



AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

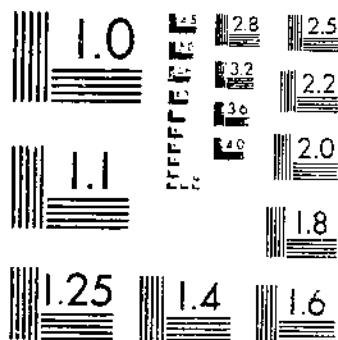
Give to AgEcon Search

AgEcon Search
<http://ageconsearch.umn.edu>
aesearch@umn.edu

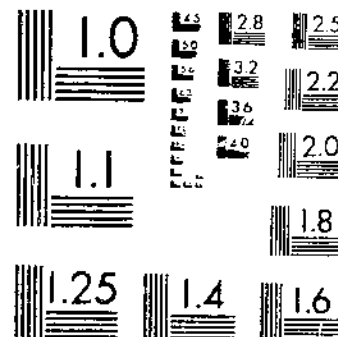
*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

TB 893 (1945) USDA TECHNICAL BULLETINS UPDATA
RESISTANCE OF DENT CORN INBRED LINES TO SURVIVAL OF FIRST-GENERATION
PATCH, L. H. EVERLY, R. T. 1 OF 1

START



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A



UNITED STATES
DEPARTMENT OF AGRICULTURE
WASHINGTON, D. C.

Resistance of Dent Corn Inbred Lines to Survival of First-Generation European Corn Borer Larvae¹

By L. H. PATCH, *associate entomologist*, and RAY T. EVERLY, *assistant entomologist*,
Division of Cereal and Forage Insect Investigations, Bureau of Entomology and
Plant Quarantine, Agricultural Research Administration.²

CONTENTS

	Page		Page
Summary.....	1	Numbers of borers surviving in inbred lines and	
Introduction.....	2	and in their single-cross hybrids.....	7
Tests of inbred lines.....	2	Degree of borer resistance in commercial hybrids.....	9

SUMMARY

A graphic method of rating strains of dent corn as either resistant, partially resistant, or susceptible to the survival of larvae of the first generation of the European corn borer is presented, using the mean data from groups of standard strains as measures for comparison. The strains were infested by hand with about 120 eggs per plant.

On a numerical scale from 0 to 10, the average rating of numerous inbred lines tested from 1938 through 1941 as inbreds or in hybrid combination on common parents is given. In 37 cases the strains were tested both as inbreds and as hybrids. The correlation between the inbred and hybrid tests was found to be highly significant.

In addition to lines previously reported, lines Ind. P8, Kan. K230, Ia. L304A, and Mich. 285 in hybrid combination and lines Kan. K230, Kan. K226, Mich. 285, and Ill. 408 in tests of lines as such were most resistant; lines Ind. 38-11, Ia. Os420, Kan. K228, and Ohio 40B in hybrid combination and lines Ohio 07, Mich. 898, Mich. 393, and Minn. A342 in tests of lines as such were partially resistant; and lines Ia. BL-351 and Neb. BR1756 in hybrid combination and lines Ind. PS7852, Ind. 33-16, Wis. 4412, and Ill. 5675 in tests of lines as such were the most susceptible when rated on the basis of more than one test in each case.

¹ Submitted for publication January 31, 1945.

² The authors express their appreciation to the following individuals who grew and supplied hybrid and inbred lines of corn: G. H. Dungan, Illinois Agricultural Experiment Station; C. S. Garrison, New Jersey Agricultural Experiment Station; I. J. Johnson, formerly at the Minnesota Agricultural Experiment Station; A. R. Marston, formerly at the Michigan Agricultural Experiment Station; N. P. Neal, University of Wisconsin; C. M. Woodworth, Illinois Agricultural Experiment Station; and to the following workers of the Bureau of Plant Industry, Soils, and Agricultural Engineering: A. M. Brunson, stationed at the Purdue Agricultural Experiment Station; R. C. Eckhardt, formerly stationed at the Iowa Agricultural Experiment Station; R. W. Jugenheimer, formerly stationed at the Kansas Agricultural Experiment Station; G. F. Sprague, stationed at the Iowa Agricultural Experiment Station; and G. H. Stringfield, stationed at the Ohio Agricultural Experiment Station.

