

Effect of Seed Coat Injury on Germination, Vigor, and Yield of Corn

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Within the last twenty years, it has been determined by experiments conducted by a number of investigators that by selecting a corn type somewhat smoother in indentation of kernel and with a higher proportion of horny endosperm than the prevailing types, improvement could be made in field stand and vigor of plants, as well as in yield and quality of grain produced. There seems to be general agreement that a relatively horny endosperm is an important factor in increasing resistance to certain ear rots and checking some important seedling diseases. There remains a question in the minds of many, however, as to whether the type of kernel indentation has anything to do with the matter.

Corn ears that feel rough to the hand have the seed coats of the kernels puckered into sharp ridges at the crowns. These ridges are frail, and in ordinary handling of the ears, the seed coat becomes broken on many kernels. In fully matured smooth types of corn, seed coat injury from reasonable handling does not take place at all.

In an investigation of this subject, data were collected on seed coat injury in the seed planted by a group of 200 Illinois farmers. These samples had been collected at random for another purpose at corn planting time. As an average of all 200 samples, 9.7 per cent of the kernels had the seed coat broken at the crown. The 10 samples with most injury averaged 26.4 per cent breakage, while the 10 best samples averaged only 0.6 per cent.

Previous experiments on the effect of seed coat injury in corn used for seed were few in number, and the results were not all in agreement. Certain experiments were therefore organized by the writer to obtain better information on the effect of seed coat injury in planted seed on the resulting crop.

A considerable number of ears of corn were used in the tests conducted for two years. The kernels were counted so that each ear was represented equally in each plot. Some of the kernels from each ear were injured. Injuries included shaving off the whole crown surface, removing one-fourth of the crown surface, puncturing the seed coat at the crown with a sharp awl, removing a little of the seed coat from the side where only horny endosperm was exposed, and removing the tip cap where the kernel is attached to the cob, thus exposing the dark tissue which covers the germ, but not exposing the germ itself. The remaining kernels from each ear were used as an uninjured check. Forty hills, planted three kernels per hill, constituted a plot, and there were nine replications in each experiment. Growing conditions in both seasons were unusual. In 1933 the soil was exceptionally wet at planting time, but became excessively dry during the summer. In 1934 the soil was barely damp enough for germination at planting time and drought continued until mid-summer. One would expect seed coat injury to be a factor primarily in the seedling stage. Although moisture conditions at planting time were very different in the two years, the results were similar (Table 1).

Seed coat injury at the crown of the kernels caused a significant reduction in yield in each case, even though the seed coat was only punctured. The reduction in yield was brought about by a reduction in stand and also a reduction in the vigor of the growing plants. Where the seed coat was removed from the whole crown, the reduction in stand, resulting from this injury, was 8.6 per cent, the reduction in height of plants when the plants were about waist high was 5.9 per cent, and the average reduction in yield of grain at harvest time was 20.7 per cent.

When the seed coat was removed from a small area on the sides of the kernels where only horny endosperm was exposed, the plants seemed to grow normally. No significant reduction in stand or yield was found. Removal of the tip cap may possibly have had a slight detrimental effect on the crop grown from kernels treated in such manner, but these tests so far have not settled this point, for the reductions found were not statistically significant.

The above results were obtained by planting unsterilized kernels in ordinary dark corn-belt soil in a rotation growing corn twice in every four years. In the same tests some of the seed was disinfected with ethyl mercury phosphate. This is a dry dust that stays on the surface of the kernels and protects the kernels at least to some extent from infection in the soil. Seed with injured seed coats treated with this disinfectant gave results nearly equal to those from uninjured seed (Table 1).

TABLE 1—EFFECT OF SEED COAT INJURY ON THE YIELD OF DENT CORN
Illinois Agricultural Experiment Station, Urbana.

Nature of seed coat injury	1933		1934	
	Acre yield	Reduction in yield from injury	Acre yield	Reduction in yield from injury
Seed Not Disinfected				
	<i>Bushel</i>	<i>Per cent</i>	<i>Bushel</i>	<i>Per cent</i>
None.....	50.8	-----	49.4	-----
Whole crown removed.....	39.0	23.2*	40.4	18.2*
One-fourth crown removed.....	46.5	8.5*	41.0	17.0*
Crown punctured.....	44.5	12.4*	41.5	16.0*
Tip cap broken off.....	48.8	3.9	48.5	1.8
Cut in side of kernel.....	-----	-----	48.9	1.0
Seed Disinfected With Ethyl Mercury Phosphate				
None.....	50.5	0.6	48.2	2.4
Whole crown removed.....	50.0	1.6	49.2	0.4
One-fourth crown removed.....	47.8	0.0	48.0	1.0

* Odds of probability greater than 30 to 1 that the reduction is significant.

The soil is inhabited by a great number of microorganisms and the nature of this population is influenced by many factors. Therefore, it would not be surprising if the results obtained from planting crown-injured corn at different times and places might give various results. Fungus isolations were made from the internal tissues of injured kernels several weeks after planting. Various *Penicillia* were especially abundant in these isolations, and frequently *Penicillium oxalicum* was recognized. Inoculations were made on injured seed with pure cultures of a number of fungi just before the seed was planted. These inoculation tests were made in the greenhouse and also in the field. *Penicillium oxalicum* caused very severe stunting and seedling

blight, regardless of whether the inoculated corn kernels were planted in wet, intermediate, or dry soil. Other *Penicillia* investigated so far were nearly harmless. *Aspergillus flavus* and *Aspergillus tamaris* gave a striking effect, except in dry soil, in that they produced virescent plants (plants partly white or cream color). *Gibberella saubinetii*, on the other hand, caused severe stunting and seedling blight only in dry soil. From results so far obtained in these tests, it seems logical to conclude that *Penicillium oxalicum* is an important cause of the harmful effects observed from planting corn with the seed coat injured at the crown, but it is likely that some other organisms may also be of importance.

Conclusions.—Rough-eared seed corn is easily injured in handling, and kernels having seed coats injured at the crown, when planted, are much more severely injured by a number of fungi than kernels with sound seed coats. This, no doubt, was one of the important factors involved when in earlier work it was found that the field performance from rough ears was not usually so good as from smoother ears. With the development of good corn-seed disinfectants in recent years, the harmful effects from seed coat injury can largely be eliminated.