part of the regular strain and variety tests conducted at the Monroe station. Each strain was planted in a single plot one row wide and ten hills long with three plants to a hill. The hills were 3 1/2 feet apart each way. Every fourth plot was planted to the Duncan variety as a check.

METHODS

The methods followed in obtaining the data on the several characters used in these investigations are as follows:

For the morphological characters the average for the plot was determined by making counts or measurements on one plant in each of five alternate hills.

The number of internodes from the ground line to the tassel was used.

Height of ear was obtained by measuring the distance from the surface of the soil to the base of the ear.

Fig. 4. Dissecting corn stalks, looking for corn borers (Pyrausta nubilalis Hübner).

Plant height at maximum growth was the distance from surface of the soil to the tip of the tassel. This measurement was taken immediately after silking.

The area of the leaf was calculated by multiplying 3/4 of the leaf length by its width. The length of leaf was determined by measuring from the base to the tip. The width was taken at the middle of the leaf. The leaf at the base of the upper ear and another appearing medium in size were used.

Heights were measured in inches and areas in square inches.

The dates of tasseling and silking were taken when approximately 90 per cent of the tassels or silks respectively appeared on each plot. For the sake of brevity, the number of days from the date of planting to the dates of tasseling or silking are referred to as number of days to tasseling or number of days to silking respectively.

The percentage of corn borer infestation was found by carefully whittling the stalk at harvest time into very fine pieces to find any sign of borer work. The number of plants on a plot showing signs of borer work was divided by the total number of plants on the plot to determine the percentage of infestation for that plot.

The arithmetic mean is used in the comparisons of the different strains and variety with one another.

The probable errors were computed in the usual manner and in calculating the probable error of a difference, the value of r was considered zero.

A difference is considered significant when the quotient of the difference divided by its probable error is 3.2 or greater. When this quotient is 3.2, the odds are over thirty to one that the difference is not due to chance alone.

Correlation coefficients were calculated by the diagonal method used by the plant breeding staff of Farm Crops Department of Michigan State College and is a modification of the form given by Crum and Patton. (1)

The actual values of all factors were used in calculating the coefficients of correlation. No corrections were made on the actual values for variations expressed by the checks.

The significance of a coefficient of correlation is determined in this thesis as follows:

If "r" is less than six times its probable error, there is no evidence of correlation.

If "r" is greater than or equal to .3 but less than .5 and more than six times its probable error, there is a slight correlation.

If "r" is equal to or greater than .5, but less than .71, and more than six times its probable error, there is a

marked correlation.

If "r^2" is equal to or greater than .5 and r is more than six times its probable error, there is a strong correlation.

All calculations were computed to the third and fourth decimal places but for clarity and brevity only two places are usually given.

RESULTS AND DISCUSSIONS

Comparative measurements of the characters of the different corns studied in 1930 and 1931 are shown in Tables 1 and 2, respectively.

Results of 1930

An examination of Table 1 shows that the various strains differed from each other in many cases by amounts which are not large, but which are statistically significant on account of the small probable errors.