In comparing inbreds of previously established resistance and susceptibility and their single-cross hybrids in adjacent hills when the plants were infested by hand with about 120 eggs per plant, the relative numbers of larvae in the inbred parents and their hybrids were estimated to be, respectively, as follows: Resistant \times resistant, 2.71 and 0.70; resistant \times partially resistant, 3.20 and 1.27; resistant \times susceptible, 3.69 and 1.83; partially resistant \times susceptible, 4.18 and 2.40; and susceptible \times susceptible, 4.67 and 2.96. The hybrids averaged a nearly constant difference of 1.86 fewer borers per plant than the inbreds used to produce them, in spite of the fact that the hybrids averaged 7.1 days earlier in silking than their inbreds.

Six widely planted Corn Belt hybrids were compared during 3 years with some of the most borer-susceptible and resistant experimental hybrids. The group of commercial hybrids was about half as borer-resistant as the resistant group.

INTRODUCTION

In a previous publication¹ five inbred lines of field corn were reported as being resistant, seven as partially resistant, and four as susceptible to the survival of larvae of the European corn borer (*Pyrausta nubilalis* (Hbn.)). The cumulative effect of an undetermined number of factors in inbred lines in producing borer resistance in hybrids was indicated. When the number of partially resistant and susceptible inbreds used in the pedigrees of double-cross hybrids was increased, a trend from pronounced borer resistance toward borer susceptibility was also indicated. Additional inbred lines have been tested in 1938 through 1941, as lines or in hybrid combinations, or both, and the results are reported herein.

Data on the comparison of tests of single-cross hybrids with their inbred parents planted in the same experiment are also presented.

During three seasons six commercial double-cross hybrids most widely planted in the Corn Belt were included in the tests of hybrids. The average borer populations in these are compared with the numbers of borers in a group of the most borer-resistant single-cross hybrids and a group of the most borer-susceptible hybrids.

TESTS OF INBRED LINES

The resistance of inbred lines and their hybrids to survival of first-generation borers was determined by infesting replicated plots by hand with 4 egg masses, or about 120 eggs, per plant and dissecting samples totaling 24 plants about 5 weeks later to count the numbers of mature borers that survived. Each plant was tagged with the date of silking. The experimental procedure and methods of analysis differed from those described in a previous publication¹ in several respects. Inbred lines of unknown reaction to borer survival were tested against groups of standard inbreds of known resistance and susceptibility. In hybrid tests all the inbred lines, including the standards, were crossed on common parents.

¹ PATCH, L. H., HOLBERT, J. R., and EVERLY, R. T. STRAINS OF FIELD CORN RESISTANT TO THE SURVIVAL OF THE EUROPEAN CORN BORER. U. S. Dept. Agr. Tech. Bul. 823, 22 pp. 1942.

Differences in the mean numbers of borers between strains may be explained in large part as follows: (1) The later silking strains contained fewer borers because of a lower rate of survival in plants in a less advanced stage of development at times of borer hatching, (2) the mean number recorded showed variability because of sampling errors, and (3) the strains differed in their inherent resistance or susceptibility to the borer. To arrive at a reliable evaluation of the third variable it was necessary to take into account the first two variables.

The steps taken were as follows: First, three points on a graph were obtained by plotting the mean number of borers per plant against the mean date of silking for the groups of standard resistant, partially resistant, and susceptible strains, respectively.

Second, a regression line of number of borers per plant on silking date was passed through each of the three points. The regression coefficients necessary for determining the slopes of these lines were calculated by multiplying the mean number of borers per plant in each case by 0.043. This constant was calculated by dividing the mean regression of number of borers per plant on silking date (0.188) of 13 experiments conducted in 8 seasons by the mean number of borers per plant (4.39) in all these experiments. Hence, on the basis of a purely mathematical relationship, a reduction of 4.3 percent of the borer populations for each day later in silking would be expected at all levels of borer population.

The validity of using the expected reduction of 4.3 percent was determined by calculating how much the regression of borers on silking date actually changed with a change of 1 borer in the mean number of borers per plant in an experiment. The data from each of the 13 experiments are given in table 1. Actually, the regression of borers on silking date increased or decreased 0.040 ± 0.0053 borer from a mean of 0.188 borer for each increase or decrease of 1 borer per plant in an experiment from the mean of 4.39 borers per plant in all the experiments. Since the value 0.040 is not significantly different from 0.043, the expected value, the validity of the procedure was established.

