

1920

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R. A. Rudnick
Iowa State College

A. L. Bakke
Iowa State College

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Recommended Citation

Rudnick, R. A. and Bakke, A. L. (1920) "The Mechanical Penetration of the Sweet Corn Pericarp," *Proceedings of the Iowa Academy of Science*, 27(1), 129-132.

Available at: <https://scholarworks.uni.edu/pias/vol27/iss1/16>

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THE MECHANICAL PENETRATION OF THE SWEET CORN PERICARP

BY R. A. RUDNICK AND A. L. BAKKE

Hawkins and Harvey,¹ Rosenbaum and Sando,² and Hawkins and Sando³ have used a modified Joly balance fitted with a puncturing needle to determine the force necessary to puncture the cells of the potato tuber, tomato, and certain smaller fruits. For the penetration of these tissues a relatively small force is necessary.

However, it occurred to the authors that a similar mechanical penetrating device might be of service in determining the relative puncturing force of the pericarp of sweet corn. Inasmuch as the pericarp of the sweet corn is tough, it became necessary to employ a device where a greater pressure could be obtained than in the usual form of Joly balance.

For this work then, the pulley and stand of a Ganong auxanometer apparatus was fitted with scale pans of a chemical balance by means of braided linen cord of sufficient length to give a free uniform movement. To one of the stirrup hooks was attached firmly a glass needle having a diameter of 0.5 mm., this dimension being obtained by grinding a needle slightly larger with emery. The features described are apparent on examination of figure 26.

The portion of the pericarp used was the part back of the germ taken as far back from the tip as was possible. This layer was glued to a cork having a hole bored through it. Later a small piece of glass tubing having a diameter of 3.5 mm. was securely sealed with sealing wax. The matter of fastening each membrane to a cork naturally consumed considerable time as a new cork would have to be used for each test. To obviate this, the pericarp layer was placed between two pieces of glass tubing which had had their edges ground so that they would fit. This jointed

¹ Hawkins, L. A., and Harvey, R. B. Physiological study of the parasitism of *Pythium debaryanum* Hesse on the potato tuber. Jour. Agr. Research, vol. 18, pp. 275-297. 1919.

² Rosenbaum, J., and Sando, C. E. Correlation between size of the fruit and the resistance of the tomato skin to puncture and its relation to infection with *Macrosporium tomato* Cooke. Amer. Jour. Bot., vol. 7, pp. 78-82. 1920.

³ Hawkins, Lon A., and Sando, Charles E. Effect of temperature on the resistance to wounding of certain small fruits and cherries. U. S. Dept. Agr. Bull. 830. 1920.

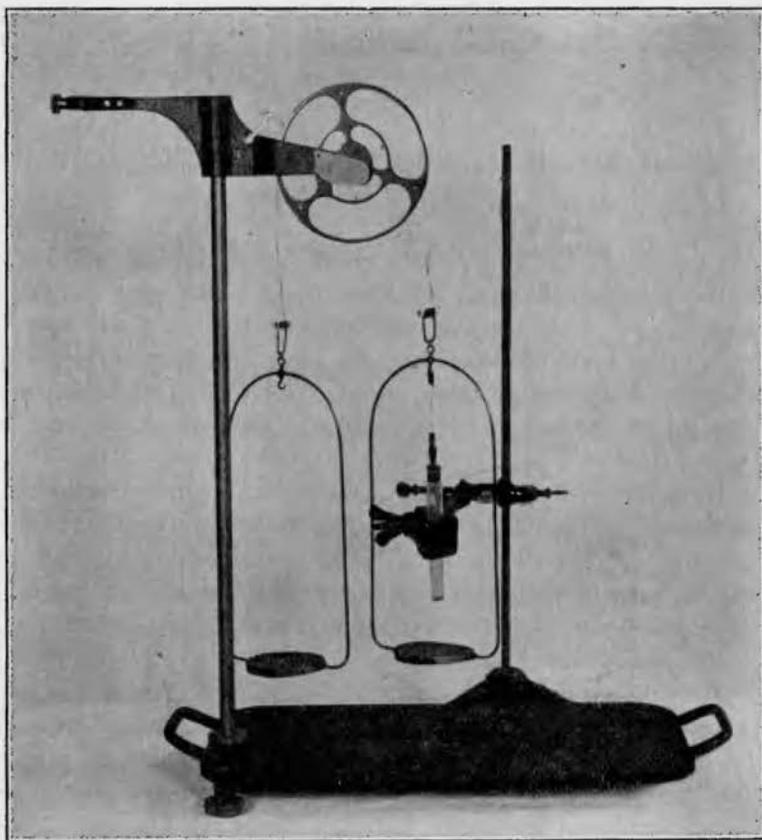


Fig. 26. Machine to determine the force necessary to puncture the pericarp of sweet corn.

glass tube was inserted into a cork and it in turn was securely placed in a vial supported by a clamp attached to a support. By such an arrangement it became an easy matter to centralize the pressure exerted by the glass needle. Weights were then added until the pericarp layer was punctured. The pans used plus the friction of the attached corn represented a weight of 32 grams.