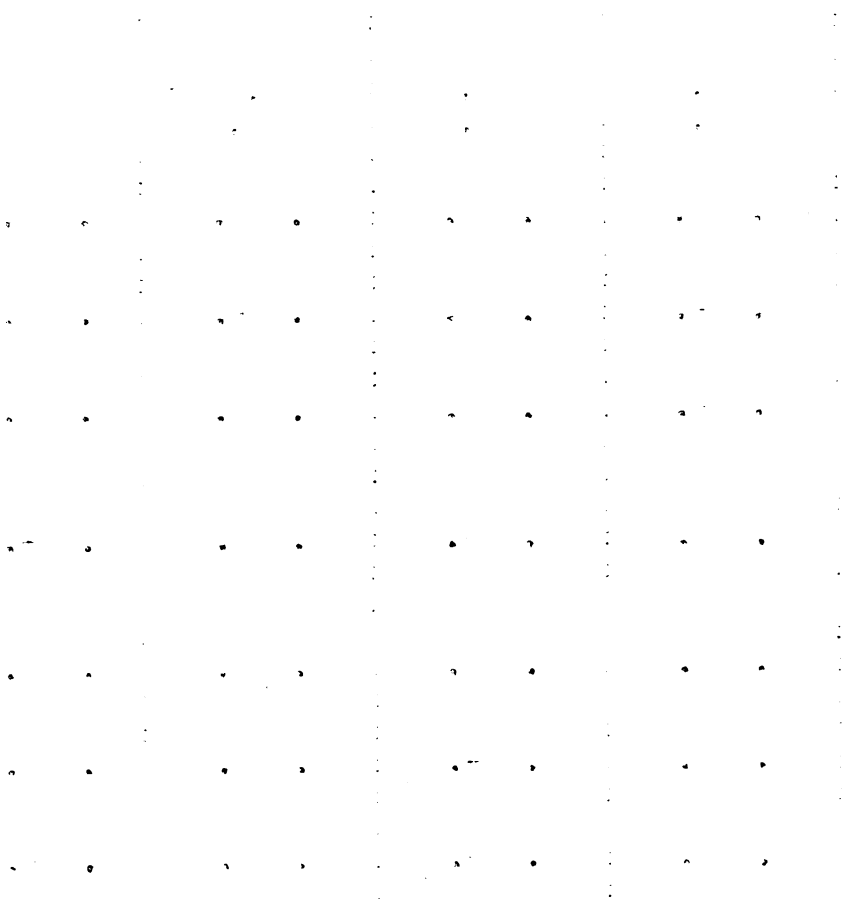
Number of internodes:- There are no large differences.

Height of upper ear:- There are practically no differences between the inbreds of local corn x Maiz Amargo and the checks, but these three groups are greater in height of upper ear than the inbreds of local corn x local corn.

Leaf area:- The differences between the inbreds of local corn x Maiz Amargo and Duncan are not very great,

Table 1. The means of the characters studied in 1930.

Plant characters	Local corns x Maiz Amargo, in-breds, F_3	Local corns x Maiz Amargo, in-breds, F_4	Local corns x local corns, in-breds, F_4	Duncan variety (checks)
Number of internodes	10.41±.07	10.65±.04	9.82±.06	11.14±.03
Height of upper ear (inches)	24.88±.13	26.05±.26	18.02±.24	26.38±.17
Height of plant at maximum growth (inches)	64.40±.30	64.04±.33	57.43±.56	82.71±.27
Leaf area at maximum growth in sq. in.	83.66±.43	78.49±.59	68.11±.86	84.02±.55
No. of days to tasseling	96.08±.27	97.48±.42	77.86±.21	79.33±.13
No. of days to silking	119.13±.30	113.55±.42	88.89±.27	87.90±.28
Percentage of infestation	12.46±.30	8.93±.40	15.64±.70	27.97±.30
Population	389	196	123	231



though statistically significant. These three groups are appreciably larger than the inbreds of local corn x local corn.

Number of days to tasseling:- The inbreds of local corn x Maiz Amargo require a longer season than either the inbreds of local corn x local corn or the checks. These last two groups are about equal in earliness.

Number of days to silking:- The F_3 and F_4 inbreds from local corn x Maiz Amargo are about equal to each other and require a longer season than either the inbreds from local corn x local corn or the checks.

Percentage of infestation:- The F_3 and F_4 inbreds from local corn x Maiz Amargo are about equal to each other and both have much lower infestations than the checks. The inbreds from local corn x local corn were intermediate between these two extremes.

Results of 1931

An inspection of Table 2 reveals many significant differences which like the results of 1930 are not very large in magnitude, but which are significant due to small probable errors.

Height of plant and leaf area at the time of moth flight:- The checks are taller and have more leaf area than the specially resistant strains.