TABLE 1.—Observed and expected regression of mean number of European corn borers per corn plant on date of silking for experiments conducted at Sandusky and Toledo, Ohio, 1930 to 1941

Year	Corn strains tested	Strain of corn	Borers per plant in experiment (B)	Coefficient of regression	
				Observed (O)	Expected (E)
	Number		Number		
1938.....	240	Hybrids.....	1.4	-0.09	-0.06
1941.....	164	Inbred lines.....	1.0	-.06	-.06
1941.....	48	Hybrids.....	2.2	-.08	-.09
1936.....	30	do.....	2.8	-.19	-.12
1941.....	112	do.....	2.8	-.11	-.12
1937.....	65	Inbred lines.....	3.1	-.11	-.13
1937.....	30	Hybrids.....	3.4	-.16	-.15
1937.....	23	Inbred lines.....	5.1	-.17	-.22
1939.....	128	Hybrids.....	6.1	-.35	-.26
1940.....	110	do.....	6.3	-.28	-.27
1940.....	142	Inbred lines.....	6.0	-.23	-.28
1939.....	120	do.....	6.8	-.26	-.29
1931.....	24	Hybrids.....	8.6	-.36	-.37
Mean.....			4.39	-.188	-.188

Third, distances were set off equally above and below each regression line at two widely separated dates of silking. A line was drawn through the two points above and another line through the two points below the regression line to delimit a band or zone. The distances set off were calculated to give zones that would on the average include

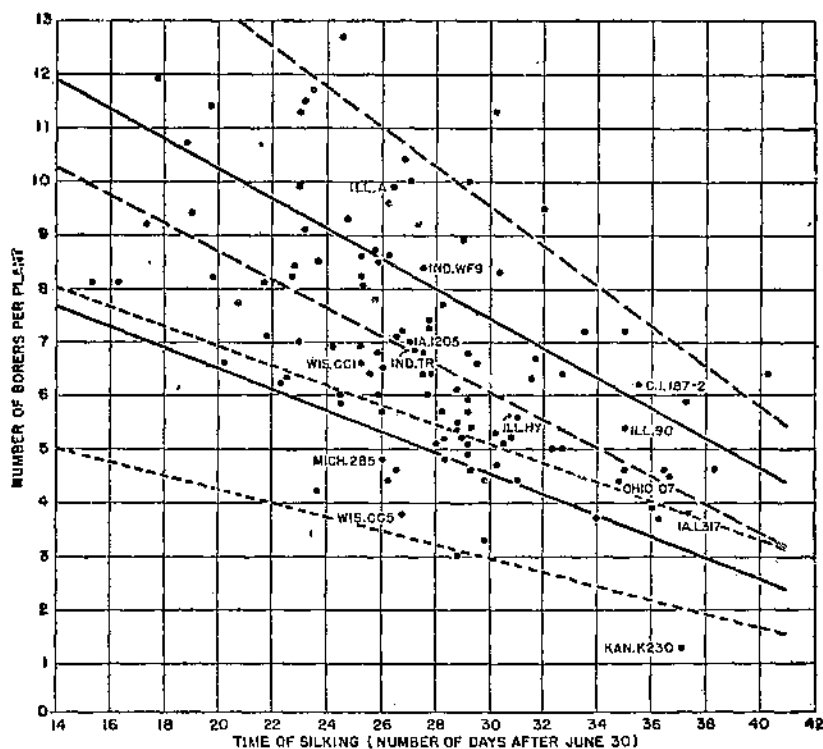


FIGURE 1.—Zones which on the average would include 95 percent of inbred lines of dent corn as resistant (within short-dash broken lines), as partially resistant (within unbroken lines), and as susceptible (within long-dash broken lines) to survival of first-generation larvae of the European corn borer as the average of the standard inbred lines used for comparison at Toledo, Ohio, 1939. The mean number of borers per plant in each inbred line tested in the experiment is plotted against the mean date of silking, but only standard borer-resistant inbred lines (Kan. K230, Wis. CC5, Mich. 285, Ia. L317, and Ohio 07), partially resistant lines (Ill. Hy, Ind. Tr, Wis. CC1, and Ia. 1205), and borer-susceptible lines (Ill. 90, Ind. WF9, C.I. 187-2, and Ill. A) are designated.

the plotted data of 95 percent of strains inherently as borer-resistant or susceptible as the average of the standards. Resistance values of such strains would not vary from the values read from the regression line more than on the basis of the variability from plot-to-plot within the strains, after removal of the variability due to the effect of replications. This within-strain variability, however, was found to increase with an increase in the mean number of borers in the strains. The amount of increase varied from year to year. In 1939, as described in a previous publication,⁴ the increase was proportional to

⁴ See footnote 3, p. 2.

the mean but in 1940 the increase was only half as much for about the same borer populations. It was necessary, therefore, to determine the relationship between the standard error of the mean and the mean for each experiment. Knowing this relationship, it was possible to determine the limits above and below each regression line as described above.

