Report 7214

AN EVALUATION OF THE PUNCTURE TEST AS A METHOD FOR FIELD SELECTION OF SWEET CORN FOR PROCESSING AT OPTIMUM MATURITY.

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Contents

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1.0 INTRODUCTION

The determination of the optimum maturity of sweet corn is critical in the economic production of sweet corn for processing as whole kernel or cream style. A number of workers have investigated several techniques which are summarized below in chronological order.

Rudnick and Bakke 1920 - 0.5 mm needle to puncture portion of skin - force increases with maturity.

Culpepper and Magoon 1924-portable puncture tester (No. 16 wire) 30 - 40 Kernels/ear 3 to 5 ears. Force increases with maturity.

Gaessler et. al. 1940 - quantity of pericarp.

Kramer 1946 - Succulometer - quantity of juice pressed out.

Gangstand and Snell 1948 - puncture test to prove that product of dry weight and days after pollenation a useful index.

Williams et. al. 1950 - moisture content determined by calcium carbide.

Twigg et. al. 1956. AIS, % pericarp and kernel size combined into one index.

Kornetsky and Kramer 1957. Succulometer - index of Twigg et. al. (1956).

Voisey and Nuttall 1965. Puncture vs. sensory. Puncture force different for each of 14 varieties tested.

Wolf et. al. 1969. Measured pericarp thickness.

Helm and Zuber 1969. Measured pericarp thickness.

Helm et. al. 1970. Pericarp thickness.

Helm and Zuber 1970. Pericarp thickness.

Hammele et. al. 1971. Rheological properties of pericarp.

Khalil and Kramer. 1971. Histology and puncture tests - pericarp toughens with maturity and requires more energy to puncture.

A quick, portable, objective, field test of maturity is required to assist the fieldmen in making decisions about harvest dates. The research noted above indicates that as the crop matures, the pericarp toughens, and its resistance to puncture increases. The puncture test is simple to execute, and inexpensive instruments can be designed for the purpose. Also, if a critical characteristic of the crop is mechanical, then direct mechanical measurement should, in theory, give the most accurate result.

To obtain a preliminary assessment of the potential of the puncture test for this purpose, experiments were conducted at a processing plant to simulate the conditions under which such a test would have to operate.

2.0 EXPERIMENTAL METHODS

A 0.062 in diameter probe was forced into the pericarp at the crown of the kernel at a constant velocity of 4 cm/min until it penetrated the pericarp. The maximum force during this process, i.e. that required for penetration, was recorded electronically.

Ten corn cobs were selected at random from the whole area of a field each day. The cobs were cut into 3 equal parts, and the tip part discarded. Ten equally distributed kernels in each of the butt and mid sections were then punctured (i.e. 20 punctures per cob and 200 punctures per field per day). This procedure was carried out several days before, and, in some cases, after the factory harvest day. The test was done on 4 fields, all of one variety.

3.0 RESULTS

The results are summarized in Table 1. These indicate that there is a trend for the puncture force to increase as the crop matures. However, the variation within cobs is high (5 to 20%), and generally almost equalled the variation between days (11 to 21%). Thus, to determine any significant differences between days would be difficult and require large numbers of samples. In this respect, the test would appear impractical since it becomes time consuming.

Sampling presents a distinct problem since the maturity of the crop is not uniform within a field. Thus, for example, where the only samples left after harvest were in a wet hollow, the test indicated that they were immature.

There was no consistent difference in the fields harvested for 80% whole kernel style (373 and 351 g) and cream style corn (363 and 403 g).

4.0 CONCLUSIONS

The puncture resistance of corn pericarp may increase with crop maturity, but this index is highly variable within cobs and within days. Thus, determination of an optimum level of puncture force on which to base the decision to harvest the crop appears impractical. The puncture test may have potential as a research tool, but it is not suitable for routine field tests. In any test method, sampling of the crop presents a problem. This has been noted previously by a number of researchers. Other methods based on testing a bulk quantity of corn kernels removed from the cob should be investigated.

5.0 REFERENCES

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Table 1. Summary of data

Field No.:	1		2		3		4	
Day No.	Mean Force[1] g	C.V. %	Mean Force[1] g	C.V. %	Mean Force[1] g	C.V. %	Mean Force[1] g	C.V. %
1	325	15	338	18	283	14	317	21
2	297	11	356	16	305	15	338	14
3	-	-	372	19	-	-	351[3]	17
4	322	14	373[3]	14	-	-	388	15
5	357	16	200[4]	15	354	16	204[4]	16
6	422	15	198[4]	17	372	18	203[4]	16
7	332	13	-	-	368	17	-	-
8	363[2]	17	-	-	401	16	-	-
9	399	14	-	-	403[2]	16	-	-
Within Day C.V. for each cob	Maximum	20	-	17	-	19	-	18
	Minimum	5	-	18	-	8	-	9

1. Mean of 200 punctures - 10 cobs/day, 20 punctures/cob.
2. Harvest day cream style.
3. Harvest day 80% whole kernel.
4. Samples left after harvest in wet hollow in field.