THE RELATION OF EAR ROT PREVALENCE IN ILLINOIS CORN FIELDS TO EAR COVERAGE BY HUSKS

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In the fall of 1930, while examining Illinois corn fields to determine the prevalence of disease, casual observation seemed to indicate to the writer that ears poorly covered by husks were much more readily infected by rot-producing fungi than those that were well covered. In the main, ear rots are caused by fungi, the spores of which are carried directly to the ears by various agencies, chiefly the wind, although some infection results from the fungi which grow from the stalk into the ear. An ear completely enclosed by its husks during the entire course of its development would appear to have been protected from external infection, while an ear not completely covered would appear to have been exposed to external infection. Yet ears poorly covered often escape infection and many well covered ears become infected.

It seemed worthwhile, therefore, to determine whether any relation does exist between husk coverage of the corn ear and the prevalence of ear rots in Illinois corn fields. Data bearing on this point have been accumulated by direct field examination during the 5-year period, 1931-1935, and a total of 57,395 ears have been examined in 297 fields. Corn fields have been examined each year in all parts of the state, except in 1931, when only fields in the central part were examined. The number of fields and the number of ears examined have varied from year to year, as shown in Table 1, but in general both the number of fields and the number of ears examined tended to be greater in each succeeding year. Records for the entire period show

that fields were examined in 69 of the 102 counties in the State.

DEFINITION OF TERMS

Throughout this discussion "covered" and "well covered" are to be understood as signifying that ears so classed were covered completely by husks, including the tips, and that the husks remained tightly closed until near harvesting. For the first 2 years, 1931 and 1932, these terms apply rigidly to ears observed to be completely and tightly covered by husks when the fields were examined. "Open," "not covered," and "not well covered" signify that ears so classed were not completely covered, but no distinctions have been made relative to the degree of partial coverage and none is implied by the various terms used.

Since the data are concerned with visually discernible ear rots, "ears with visible infection" and "ears without visible infection" constitute the 2 classes into which corn ears were assorted upon examination. Ears were considered to be rot-free if, at the time of examination, no visible mold or fungus sporulation appeared on or between the kernels or on the cob. Naturally, no account could be taken of the hidden infections which require the use of a germinator for determination.

RELATIVE ABUNDANCE OF COVERED AND OPEN EARS

Since most of the corn seed used in Illinois is produced by open pollination and is genetically heterozygous, it might be expected that covered and open ears would be found to occur in approximately equal numbers. However, an increasing number of farmers are practicing field seed selection, and, since this involves the choice of covered in preference to open ears, the expected ratio may not be secured. It is commonly believed, also, that weather and other conditions tend to influence ear length and size, thereby determining whether the ears will be covered or not by the supposedly uniform husks.

In Illinois corn fields, as shown in Table 1, below, the number of open ears exceeds considerably the number of closed ears, in spite of the practice of selection and of any expected equality based on the genetic constitution of the crop. Over a

Table 1.-- Relative abundance of covered and open ears in Illinois corn fields, 1931-1935.

Year	Fields exam.	Ears exam.	Number of ears		Percent of ears	
			Open	Covered	Open	Covered
1931	26	7,800	5,314	2,486	68.1	31.9
1932	52	7,605	5,341	2,264	70.2	29.8
1933	51	9,300	5,300	4,000	57.0	43.0
1934	71	13,660	7,693	5,967	56.3	43.7
1935	78	15,880	8,424	7,456	53.0	47.0
Total	278	54,245				
Average					60.9	39.1

period of years, the average ratio of open to closed ears is almost exactly 3 to 2, and, although the ratio varies somewhat from year to year, the number of open ears exceeds the number of closed ears every year.

In a given year, considerable variation occurs in the relative number of open and closed ears in different fields, even in the same county. In Hancock County, for example, 2 fields examined in 1932 gave a ratio of open to covered ears of 4 to 1 and 2 to 3, and in Jasper County 2 fields gave ratios of 1 to 3 and 1 to 2. In 1934 and 1935, there was a larger average proportion of covered than of open ears in 5 fields in Piatt County, the ratio being 5 covered to 3 open ears, and in Edwards County in the same 2 years a ratio of 1.25 covered to 1 open was obtained.