A graphic illustration of the resistant, partially resistant, and susceptible zones for the tests of inbred lines as such in 1939 is given in figure 1. The mean number of borers per plant in each inbred line is plotted against the mean date of silking. The designation of the inbred lines is given only for those used for standards. The regression lines have been omitted in figure 1.

Tests of inbred lines were conducted also in 1940 and 1941. Tests of inbred lines crossed on common parents were conducted from 1938 through 1941. In 1938 and 1939 the common parents were varieties and in 1940 each inbred line was crossed on inbreds Ill. A, Ill. Hy, and Ill. R4. The mean numbers of borers per plant in the A, Hy, and R4 hybrids in 1940 were 7.28, 5.85, and 4.20, respectively, showing that partially resistant inbred line Hy had about half the effect of resistant inbred line R4 in reducing the level of borers under the level in the borer-susceptible inbred A hybrids. The A hybrids silked 1.4 days earlier than the Hy and R4 hybrids. In 1941 each inbred line was tested on inbred lines Ill. Hy and Ill. R4 as the common parents. In an experiment where each inbred line was tested on more than one common parent, the data from the hybrids were averaged and considered as one test of the inbred line.

Zones were constructed and the data were plotted for each experiment. The strains were rated numerically from 0 to 10. Strains plotted below the resistant zones were rated 0 and those above the susceptible zone were rated 10. The strains in the lower third, middle third, and top third of the resistant zone were rated 1, 2, and 3, respectively. Similarly, the strains in the partially resistant zone were rated 4, 5, and 6, and those in the susceptible zone, 7, 8, and 9. In the case of overlapping zones the rating taken in one zone was averaged with the rating taken in the overlapping zone to obtain an estimate of the rating for the test. For example, if the lower third of the partially resistant zone carrying a rating of 4 overlapped the upper third of the resistant zone carrying a rating of 3, all strains within this area would be rated 3.5, the mean value of 4 and 3. The inbred lines are listed in table 2 with the average rating in the tests as inbred lines and the average rating in the tests as hybrids, in case more than one test was given.

In table 2 there are 37 inbred lines tested both as inbreds and as hybrids on common parents. Their average rating as inbreds is 4.64 and in hybrids is 4.35. The correlation of 0.588, calculated from the 37 pairs of data, is larger than 0.418, the value required for high significance. In general, in these comparisons the reaction of the inbred lines in hybrids on common parents agreed, within the limits of errors of sampling, with their behavior when tested as inbred lines. In addition to lines previously reported, lines Ind. P8, Kan. K230, Ia. L304A, and Mich. 285 in hybrid combination and lines Kan. K230, Kan. K226, Mich. 285, and Ill. 408 in tests of lines as such were most resistant; lines Ind. 38-11, Ia. Os420, Kan. K228, and Ohio 40B in hybrid combination and lines Ohio 07, Mich. 898, Mich. 393, and

Minn. A342 in tests of lines as such were partially resistant; and lines Ia. BL351 and Neb. BR1756 in hybrid combination and lines Ind. PS-7852, Ind. S3-16, Wis. 4412, and Ill. 5675 in tests of lines as such were the most susceptible when rated on the basis of more than 1 test in each case.

TABLE 2.—Rating of inbred lines of dent corn for inherent resistance, 0-3; partial resistance, 4-6; and susceptibility, 7-10, to the survival of larvae of the first generation of the European corn borer, Toledo, Ohio, 1938-41

[The letters I and C after the number of tests indicate that the inbred line was tested as such or in hybrid combination on common parents, respectively.]

