

4th ICC Latin American Cereals Conference

13th International Gluten Workshop

11-17 March 2018
Mexico City, Mexico



HAGBERG FALLING NUMBER MEASUREMENT: NEW MACHINE VERSUS CONVENTIONAL MACHINE

Arnaud Dubat Business Development Director

April 2, 2018

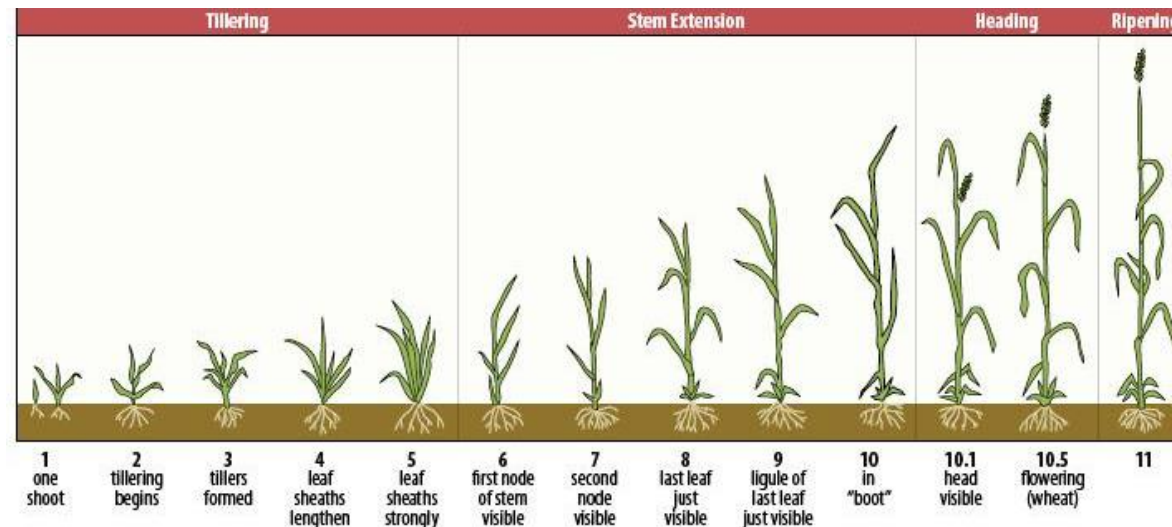


What is wheat sprouting?

- "A wheat plant is not interested in making a good loaf of bread or a cake or a cookie for us. A wheat plant is interested in making a new wheat plant!"*

Art Bettge

- Germination process (temperature, humidity) triggers the beginning of activity for different enzymes including one called α -amylase, converting starch into simple sugars, useful for the plant to grow.



What are the consequences of using sprouted wheat?