Table 2. The means of the characters studied in 1931

Plant characters	Northwestern Dent x Maiz Amargo, inbreds, F_3	Local corns x Maiz Amargo, specially resistant strains	Local corns x Maiz Amargo, inbreds, F_4	Local corns x Maiz Amargo, inbreds, F_5	Local corns x local corns, inbreds, F_3	Local corns x local corns, inbreds, F_4	Local corns x local corns, inbreds, F_5	Duncan variety (checks
Height of plant at moth flight (inches)		24.56±.29						38.88±.4
Leaf area at moth flight (sq. in.)		56.74±.96						83.88±1.
Number of internodes	10.23±.09	11.41±.09	11.90±.06	11.84±.06	10.10±.14	11.17±.09	11.16±.10	12.12±.0
Height of upper ear (inches)	30.21±.38	35.66±.50	38.99±.29	38.62±.31	30.77±.64	30.10±.67	30.59±.64	38.90±.3
Height of plant at maximum growth (inches)	68.98±.61	75.59±.73	80.01±.36	78.64±.42	76.5±.93	72.37±1.18	75.48±1.04	90.89±.3
Leaf area at maximum growth (sq. in.)	80.46±.86	83.91±.90	91.76±.64	94.70±.64	75.48±1.35	67.00±1.85	67.16±1.31	97.16±.4
No. of days to tasseling	70.77±.32	99.70±.70	84.63±.22	82.31±.19	76.05±.62	80.05±.29	77.26±.40	77.03±.1
No. of days to silking	84.70±.22	110.11±.48	88.32±.19	88.35±.13	82.85±.31	84.55±.22	82.68±.30	86.07±.2
Percentage of infestation	18.27±.82	11.79±.63	24.26±.83	17.05±.68	12.83±.85	19.13±1.5	13.06±1.05	37.31±.6
Population	103	106	176	234	60	40	44	297

Number of internodes:- No differences are pronounced.

Height of upper ear:- The inbreds of Northwestern Dent x Maiz Amargo and all the inbreds of local corn x local corn are about equal to each other, but lower than either the inbreds of local corn x Maiz Amargo or the checks. There are practically no differences between any of the inbreds of local corn x Maiz Amargo and the checks.

Height of plant:- The F_3 inbreds of Northwestern Dent x Maiz Amargo have on the average the shortest plants. All of the other inbred strains are about equal to each other in height, but are considerable shorter than the checks.

Leaf area at maximum growth:- The F_4 and F_5 inbreds of local corn x local corn have the smallest leaf area and the checks the largest. The means of the F_4 and F_5 inbreds of local corn x Maiz Amargo lie near the check mean and the other three means lie near the smaller extreme.

Number of days to tasseling:- The inbreds of Northwestern Dent x Maiz Amargo require the shortest season while the specially resistant strains require the longest. Between these two extremes are the F_4 and F_5 inbreds of local corn x Maiz Amargo which require a slightly longer season than either the inbreds of local corn x local corn or the checks.

Number of days to silking:- The F_4 and F_5 inbreds of local corn x Maiz Amargo though not requiring as long a season as the specially resistant strains are somewhat earlier than all the other inbreds or the checks.

There are some noticeable differences in the percentage of infestation. The specially resistant strains and the F_3 inbreds of local corn x local corn have the lowest percentages while the checks have the highest. The other groups are about equal to each other.

The actual data show the local corn x Maiz Amargo inbreds have a higher percentage of infestation than the inbreds of local corn x local corn for the same generation of inbreeding. This is opposite to the result of 1930 and seems to contradict the idea of resistance to the corn borer being carried by the local corn x Maiz Amargo inbred strains. A study of the standard variety (checks) shows that the infestation was much higher in 1931 in the area where the local corn x Maiz Amargo inbreds grew than where the inbreds of local corn x local corn were grown. The percentages of infestation for each group of inbred strains together with the percentages of infestation for their respective checks are shown in Table 3. No explanation is available for the variation in the infestation of the check. When the percentages of infestation of the different groups of inbreds are corrected for the variation shown by the checks, the comparisons for 1931 agree closely with those for 1930.

Table 3. A comparison of the mean percentages of corn borer infestation of the inbreds in 1931 with and without correction.

	No. of plots	Mean percentage of infestation	Relative infestation	Infestation corrected to check field average
Northwestern Dent x Maiz Amargo, inbreds, F_3	103	18.27± .82	.495	18.47± .43
Checks	33	36.89±1.61	1.000	
Local corn x Maiz Amargo, specially resistant strains	106	11.79± .63	.313	11.68± .45
Checks	38	37.63±1.73	1.000	
Local corn x Maiz Amargo, inbreds, F_4	176	24.26± .83	.466	17.38± .26
Check	57	52.06±1.39	1.000	
Local corn x Maiz Amargo, inbreds, F_5	234	17.05± .68	.364	13.58± .31
Check	78	46.73±1.48	1.000	
Duncan variety (check) for the field	297	37.31± .65		37.31± .65
Local corn x local corn, inbreds, F_3	60	12.83± .85	.615	22.94± .77
Checks	19	20.85±1.61	1.000	
Local corn x local corn, inbreds, F_4	44	19.13±1.50	.974	36.33± .91
Checks	14	19.64±1.79	1.000	
Local corn x local corn, inbreds, F_5	40	13.06±1.07	.474	17.68±1.03
Checks	13	27.50±2.84	1.000	