State and pedigree	Tests	Rating	State and pedigree	Tests	Rating	State and pedigree	Tests	Rating
Colorado:	Number		Iowa—Con.	Number		Michigan—Con.	Number	
G 3	1-C	4	I 287	2-C	3.5	916	1-I	5
NI-23	1-C	9	I 289	1-C	3.5	927	1-I	8
Illinois:			I 292	1-C	5	1440	1-I	6
A	(2-I	8.5	L 304A	(1-I	5		1-C	3
	2-C	8.5		2-C	2	Minnesota:		
R4	(2-I	3.5	L 304B	(1-I	3	A 25	1-I	5
	2-C	3	L 317	2-I	5	A 27	1-I	5
Hy	(1-I	5		2-C	2	49	1-C	1
	1-C	5	BL 330	(1-I	3.5	50	1-C	6
NI-14	(2-I	6.5		2-C	4.5	A 321	1-I	4
	1-C	6	DL 351	2-C	8.5	A 334	2-I	3.5
90	(2-I	7.8	KB 385	1-C	4		2-I	3.3
	1-C	9	EB 397	1-C	4	A 340	1-C	3
220	1-I	4	MC 415	1-C	4	A 342	2-I	5
PR 364	1-C	4	Os 420	2-C	4.5	A 348	1-I	6.5
408	(2-I	2.5	Os 426	1-I	6	A 367	1-I	4
	1-C	3.5	WD 456	1-C	6		1-I	6.5
4212	1-I	3.5	St 637	2-C	5	A 374	1-C	6
4226	1-I	8		2-I	6.5	A 375	1-I	9
4451	1-I	3.5	RD 314	(2-I	3.3	A 385	1-I	4
5120	1-C	6.5		2-I	3.3	A 392	2-I	2.3
5075	2-I	9.5	RD 317	1-C	3.5		1-C	5
5076	(1-I	8	RD 319	1-C	5	Nebraska:		
	1-C	6.5	Wpl. 1031	1-C	6	K 1530B	1-C	5
5077	1-I	9	K 1146	1-I	5	K 1558	1-C	4
5680	1-C	6	K 1303	1-I	5	BR 1756	2-C	8
5708	1-C	4	K 1385	1-I	3.5	WR 1950B	1-C	8
6717	1-I	10	Kansas:			2103B	1-C	5
Indiana:			K YS	1-C	2	New Jersey:		
TR	2-I	5.8	K 4	1-C	1	A 12	1-I	10
B2	1-C	5	Daw. 7	1-C	7	A 30	1-I	10
CR 4-1	1-C	7	YS55	1-C	6.5	B-42	1-I	10
F-4	1-C	5	K 226	(2-I	2.8	A 47	1-I	10
D-7	1-I	6		4-C	3.6	A 61	1-I	10
P-8	(1-I	4	K 228	1-I	4	Ohio:		
	2-C	1.5		2-C	4.3	02	1-C	6
WF0	(2-I	7.8	K 230	(2-I	1.8	07	(2-I	4.6
	2-C	7		4-C	2		3-C	3
TE-14	1-I	6.5	Michigan:			07-10	1-I	5
LO 10-1	1-C	4	77	1-I	4		1-C	2
Lan. 10	1-C	4	105	2-I	3.8	14	1-C	9
33-16	2-I	9.5	185	2-I	7	17	1-C	6.5
38-11	(2-I	0.3	273	1-C	6.5	21	1-C	5
54-14	(2-C	4.3	285	(2-I	2	20	1-C	3.5
PS 55	1-C	6	331	2-C	2.8	28	1-C	3
60	1-I	2	303	1-C	6.5	28A	1-I	4
R-94	1-I	6.5	309	2-I	5		1-C	2
KD 104	2-C	2.8	307	1-C	6.5	33	2-C	2.5
461	1-I	4	330	1-I	6	40A	1-C	8
461-3	2-C	4.3	333	1-I	4	40B	2-C	5.5
PS 7852	2-I	9	334	1-I	6.5	51	1-C	5
Iowa:			337	1-I	2.5	51A	1-C	4
PR	2-C	5.5	338	1-I	9	56	1-C	5
I 153	1-C	3.5	339	1-I	6.5	01-07	1-I	4
I 189	2-C	4.3	305	1-I	4		1-C	2
I 189-L1	1-C	4	398	(2-I	4.3	65	1-C	5
I 205	2-C	5		1-C	6.5	67	2-C	3.5
I 219	1-C	6	901	1-I	10	67A	1-I	3.5
I 233	1-C	5	902	1-I	5		1-C	6.5
I 234	1-C	5	906	1-I	9	84	1-C	6.5
I 242	1-C	5	913	1-I	4	930	1-C	5
			915	1-I	6	908-317	1-C	4

TABLE 2.—Rating of inbred lines of dent corn for inherent resistance, 0-5; partial resistance, 4-6; and susceptibility, 7-10, to the survival of larvae of the first generation of the European corn borer, Toledo, Ohio, 1938-41—Continued

