NOTE

Shortening Falling Number Analysis Time for Measuring the Sprout Damage of Wheat at Harvest

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The falling number (FN) method has been internationally standardized by the International Association for Cereal Chemistry (ICC method 107), AACC (method 56-81B), and the International Organization for Standardization (ISO method 3093). It is accepted worldwide for the determination of alpha-amylase activity and sprout damage of cereals.

It is well known that 5% heavily sprouted grain mixed with 95% sound grain can make the mixture unacceptable for bread baking. Thus, to avoid large economic loss during a rainy harvest, it is necessary to segregate sprout-damaged grain from sound grain during binning. In some countries farmers receive payment based on falling number values. In Sweden, the base price of wheat is fixed at FN 190. At FN 270 farmers receive a maximum premium price of 4%, and at FN 90 a maximum price deduction of 12%. In the European Economic Community, wheat is considered to have minimum acceptable breadmaking quality if the FN is not less than 160.

TABLE I
Relative Stirrer Position at 190 sec Compared with Falling Number (FN) Value for 25 Wheat Samples

Sample	Stirrer Position at 190 sec (mm)	Difference Between Duplicate Readings (mm)	FN Value (sec)
Australian wheat	+10	8	532
Australian wheat	+ 9	3	490
Australian wheat	+10	0	459
Australian wheat	+13	1	440
Australian wheat	+ 6	0	417
Swedish wheat	+ 9	1	390
US Northern Spring wheat	+ 7	1	383
Australian wheat	+10	1	366
Canadian Red Spring wheat	+ 9	1	366
Swedish wheat	+ 6	1	349
Swedish wheat	+ 6	2	337
Australian wheat	+ 7	3	334
Swedish wheat	+ 5	1	331
Swedish wheat	+ 3	0	327
Swedish wheat	+ 3	2	319
Swedish wheat	+ 2	2	303
Swedish wheat	+ 2	2	296
Swedish wheat	0	1	295
Swedish wheat	− 3	1	284
Swedish wheat	−16	0	252
Swedish wheat	−11	1	250
Swedish wheat	−11	3	245
Swedish wheat	−28	3	220
Swedish wheat	−34	2	222
Australian wheat	−34	10	216