sound



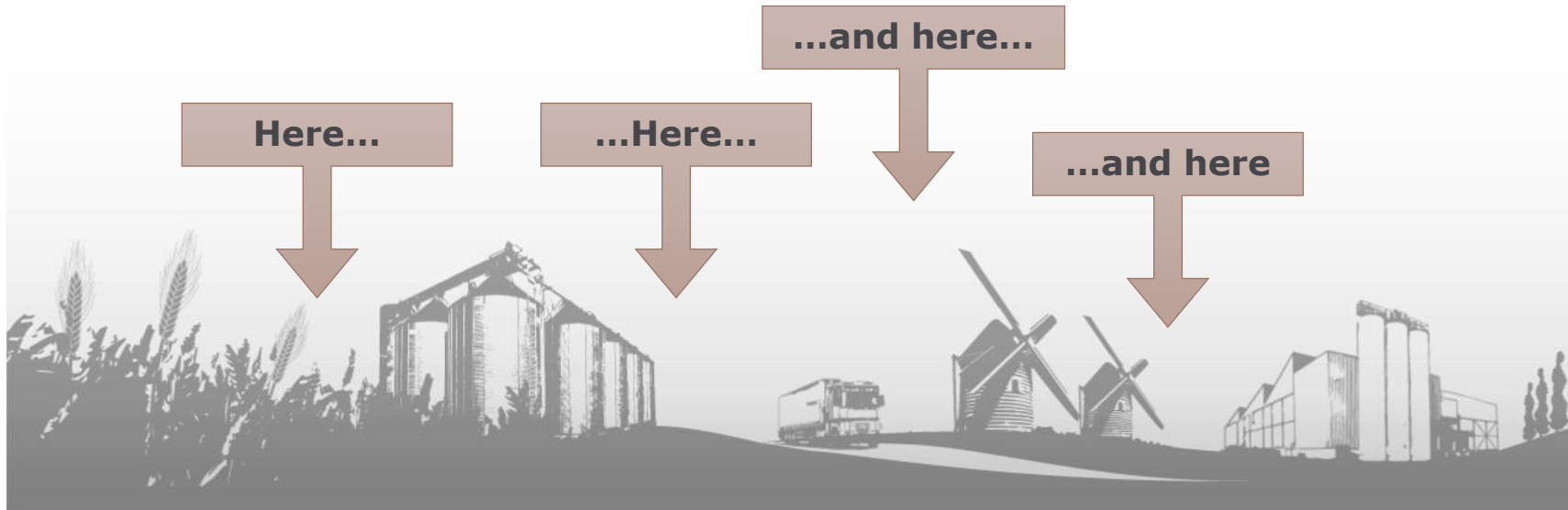
sprouted



severely sprouted



When to detect sprout-damaged grains?



- The sooner the better!
- Sprouted lots cannot be **corrected**, they must be **isolated**.
- There is a need for rapid, simple and accurate detection tool.

Falling number method – 1960's until today

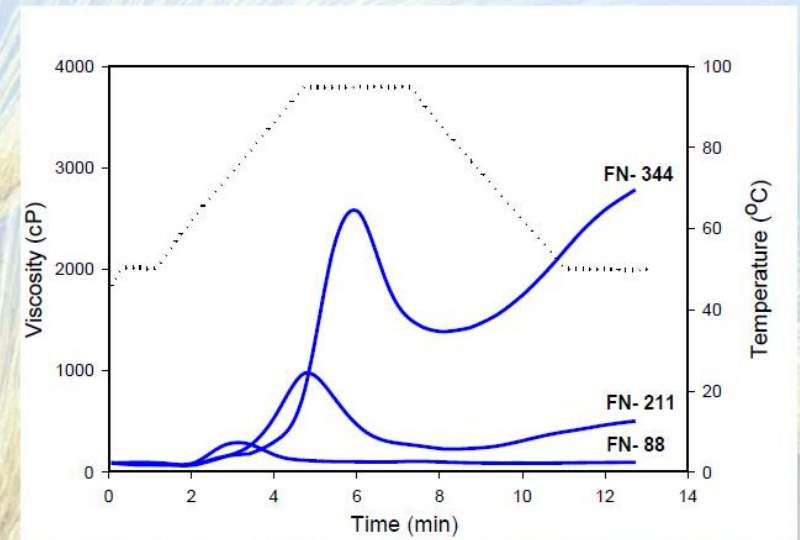
- **Developed in the early 1960's** by Sven Hagberg and his co-worker Harald Perten, both at the Cereal Laboratory of the Swedish Institute for the Crafts and Industries.
- **Purpose:** provide a rapid means of detecting sprout-damaged wheat or rye
- **1968:** International Association of Cereal Science and Technology approved the method as ICC Standard No. 107/1