State and pedigree	Tests	Rating	State and pedigree	Tests	Rating	State and pedigree	Tests	Rating
Ohio—Con.	Number		Wisconsin—Con.	Number		Wisconsin—Con.	Number	
3028.....	2-C	4.5	2142.....	1-I	5	4308.....	12-I	3
3113.....	2-I	3.3	2145.....	1-I	9	4365.....	11-O	6
3519.....	2-O	5	2641.....	1-I	6.5	4391.....	1-I	3.5
U. S. Department of Agriculture:	1-I	9	2643.....	1-I	6	4412.....	1-I	3
O. I. 4-8.....	2-O	6	2646.....	1-I	0.5	4417.....	2-I	9
O. I. 187-2.....	2-O	8	2652.....	1-I	4	4470.....	1-I	5.5
O. I. 187-2.....	2-O	7.3	3911.....	1-I	6.5	4480.....	2-I	7.5
O. I. 540.....	2-I	3.5	3912.....	1-I	0.5	4481.....	1-I	8
West Virginia:	1-C	5	3917.....	1-I	5	4483.....	1-I	10
37-29.....	2-C	4.3	3920.....	2-I	3.5	4491.....	1-I	8
37-47.....	2-O	3.5	3922.....	1-I	3	4494.....	2-I	8.8
37-51.....	1-O	4	3945.....	1-O	5	4497.....	1-I	6.5
Wisconsin:			3970.....	2-I	6.3	4512.....	1-I	6.5
CC-1.....	2-I	4.5	4013.....	1-I	0.5	4515.....	1-I	6.6
CC-2.....	1-O	2	4014.....	2-I	3.5	4521.....	1-I	8
CC-3.....	1-C	9	4024.....	1-I	5	4532.....	1-I	5
CC-4.....	1-C	3.5	4076.....	1-I	6	4533.....	1-O	6.5
CC-5.....	3-I	1.7	4085.....	1-I	6	7222.....	1-C	4
CC-6.....	1-C	2.2	4087.....	1-I	8	7268.....	1-C	6
CC-7.....	1-C	8	4089.....	1-I	4	7275.....	1-C	6
CC-8.....	1-C	6.3	4125.....	1-I	5	7484.....	1-O	6
CC-9.....	1-C	2	4135.....	1-I	6	7700.....	1-O	5
CC-11.....	1-C	3.5	4137.....	1-I	4	9502.....	1-I	8.5
2035.....	1-I	8	4138.....	1-I	6	9503.....	1-I	6
2059.....	1-I	8	4170.....	1-I	3.5	9513.....	1-I	8
2071.....	1-I	6.5	4183.....	1-I	4	9523.....	1-I	6
2080.....	1-I	6.5	4185.....	1-I	5	9528.....	1-I	6
2097.....	1-I	9	4201.....	1-I	5	9535.....	1-I	6.5
2107.....	1-I	8	4205.....	1-I	5	9546.....	1-I	8
			4207.....	1-I	6.5	9561.....	1-I	8.5
			4215.....	1-I	6.5	9632.....	1-I	8
			4275.....	1-I	9	9730.....	1-I	9
						9765.....	1-I	9

NUMBERS OF BORERS SURVIVING IN INBRED LINES AND IN THEIR SINGLE-CROSS HYBRIDS

Four borer-resistant inbred lines, one partially resistant line, and four lines known to be susceptible to the survival of the corn borer were tested as inbred lines and in different single-cross combinations in an experiment conducted in 1941. Triplicated plots, 2- by 3-hills in size, isolated by unplanted rows, were planted on May 13. Three different lines occupied the three hills on one side of each plot and all possible single-cross combinations among them occupied hills on the other side of each plot. All plants were infested by hand on July 9 with 6 egg masses, or about 120 eggs per plant. Natural infestation was at such a low level that it was not considered to be a factor. The plant height on July 11, the date of silking, and the number of mature borers were recorded on a tag attached to each plant.

The regression of number of borers per plant on silking date was calculated for the inbred lines as a group. For each day later or earlier in silking than the mean date of silking of all lines, the number of borers per plant was reduced or increased 0.158 borer. The mean number of borers per plant in each line was corrected for the difference in silking on this basis. In a similar manner corrections were made for the hybrids using the data from them as a basis. The mean numbers of borers per plant for each single cross and their inbred parents are given in table 3.

Groups 1, 2, and 3 as shown in table 3, have resistant inbreds designated as the second parent, whereas resistant, partially resistant, and susceptible inbreds, respectively, are designated as the first parent. Groups 3, 4, and 5 have susceptible inbreds designated as the first parent, whereas resistant, partially resistant, and susceptible inbreds, respectively, are designated as the second parent. Averages of the number of borers per plant in the inbred parents and the single crosses produced from them of groups 1 and 3, of groups 2 and 4, and of groups 3 and 5 will, therefore, give the relative effect of resistant, partially resistant, and susceptible inbreds on borer survival. These three averages are 2.17, 2.85, and 3.28 borers per plant, respectively. If the partially resistant inbreds had had half the effect of the susceptible inbreds in raising the borer population above that in groups 1 and 3, the expected average for groups 2 and 4 would be 2.73 borers per plant, which is nearly equal to 2.85, the actual number.