Whenever the variety of corn in a field could be recognized, it was noted as a part of the data, and such records are combined in Table 2. Although the number of fields examined of each variety is small, a somewhat greater prevalence of covered ears is indicated for the Bloody Butcher, Calico, and Democrat varieties, while open ears predominate in the Krugg variety.

Table 2.-- Prevalence of open and covered ears in some corn varieties.

Variety	Fields exam.	Ears exam.	Number of ears Open	Number of ears Covered	Ratio of open to covered ears
Bloody Butcher	2	200	64	136	1 : 2.1
Calico	4	700	322	378	1 : 1.2
Democrat	12	2,000	764	1,236	1 : 1.6
Krugg	2	502	325	177	1.8 : 1

FIELD PREVALENCE OF CORN EAR ROT

The presence of ear rot was determined in the field by pulling back the husks of each ear and examining it for the presence of fungus growth or sporulation, without removing the ear from the stalk. Ears that showed superficial characters of disease but no visible mold growth, as in Basisporium and some Diplodia infections, were broken to determine whether any mycelium, spores, or fungus fruiting bodies were present and were counted as rot-infected when these were found. Data were taken on this basis, which is designed to show the total field prevalence of ear rot regard-

Table 3.-- Prevalence of ear rot in Illinois corn fields, 1932-1935.

Year	Fields exam.	Ears exam.	Number of ears Rotted	Number of ears Not rotted	Percent of ears Rotted	Percent of ears Not rotted
1932	48	7,005	3,911	3,094	55.8	44.2
1933	51	9,300	4,183	5,117	45.0	55.0
1934	71	13,660	12,359	1,301	90.5	9.5
1935	78	15,880	4,462	11,418	28.1	71.9
Total	248	45,845				
Average					54.8	45.2

less of particular causes, only during the 4 years, 1932-1935. A summary of them is presented above in Table 3.

Table 2.--- Prevalence of open and covered ears in some corn varieties.

Variety	Plots exam.	Ears exam.	Number of ears: Open	Covered	Ratio of open to covered ears
Bloody Butcher	2	800	64	136	1 : 2.1
Calico	4	700	322	378	1 : 1.2
Democrat	12	2,000	764	1,236	1 : 1.6
Cruse	2	602	328	177	1.8 : 1

Ear rot varied in prevalence from year to year, within wide limits, being least abundant in 1935, when 28.1 percent of the ears examined were infected, and most abundant in 1934, when 90.5 percent were infected. While various factors may have been concerned in these annual variations, as for example in 1934 when ear rot was undoubtedly greatly favored by prior damage done by corn ear worms, the significance of the ear rot problem in corn production is emphasized by the fact that of over 45,800 ears examined over a period of 4 years an average of almost 55 percent were visibly infected with one or another kind of rot.

RELATION OF EAR ROT PREVALENCE TO HUSK COVERAGE

Data on the relation of ear rot, without reference to particular causes, and husk coverage have been taken over a period of 3 years, 1933-1935, and are summarized in Tables 4 and 5. Among those ears not completely covered by husks ear rot prevailed, as shown in Table 4, to a high degree in 1933 and to an especially high degree in 1934, when the percentage of rot-infected ears exceeded the uninfected ears by nearly 85 percent; but in 1935 the rotted ears, while still constituting nearly a

Table 4.-- Prevalence of ear rot in corn ears not completely covered by husks, 1933-1935.

Year	Open ears examined	Number of ears		Percent of ears	
		Rotted	Not rotted	Rotted	Not rotted
1933	5,300	2,801	2,499	52.9	47.1
1934	7,693	7,101	592	92.3	7.7
1935	8,424	2,686	5,738	31.9	68.1
Average				59.0	41.0

third of the entire number, were less abundant than sound ears. In spite of these fluctuations, the average percentages for the 3 recorded years indicate a strong tendency for open ears to become infected more frequently than covered ears.

Among those ears completely covered by husks, ear rot prevailed to a high degree also, as indicated in Table 5, but the percentage of rotted ears was less than

the percentage of clean ears in both 1933 and 1935, while in 1934 the proportion of rotted ears greatly exceeded the proportion of clean ears. The average percentages

Table 5.-- Prevalence of ear rot in corn ears completely covered by husks, 1933-1935.