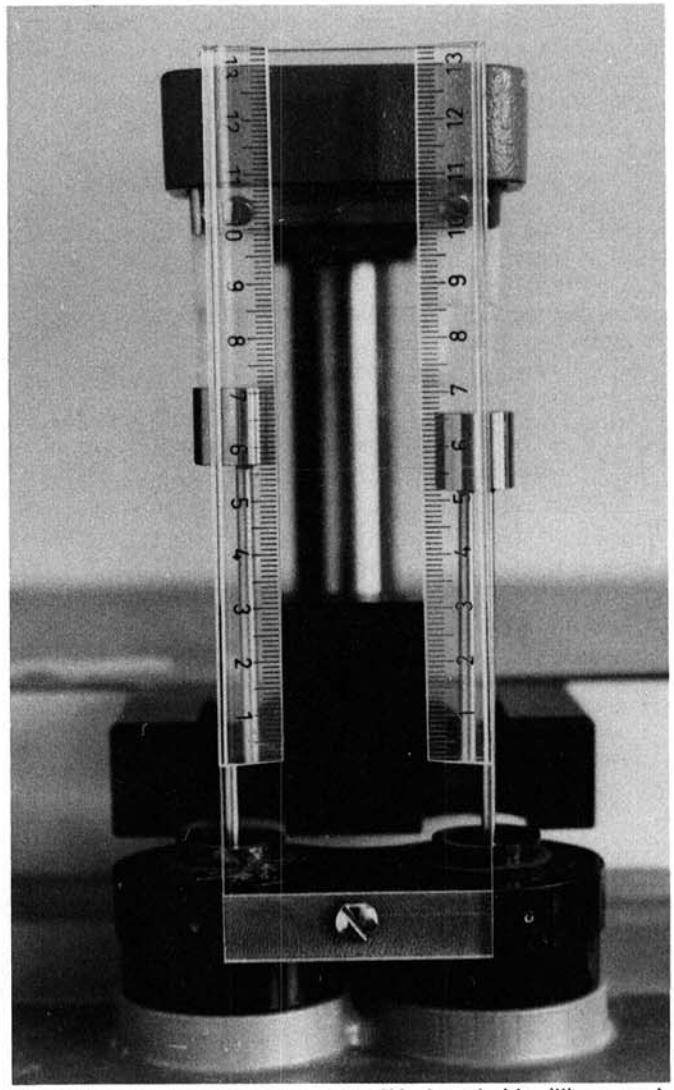

Fig. 1. Falling Number apparatus model 1600 adapted with millimeter scale for determination of stirrer position.

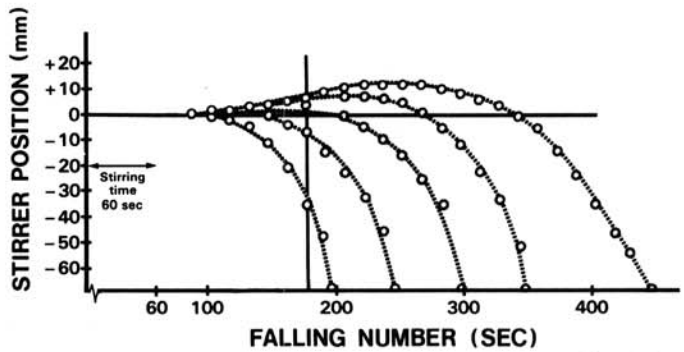

Fig. 2. Characteristic stirrer movement (in relation to release point) during falling number determination for several wheat meals.

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MATERIALS AND METHODS

Twenty-five wheat samples received from Australia, Canada, Sweden, and the United States were ground in a Falling Number Laboratory Mill 3100 and analyzed in a Falling Number model 1600 apparatus. To follow the stirrer movement, a millimeter scale was mounted on the test tube holder (Fig. 1). After release, relative to the 62-mm mark of the scale, the stirrer position was noted every 10 sec.

RESULTS AND DISCUSSION

The results of the FN tests (Table I) show that it is possible to accelerate the falling number determination for screening purposes by limiting the analysis time to 190 sec. By noting the relative position of the stirrer at 190 sec it is possible to estimate the final FN value of wheat.

Tests with wheat of different FN values (Table I) show that if the stirrer has not started to fall below the release position at 190 sec, the final FN value is usually over 290 sec. If the stirrer has dropped only a few millimeters at 190 sec, the FN value is usually less than 290. The standard deviation of duplicate readings of stirrer position is 1.5 mm in the FN range 250–350. Statistical treatment of the data in Table I for the range 250–350 using a quadratic equation gives a correlation $r = 0.88$. Within 95% confidence limits a stirrer position of 1 mm at 190 sec corresponds to a final FN of 285–330 (determined by the University of Stockholm, Department of Statistics).

The FN stirrer often rises for several minutes before it begins to drop. The stirrer falls farthest during the last 80–100 sec of the analysis (Fig. 2). Table I also indicates that if the stirrer is moving upwards more than 6–7 mm at 190 sec the FN value is usually over 350.

Taking into account the practical experience that a wheat flour for bread baking gives best results at an FN value between 200–300, and that flours usually have 5–10% higher FN values than grain, the segregation of wheat at binning in harvest could easily be done in 3 classes: 1) FN values under 190, to be mixed with wheat of higher FN value before milling; 2) FN values between 190–290, good for direct milling for breadmaking; 3) FN value over 350, the low α-amylase activity is to be balanced by enzyme addition.

The falling number test does not measure a constant viscosity, but the liquefaction of the gelatinized starch at the temperature of boiling water. The speed and degree of liquefaction depend both on the resistance of flour starch to heat and on the action of α-amylase during the period between starch gelatinization and heat inactivation of the enzymes.

Limiting the FN measurement to 190 sec is a simple way to detect sprout damaged grain so it can be segregated when it is binned or sold. To shorten the FN analysis time by reducing the sample weight or by other modification may lead to misunderstanding, as the final values are not comparable to the standard method.

ACKNOWLEDGMENT

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