TABLE 3.—Effect of single-cross hybrid dent corn on survival of larvae of the European corn borer when produced from different combinations of inbreds of known resistance (R), partial resistance (P), and susceptibility (S), Toledo, Ohio, 1941

First inbred parent		Second inbred parent		Single-cross hybrid			
Pedigree and reaction to borer	Borers per plant ¹	Pedigree and reaction to borer	Borers per plant ¹	Average borers per plant of inbreds ¹	Borers per plant ¹	Days earlier in silking than mean of inbreds	Inches taller than inbreds July 11
Group 1:	<i>Number</i>		<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>
Ill. R4 (R).....	1.9	Kan. K230 (R).....	1.9	1.99	0.66	8.8	19.6
Ill. R4 (R).....	2.6	Ill. L317 (R).....	4.1	3.30	1.32	10.3	16.3
Mean.....				2.60	.84		
Group 2:							
Ill. Hy. (P).....	4.9	Wis. CC5 (R).....	1.7	3.30	1.95	7.9	19.1
Ill. Hy. (P).....	3.8	Ill. R4 (R).....	2.9	3.35	.32	8.6	19.3
Ill. Hy. (P).....	4.4	do.....	2.6	3.45	1.14	10.3	16.0
Ill. Hy. (P).....	4.4	Ill. L317 (R).....	4.1	4.25	1.16	10.0	20.0
Mean.....				3.59	1.14		
Group 3:							
Ill. A (S).....	4.9	Wis. CC5 (R).....	1.7	3.30	2.06	4.6	19.8
Ill. A (S).....	4.5	Ill. R4 (R).....	2.4	3.45	2.30	7.0	19.9
Wis. 4412 (S).....	4.0	do.....	2.4	3.20	2.14	6.2	13.8
Wis. 3945 (S).....	4.0	do.....	2.9	3.75	.83	6.5	10.3
Ill. A (S).....	4.5	do.....	1.9	3.20	1.91	7.0	11.6
Ill. A (S).....	4.5	Kan. K230 (R).....	1.9	3.20	1.55	11.7	20.7
Mean.....				3.35	1.80		
Group 4:							
Ill. 90 (S).....	5.6	Ill. Hy. (P).....	2.3	3.95	3.07	2.1	16.6
Ill. A (S).....	5.5	do.....	2.3	3.90	2.77	.7	18.5
Ill. A (S).....	4.9	do.....	4.9	4.99	2.33	5.1	20.1
Wis. 3945 (S).....	4.6	do.....	3.8	4.20	1.45	4.4	16.3
Mean.....				4.24	2.41		
Group 5:							
Ill. 90 (S).....	5.6	Ill. A (S).....	5.5	5.55	2.93	7.1	15.4
Wis. 4412 (S).....	4.0	do.....	4.5	4.25	3.20	7.6	15.5
Mean.....				4.90	3.07		

¹ Borer population after adjustment for differences in maturity of corn strains.

On the basis of these results the corrected mean numbers of borers in each pair of inbreds and in their hybrids were plotted against the number of the group in which they occurred and regression lines were

fitted to the two sets of plotted data. The regression lines were nearly parallel, indicating a nearly constant difference in borer population between the inbreds and their hybrids. On the basis of the regression coefficients, which were more than four times their standard error, or highly significant in each case, and of accompanying averages of the dependent and independent variables, estimates were made of the mean number of borers in the inbreds and their hybrids in each group. The estimates of the mean number of borers per plant in the inbred parents and in their hybrids, respectively, are as follows: Resistant \times resistant, 2.71 and 0.70; resistant \times partially resistant, 3.20 and 1.27; resistant \times susceptible, 3.69 and 1.83; partially resistant \times susceptible, 4.18 and 2.40; and susceptible \times susceptible, 4.67 and 2.96. The hybrids averaged 1.86 fewer borers per plant than the inbreds involved. This difference ranged from 2.01 borers, when two resistant inbreds were used, to 1.71 borers per plant, when two susceptible inbreds were used; but these differences are not significantly different from the average of 1.86 borers.

The smaller numbers of borers in the hybrids than in the inbreds used to produce them occurred in spite of the fact that the hybrids averaged 7.1 days earlier in silking than their inbreds. The hybrids, also, averaged 16.1 inches taller than their inbred parents on July 11. As indicated in the discussion of table 1, within lots of inbreds and within lots of hybrids the earlier silking strains on the average have had the most borers. The larger number of borers in the inbreds, which as a group silked later than their hybrids, indicates that this relationship does not apply when comparison is made of inbreds with their hybrids (table 3). On the basis of only 1 year's work a discussion as to the possible factors involved is not warranted.