The variety of sweet corn used was the well known Stowell's Evergreen. The corn came originally from Connecticut but had been grown in Iowa, for varying periods, one, two and three years. The corn was carefully selected from the plots so that the three stages, canning, dented and mature were typical for such designation. The number of grams necessary to cause penetration of the first series, that which has been grown in Iowa

for one year, is given in the first column of Table I. The effect of soaking the seed for varying periods at room temperature upon the physical penetration was also a part of the proposition and is shown in the remaining columns. In practically every case there were at least four readings taken. In the data only the averages are given.

TABLE I. DATA SHOWING THE NUMBER OF GRAMS NECESSARY TO PENETRATE THE PERICARP OF "STOWELL'S EVER-GREEN" SWEET CORN WHEN DRY AND WHEN SOAKED FOR VARYING PERIODS. THE CORN HAD BEEN GROWN IN IOWA FOR ONE YEAR (1919)

	DRY	8 HRS.	12 HRS.	24 HRS.	36 HRS.	48 HRS.	72 HRS.
Canning stage..	103.75	88	121	93.5	93.6	89	70.8
Dented.....	111.75	89.5	93	90.2	92.6	90.25	107.7
Mature.....	134	80.3	83	72.7	54	53.8	51.2

In the canning stage the number of grams necessary for the penetration is a little less than for the dented and consequently smaller than for the mature. On soaking the penetration force of the pericarp of the mature fruit is much less than in the corn selected at the canning period. This same relation is also apparent when comparing the mature and dented kernels.

TABLE II. DATA SHOWING THE NUMBER OF GRAMS NECESSARY TO PENETRATE THE PERICARP OF "STOWELL'S EVER-GREEN" SWEET CORN WHEN DRY, AND WHEN SOAKED FOR VARYING PERIODS. THE CORN HAD BEEN GROWN IN IOWA FOR TWO YEARS (1918 AND 1919)

	DRY	8 HRS.	12 HRS.	24 HRS.	36 HRS.	48 HRS.	72 HRS.
Canning stage..	92	82.3	121	97.8	69.4	98.2	68.2
Dented.....	121.5	93.5	93	95.7	70.5	65.4	89
Mature.....	172.75	85	94	90.2	64.75	67.6	87.2

In the same variety of sweet corn grown in Iowa for two years the pericarp when dry is punctured by 92 grams, as compared with 103.75 grams at the canning stage; the dented requires 121.5 and the mature, 172.75 grams. There is a wide difference between the three stages of development. Soaking the seed for varying periods from 8 to 72 hours gives results that are somewhat diversified.

In Table III, the differences in the penetration force between the different stages — canning, dented, and mature — is practically as well marked as in the previous citations. Soaking the

TABLE III. DATA SHOWING THE NUMBER OF GRAMS NECESSARY TO PENETRATE THE PERICARP OF "STOWELL'S EVERGREEN" SWEET CORN WHEN DRY AND WHEN SOAKED FOR VARYING PERIODS. THE CORN HAD BEEN GROWN IN IOWA FOR SEVERAL YEARS

	DRY	8 HRS.	12 HRS.	24 HRS.	36 HRS.	48 HRS.	72 HRS.
Canning stage..	116.7	75	89.25	73.5	64.7	72.7	63.2
Dented.....	119.5	83	92.75	94.2	71.8	57.4	58.5
Mature.....	147.5	74	82.75	99.2	58.7	80.2	65.8

kernels for different periods gives results that are at variance with each other.

Considering the dry pericarp itself it is evident that there is much variation throughout. Knowing that plant tissues are modified considerably by the environmental conditions which affect the plant, it is only natural to expect variations in the three sets. The weather conditions of 1918 and 1919 were much different, the former being characterized by periods of very intense evaporation. The present study does not concern itself with the evaporating power of the air and its effect upon the balance between the forces of transpiration and absorption. The province of this publication is simply to show how the proposed mechanical device can serve as a measure of the toughness or mechanical resistance of the pericarp layer.

Recognizing the fact that the data herewith submitted are meager yet the following conclusions are fully substantiated:

(1) There is a considerable variation in the force necessary to penetrate the pericarp of sweet corn in the canning, dented and mature states:— the more mature requires the greater force.

(2) Soaking sweet corn seed for varying periods from 8 to 72 hours does not give a commensurate reduction in the force necessary to penetrate the pericarp.

DEPARTMENT OF BOTANY,
IOWA STATE COLLEGE.