Relationships

The amount of relationship between two characters is measured by the coefficient of correlation. The coefficients between the height of plant and leaf area at the time of moth flight and percentage of corn borer infestation at harvest time (Table 4) indicate positive relationships, but only one of these is significant, namely, that between percentage of infestation and height of plant in the inbreds of local corn x Maiz Amargo.

Table 4. Coefficients of correlation between height of plant and leaf area at time of moth flight (July 8) with percentage of corn borer infestation at harvest time, in 1931.

Material	Height of plant	Area of leaf
Local corn x Maiz Amargo special resistant strains	.40 ± .03	.06 ± .06
Check (Duncan variety	.17 ± .10	.41 ± .09

Table 5 gives the data showing the relationship between the percentage of corn borer infestation and the number of internodes. No association is shown.

The data in Table 6 show no relationship between percentage of corn borer infestation and height of upper ear.

Table 7 presents data showing the correlation between percentage of corn borer infestation and height of plant at maximum growth. No relationship is shown by the coefficients of correlation in 1930. The data for 1931 show that with one exception the coefficients of correlation are either too small or the probable errors are too large for the coefficients to be significant. The one exception is the slight positive correlation given by the local corn x Maiz Amargo specially resistant strains.

The coefficients of correlation obtained between the percentage of corn borer infestation and the leaf area at maximum growth, Table 8, indicate a positive relationship. However, only one of them (Duncan in 1931) has a coefficient of correlation of sufficient size to be significant.

Table 9 gives the data showing the correlation between percentage of corn borer infestation and the number of days to tasseling. In 1930, the F_4 inbreds of local corn x local corn show a slight correlation. In 1931, the F_4 and F_5 inbreds of local corn x Maiz Amargo give slight correlations

Fig. 5. View of two extreme types of corn strains, for height. The shorter strain has an infestation of 0 per cent and the taller has an infestation of 37 per cent.

Fig. 6. The opposite of the conditions shown in figure 5 is expressed in figure 6. The taller strain has an infestation of 0 per cent and the shorter strain has an infestation of 29 per cent.

Table 5. Coefficients of correlation between percentage of corn borer infestation and the number of internodes.

	1930	1931
Northwestern Dent x Maiz Amargo, inbreds, F_3		.06±.07
Local corn x Maiz Amargo, inbreds, specially resistant strains		.05±.06
Local corn x Maiz Amargo, inbreds, F_3 in 1930, F_4 in 1931	.02±.03	.03±.04
Local corn x Maiz Amargo, inbreds, F_4 in 1930, F_5 in 1931	.04±.05	.16±.04
Duncan variety (check)	.02±.04	.02±.04
Local corn x local corn, inbreds, F_3		-.37±.07
Local corn x local corn, inbreds, F_4		.28±.10
Local corn x local corn, inbreds, F_4 in 1930, F_5 in 1931	.16±.06	.17±.10
Weighed average	.04±.02	.06±.02
Weighed average both years	.05 ± .01	

Table 6. Coefficients of correlation between percentage of corn borer infestation and height of upper ear.

	1930	1931
Northwestern Dent x Maiz Amargo, inbreds, F_3		.07±.06
Local corn x Maiz Amargo, specially resistant strains		.16±.05
Local corn x Maiz Amargo, inbreds, F_3 in 1930, F_4 in 1931	.04±.05	.17±.05
Local corns x Maiz Amargo, inbreds, F_4 in 1930, F_5 in 1931	.06±.05	-.10±.04
Duncan variety (check)	.20±.04	-.06±.04
Local corn x local corn, inbreds, F_3		-.25±.08
Local corn x local corn, inbreds, F_4		.18±.10
Local corn x local corn, inbreds, F_4 in 1930, F_5 in 1931	-.05±.06	.23±.10
Weighed average	.07±.02	.01±.02
Weighed average both years	.04 -	.01

Table 7. Coefficients of correlation between percentage of corn borer infestation and height of plant at maximum growth.