DEGREE OF BORER RESISTANCE IN COMMERCIAL HYBRIDS

Six commercial double-cross hybrids were included in the tests of hybrids in 1940, 1941, and 1942, with the purpose of determining the degree of resistance to survival of the first-generation borers possessed by some of the most widely planted Corn Belt hybrids compared with that of some of the most borer-resistant and susceptible single-cross experimental hybrids. Hybrids Ind. 613D and Ind. 425 were included as two of the most widely grown hybrids in Indiana in 1939, Ia. 939 and U.S. 44 as two hybrids grown in Ohio, and U.S. 13 and Wis. 696 were included as representing Illinois and Wisconsin, respectively. As standards for comparison, resistant inbred lines Kan. K230, Mich. 285, Ia. L317, Ohio 07, and Wis. CC5, crossed on resistant inbred line Ill. R4, were included each year. At the other extreme seven susceptible inbred lines crossed on susceptible Ill. A were used in 1940 and three single crosses involving inbred lines Ill. A, Ill. 90, C.I. 187-2, and Ind. WF9 were tested in 1941 and 1942.

The mean number of borers per plant in each hybrid and the mean of each hybrid group are given in table 4. The rating of the hybrids given in table 4 were obtained from table 2 by averaging the ratings of their component inbreds when tested as inbreds. In five cases, in the absence of tests of inbreds as such, it was necessary to use the rating of the inbred when used in hybrid combination.

As may be noted from table 4, the group mean number of borers per plant of the resistant hybrids is 1.97, as compared with 4.13 and 5.45 in the commercial and susceptible hybrids, respectively. Since the difference in silking between the groups was only 1 day, a correction of these means for stage of plant maturity was not deemed necessary. Thus there was about half as much borer resistance in the commercial as in the resistant hybrids. From table 4 the average ratings for borer resistance of the resistant, commercial, and susceptible hybrid groups are 3.3, 5.6, and 8.4, respectively. The group of commercial hybrids, therefore, both actually and from prediction, was about half as borer-resistant as the resistant group.

TABLE 4.—Comparison of numbers of mature larvae of the European corn borer resulting from given numbers of first-generation eggs in commercial hybrid dent corn with the numbers in groups of hybrids of known resistance and susceptibility to borer survival, Toledo, Ohio, 1940 and 1941, and Lafayette, Ind., 1942

Pedigree	Rating for borer resistance	Borers per plant			
		1940	1941	1942	Mean
Resistant group:¹		<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>
Kan. K230 × Ill. R4.....	5.7	2.72	1.70	0.75	
Mich. 285 × Ill. R4.....	2.8	3.10	1.83	0.50	
Ia. L317 × Ill. R4.....	4.3	3.48	1.15	1.19	
Ohio 97 × Ill. R4.....	4.0	4.00	1.54	0.94	
Wis. OOs × Ill. R4.....	2.6	3.20	1.91	1.44	
Mean.....	3.3	3.30	1.65	0.90	1.97
Commercial group:¹					
U. S. 13 (Wf9 × 35-11) (Hy × L317).....	6.0	5.50	2.92	1.44	
Ia. 939 (Os 420 × Os 426) (1280 × 1205).....	4.5	6.28	3.40	2.19	
Wis. 696 (OC5 × OC7) (Wf9 × Hy).....	5.2	7.54	3.33	1.88	
U. S. 44 (4-S × 187-2) (Hy × 540).....	5.6	6.80	3.41	2.60	
Ind. 425 (A × 90) (Wf9 × Hy).....	7.3	6.60	5.00	1.33	
Ind. 613D (Wf9 × Hy) (Ind. 65 × Tr.).....	6.2	7.70	4.20	2.12	
Mean.....	5.6	6.74	3.73	1.93	4.13
Susceptible group:¹					
Ind. 35-16 × Ill. A.....	9.0	5.36			
Ill. 6675 × Ill. A.....	9.0	6.70			
Ind. 7832 × Ill. A.....	8.8	7.04			
Wis. 4450 × Ill. A.....	8.0	8.90			
Wis. 4194 × Ill. A.....	7.7	6.10			
Wis. 3045 × Ill. A.....	8.5	9.62			
Wis. 4412 × Ill. A.....	8.8	10.18			
C. I. 187-2 × Ill. A.....	8.3		4.05	8.18	
Ill. 90 × A.....	8.2		5.58	2.91	
C. I. 187-2 × Ind. Wf9.....	7.9		4.95	4.00	
Mean.....	8.4	8.13	4.86	3.37	5.45

¹ As an average of the 3 years the resistant, commercial, and susceptible groups siled 25.6, 24.6, and 24.6 days, respectively, after June 30.

END