Year	Closed ears examined	Number of ears		Percent of ears	
		Rotted	Not rotted	Rotted	Not rotted
1933	4,000	1,382	2,618	34.6	65.4
1934	5,967	5,258	709	88.1	11.9
1935	7,456	1,776	5,680	23.8	76.2
Average				48.8	51.2

for the 3 years indicate that, among covered ears, there is a distinct tendency for clean ears to predominate.

Of more significance, however, is the direct comparison given in Figure 1 of the percentages recorded in Tables 4 and 5. In each of the 3 years, regardless of

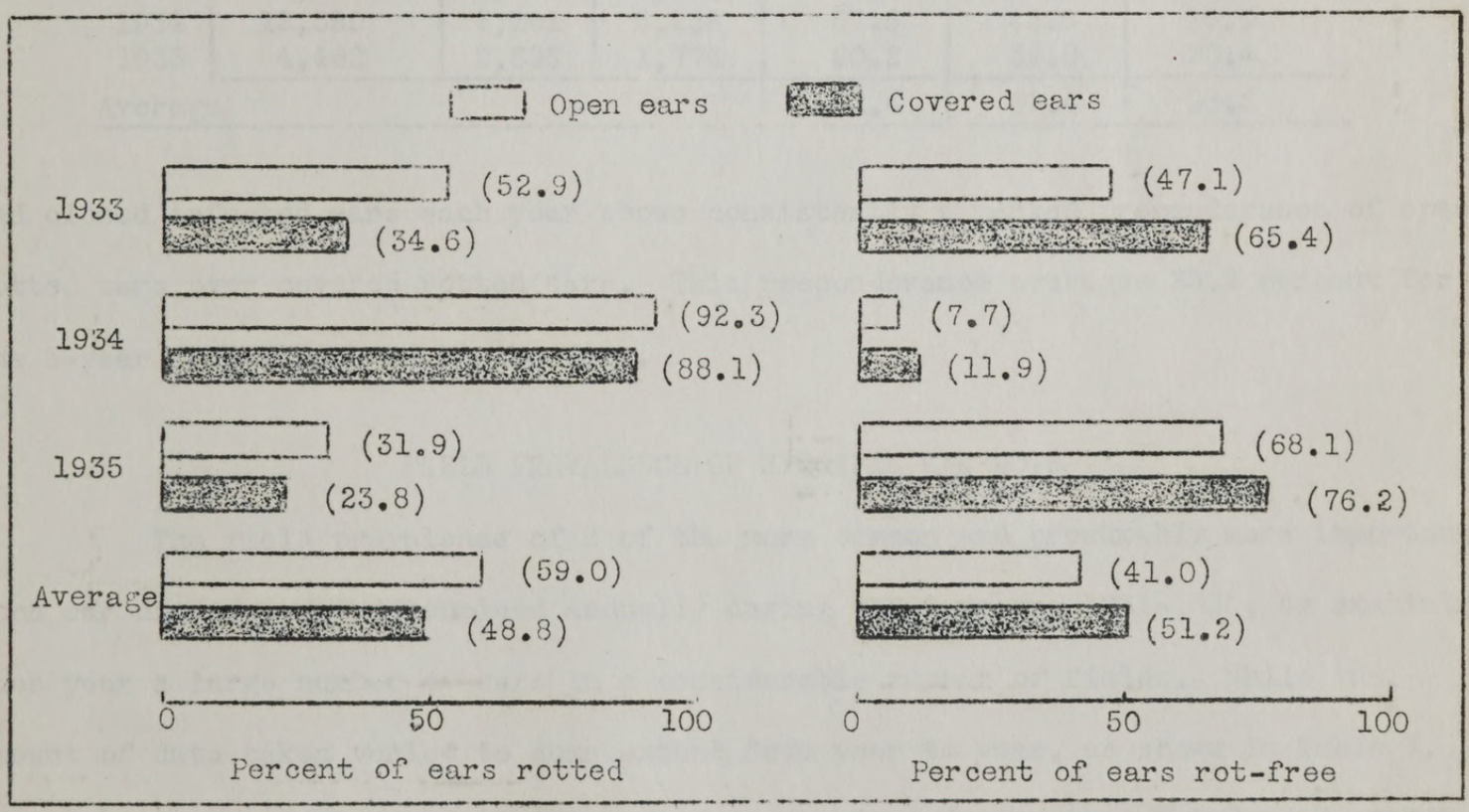

Fig. 1.-- Prevalence and absence of ear rot in open and covered corn ears, 1933-35.