	1930	1931
Northwestern Dent x Maiz Amargo, inbreds, F_3		.012±.066
Local corn x Maiz Amargo, specially resistant strains		.364±.057
Local corn x Maiz Amargo, inbreds, F_3 in 1930, F_4 in 1931	-.011±.034	.281±.047
Local corn x Maiz Amargo, inbreds, F_4 in 1930, F_5 in 1931	.075±.055	.208±.042
Duncan variety (check)	.089±.044	.139±.038
Local corn x local corn, inbreds, F_3		-.325±.079
Local corn x local corn, inbreds, F_4		.261±.100
Local corn x local corn, inbreds, F_4 in 1930, F_5 in 1931	-.002±.061	.226±.096
Weighed average	.033±.022	.170±.021
Weighed average both years	.105 ± .015	

Table 8. Coefficients of correlation between percentage of corn borer infestation and leaf area at maximum growth.

	1930	1931
Northwestern Dent x Maiz Amargo, inbreds, F_3		.09±.06
Local corn x Maiz Amargo, specially resistant strains		.21±.06
Local corn x Maiz Amargo, inbreds, F_3 in 1930, F_4 in 1931	-.05±.03	.03±.05
Local corn x Maiz Amargo, inbreds, F_4 in 1930, F_5 in 1931	.07±.05	.16±.04
Duncan variety (check)	.12±.04	.31±.04
Local corn x local corn, inbreds, F_3		.27±.08
Local corn x local corn, inbreds, F_4		.33±.09
Local corn x local corn, inbreds, F_4 in 1930, F_5 in 1931	.03±.06	.09±.10
Weighed average	.03±.02	.19±.02
Weighed average both years	.11 ±	.01

Table 9. Coefficients of correlation between percentage of corn borer infestation and number of days to tasseling.

	1930	1931
Northwestern Dent x Maiz Amargo, inbreds, F_3		-.11±.06
Local corn x Maiz Amargo, specially resistant strains		-.14±.06
Local corn x Maiz Amargo, inbreds, F_3 in 1930, F_4 in 1931	-.06±.03	-.35±.05
Local corn x Maiz Amargo, inbreds, F_4 in 1930, F_5 in 1931	-.22±.04	-.31±.04
Duncan variety (check)	-.22±.04	-.28±.04
Local corn x local corn, inbreds, F_3		-.54±.06
Local corn x local corn, inbreds, F_4		-.30±.10
Local corn x local corn, inbreds, F_4 in 1930, F_5 in 1931	-.39±.05	-.14±.10
Weighed average	-.18±.02	-.28±.02
Weighed average both years	-.23 ± .01	

and the F_3 inbreds of local corn x local corn give a marked correlation. A negative relationship is shown by all of the coefficients given in the table.

Table 10 gives the data showing the correlation between percentage of corn borer infestation and the number of days to silking. The F_4 inbreds of local corn x local corn show a slight negative correlation in 1930. The remaining coefficients for 1930 and all of those for 1931 are too small to be considered significant. A negative relationship is shown by all of the coefficients given in this table.

Table 10. Coefficients of correlation between percentage of corn borer infestation and number of days to silking.

	1930	1931
Northwestern Dent x Maiz Amargo, inbreds, F_3		-.27±.06
Local corn x Maiz Amargo, specially resistant strains		-.03±.06
Local corn x Maiz Amargo, inbreds, F_3 in 1930, F_4 in 1931	-.19±.03	-.18±.05
Local corn x Maiz Amargo, inbreds, F_4 in 1930, F_5 in 1931	-.21±.05	-.11±.04
Duncan variety (check)	-.16±.04	-.18±.04
Local corn x local corn, inbreds, F_3		-.36±.07
Local corn x local corn, inbreds, F_4		-.04±.10
Local corn x local corn, inbreds, F_4 in 1930, and F_5 in 1931	-.35±.05	-.32±.09
Weighed average	-.20±.02	-.17±.02
Weighed average both years	-.19 ± .01	

SUMMARY

Data are presented in this thesis which were obtained in 1930 from 708 inbred strains from crosses of local corn x Maiz Amargo or local corn x local corn and 231 check plats, and in 1931 from 763 inbred strains from crosses of Northwestern Dent or local corn x Maiz Amargo and of local corn x local corn and 297 check plats. The strains have been grouped together according to the type of parental cross and the number of generations of inbreeding.