WARNING : Falling Number does not only measure α -amylases activity

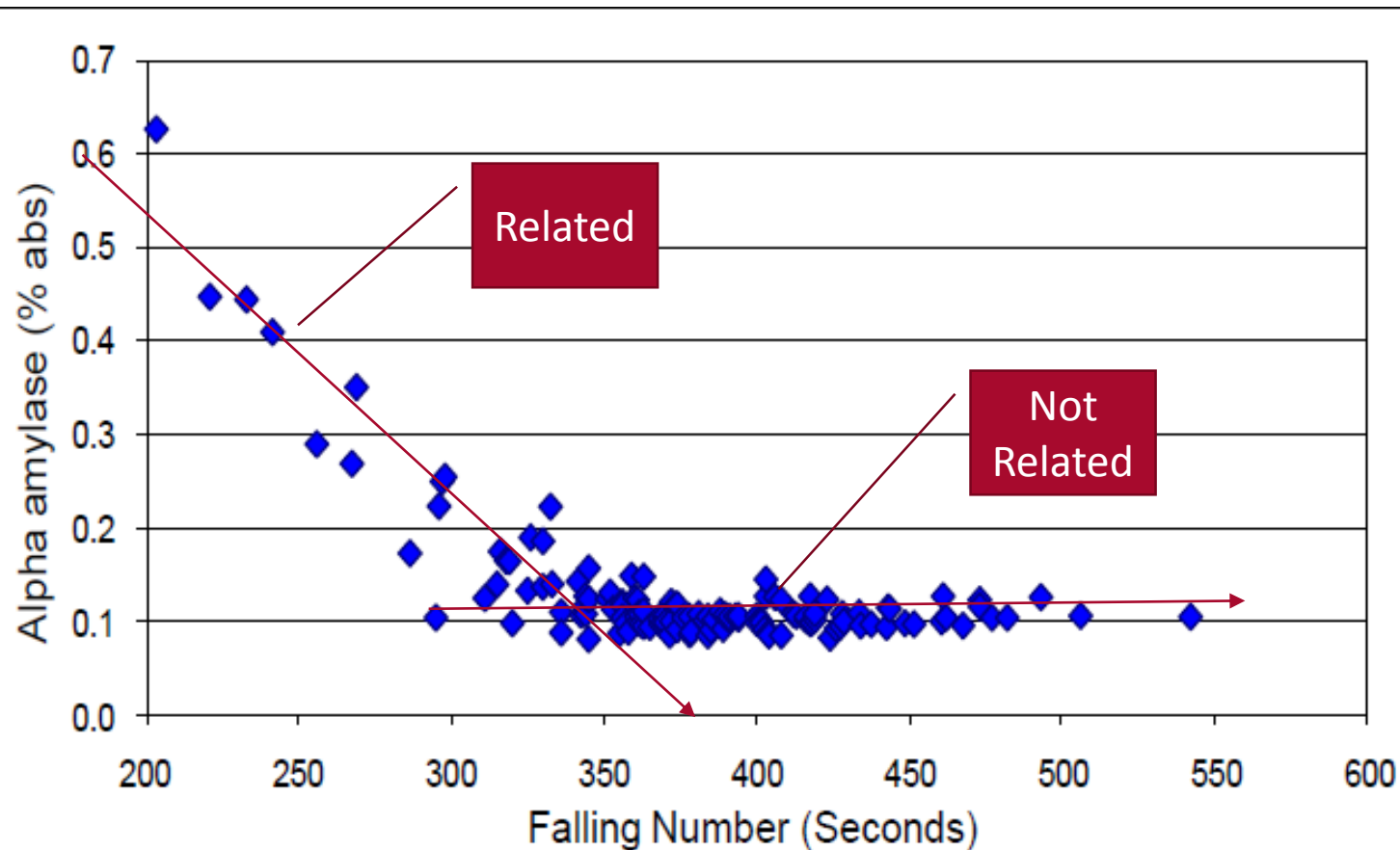
- The final result is a combination of:
 - α -amylases activity
 - Slurry viscosity
- Slurry viscosity depends on starch properties:
 - Amylose/Amylopectin ratio
 - A & B granules repartition
 - Particle size of the sample

Starch pasting profiles of flour samples
(8% flour slurry by RVA, Chelsea, SWW wheat)



Source : USDA

High Falling number values (>350) only mean there is no α -amylase activity...



In the Zone 350-550 α -amylase activity (Ceralpha Measurement) is 0,1% abs.

