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READOUT STABILITY OF THE OTTAWA PEA TENDEROMETER

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SUMMARY

Tests were conducted over a 2 month period to examine the stability of the electronic force indicating system of the Ottawa Pea Tenderometer. The results show that over a period of 65 days changes in the zero and sensitivity of the force indicating system were not detectable. The electrical force calibration system was also stable within 0.5% of full scale. It was concluded, therefore, that the Ottawa Pea Tenderometer could be operated for long periods without adjusting the electronic force indicating system. This, however, does not eliminate the need for routine calibration checks to verify accuracy. These checks are easy to accomplish and allow confidence in the instrument readings.

1. INTRODUCTION

The stability of the calibration of any measuring instrument is important since this governs its long term precision of measurement, particularly if the calibration is not checked regularly by some independent means. Instruments for measuring pea tenderness and maturity are a typical example. The readings establish the price paid to the grower, and precision of measurement is critical.

The Ottawa Pea Tenderometer (OPT) was developed during a program to investigate the problems existing at grading stations in measuring pea tenderness (see references section 5). The system was fully described previously (11, 16). The force required to operate a pea test cell was indicated by an electronic system comprising a load cell, an amplifier, a peak detector and a 4 digit panel meter. The system was calibrated by applying a known force to the load cell using a lever and weight and adjusting the amplifier until the digital readout gives a preselected number to represent that force. In addition, an electric means of calibration that simulated the application of the same force was incorporated. This provides a means of rapidly checking the calibration by operating a switch. In this case, the switch was placed in parallel with the motor switch so that the calibration was automatically displayed for each test sample. The stability of this arrangement was tested for periods up to 18 days, and it was concluded that the force indicating system was stable within 1%, and that this accuracy could be maintained using only the electric calibration (16).

Subsequently, the design of the OPT was further developed and a final prototype constructed (11). The 4 digit readout was replaced by a 3 digit unit to make calibration procedures and reading of the results easier. The stability of this system was evaluated over a 12 day period and found to be within $\pm$ 0.5%. At the same time, frozen and then thawed peas were tested daily to examine the stability of the actual readings. Because of the variation between pea readings these results were inconclusive.

Unfortunately, instrument stability tests take a great deal of time which is not often available in a developmental program. When development of the OPT was complete, however, an opportunity arose to conduct a test over an extended period. The purpose here is to report the results of the test designed to simulate the operation of an OPT during a pea growing season.

2. TEST PROCEDURES

The OPT was set up and operated as described in the report (11) that established these procedures.

The force indicating system was switched on and allowed to warm up for 2 hr. It was then calibrated so that 100 Kg at the load cell (25 Kg on the lever) produced a reading of 50. The OPT has a full-scale reading of 200. The resolution of measurement is thus one digit or 0.5% of full scale. The electric calibration factor was then noted. A coil spring was installed in the OPT press in place of the 30 cm^2 wire extrusion cell normally used to compress the spring to simulate testing peas. Thus, readings could be obtained on a sample that nominally had constant properties.

The following were then noted each working day for a period of 2 months:

a) Reading with zero force on load cell, i.e. zero reading.

b) Reading with 100 Kg calibration force applied.

c) Electric calibration reading.

d) Test reading on the spring.

None of the amplifier adjustments were touched throughout the test period.

3. RESULTS

The results are shown in Table 1. These show that the system was highly stable. Readings without force and with 100 Kg on the transducer were 0 and 50 respectively throughout the test indicating that zero and sensitivity of the electronic system were constant. The calibration factor reading ranged from 183 to 185 or ± 0.5% of full-scale. Thus, it did not change by more than the ± unit of reading allowed in the normal operating procedures before adjustment is considered necessary.

The readings from the spring ranged from 80 to 84 (160 to 168 Kg), i.e. a total change of 3.75% of reading or 1.5% of full-scale. These changes must be considered in relation to how constant was the force applied by the spring. This in all probability was affected by: 1) the accuracy with which the limit switches stopped the crosshead which can account for a 0.26 Kg change in reading (0.33% of reading) (2); 2) the fact that the spring was removed between each reading and may not have been installed in exactly the same position for each test; 3) the effect of temperature and other unknown factors on the spring rate. It, therefore, appears that the spring readings were constant within at least ± 1.0% of full-scale reading and in all probability, allowing for changes in actual force applied by the spring, these changes were within ± 0.5%.

4. CONCLUSIONS

The force indicating system of the Ottawa Pea Tenderometer is stable and accurate within ± 0.5% of full-scale without adjustment for periods up to 65 days. There is no reason to assume that this performance would not be maintained for longer periods. The electronic calibration system appears adequate to verify instrument calibration during testing.

This performance should not eliminate the routine calibration checks on a daily basis using the weight. Such checks maintain confidence in the results for all parties concerned in the readings.

5. REFERENCES

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Table 1. Summary of results - Test period 17 Jan. to 28 March 1974.

Number of readings taken 50

Reading	Zero	100 Kg	Electric calibration	Test spring
Mean	0	50	183.98	82.22
Minimum	0	50	183.00	80.00
Maximum	0	50	185.00	84.00
C.V. %	0	0	0.23	1.26