The characters studied are: height of plant at moth flight, leaf area at moth flight, number of internodes, height of upper ear, height of plant at maximum growth, leaf area at maximum growth, number of days to tasseling and silking, and percentage of corn borer infestation at harvest.

These characters have been studied to answer two questions: first, how greatly do these groups of strains differ from each other in any of the characters? and, second, what is the relationship between the percentage of corn borer infestation and each of the other characters?

It has been shown that a large majority of the differences between group means are statistically significant due to the small probable errors. Attention has been called to the fact that many of these significant differences have

no practical value because they are small in magnitude and because the frequency distributions overlap so greatly.

The 1931 results on the two measurements taken at time of moth flight, height of plant and leaf are, indicate that the checks have materially larger plants than the specially resistant strains.

The two year's results on the other characters are as follows:

a) There are no pronounced differences in number of internodes.

b) The inbreds of local corn x Maiz Amargo and the checks tend to have the higher ears.

c) The checks tend to have the tallest plants with the F_4 inbreds of local corn x Maiz Amargo almost as tall. The shortest strains are the inbreds of local corn x local corn in 1930 and inbreds of Northwestern Dent x Maiz Amargo in 1931.

d) The checks have the largest leaf area while the inbreds of local corn x local corn have the smallest. The other strains are intermediate in size and do not have the same ranking both years.

e) The specially resistant strains require the greatest number of days from planting to date of tasseling or date of silking. The other inbreds of local corn x Maiz Amargo are next in length of season. The inbred strains

of local corn x local corn and the checks are comparatively short in length of season and require about the same number of days.

f) When using the 1931 corrected results, the lowest percentage of infestation occurred in the strains of local corn x Maiz Amargo which had been inbred the longest time, with the exception of the specially resistant strains in 1931. A similar decrease in infestation is noticed between the F_4 and F_3 inbreds of local corn x local corn. The checks had the highest percentage of infestation both years.

A study of the 94 coefficients of correlation given in the accompanying tables reveals only seven slight and one marked correlations.

The seven slight correlations were between the percentage of corn borer infestation and

1) the height of plant at moth flight,

2) the height of corn at maximum growth in the specially resistant strains of local corn x Maiz Amargo,

3) the area of leaf at maximum growth in the checks in 1931,

4) the number of days to tasseling in the F_4 inbreds of local corn x Maiz Amargo in 1931,

5) in the F_5 inbreds of local corn x Maiz Amargo,

6) in the F_4 inbreds of local corn x local corn in 1930,

7) the number of days to silking in the F_4 inbreds of local corn x local corn in 1930.

The one marked correlation was between percentage of corn borer infestation and number of days to tasseling in the F_3 inbreds of local corn x local corn.

The two year weighed average coefficients of correlation show that there is practically no relationship between percentage of corn borer infestation and any of the other characters. The strongest relationship ($-.23 \pm .01$) was found to be between percentage of infestation and number of days to tasseling.

CONCLUSION

The data presented in this thesis show that none of the easily discernible morphological or physiological characters are correlated closely enough with percentage of corn borer infestation to aid in the selection of resistant strains.

LITERATURE CITED

1. Crum, W. L. and Patton, A. C.

An Introduction to the Methods of Economic Statistics. A. W. Shaw Co., New York. 1925.

2. Marston, A. R. and Dibble, C. B.

Investigation of Corn Borer Control at Monroe, Michigan. Mich. Agr. Exp. Sta. Special Bull. 204. 1930.

3. Neiswander, C. R. and Huber, L. L.

Height and Silking as Factors Influencing European Corn Borer Population.
Ann. Entomol. Soc. Am. 22:527-542. 1926.

4. Raubaud, E.

International Corn Borer Investigations. Resistance of various corn varieties to corn borer infestation. Sci. Rpts. 2:17. International Livestock Exposition, Union Stockyards, Chicago, Ill. 1927-1928.

5. Salter, R. M., Thatcher, L. E., and McClure, J. T.

Agronomic Research on the European Corn Borer in Ohio. Jour. Am. Soc. of Agron. 20:1011-1032. 1928.

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