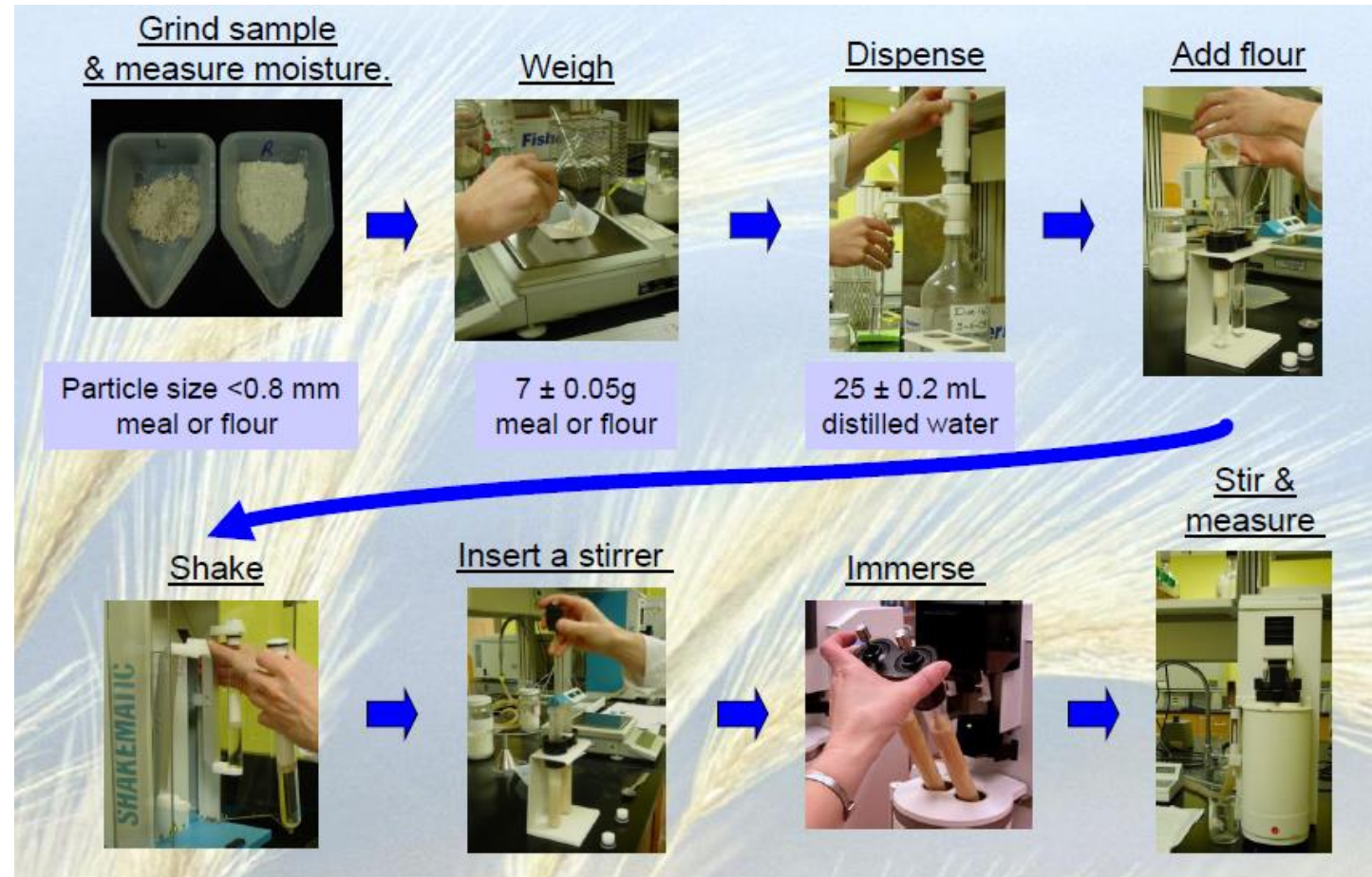
There is no point of trying to differentiate a 400 from a 500 wheat sample, they both do not have α -amylase activity.

→ It does not make much sense to wait more than 500 seconds when a 400 second test gives the information...no activity!

Source : USDA

April 2, 2018

How is the test performed until today?



Source : USDA/Meera Kweon

A “looking simple” but really tricky measurement...

Sources of Error

[source: USDA-FGIS Directive 9180.38 (5/2013)]

- (1) Error in measuring bath temperature and/or barometric pressure.
- (2) Incomplete mixing of samples.
- (3) Balance error.
- (4) Water dispenser error.
- (5) Incorrect temperature of sample water.
- (6) Impure sample dilution water.
- (7) Failure to scrape.
- (8) Improper timing.
- (9) Improper mixing.
- (10) Incomplete mixing
- (11) Incorrect bath level.
- (12) Error in moisture correction.
- (13) Erosion of grinder screen.
- (14) Incorrect stirrer weight.
- (15) Out-of-tolerance viscosity tubes.
- (16) Operator differences.

Many operator-related potential errors
...and others coming from the technology

Control Point	Action
Cooling lid	Crystals may develop along the edge of the aluminum cooling lid and prevent the lid from being pushed firmly down into the water bath.
Cooling system	Cooling water should have a rate of approximately 400 ml/min.
Water for water bath	Use distilled water or water of equivalent purity in the water bath. DO NOT add chemicals to adjust the water bath temperature as this will lead to erroneous results.
Water bath level	Periodically check the water level in the water bath.
Altitude correction	The FN value is affected by the boiling temperature of the water in the water bath, which is a function of the atmospheric pressure.
Is water boiling?	Lift off the cooling lid – use a towel for protection and be careful as the lid is hot.
Viscometer tubes and stirrers	Tubes should be sparkling clean and dry. Stirrers should be clean and dry.

From observation to innovation

Apart from operator, most issues are related to the use of boiling water and cooling lid

- Objective 1/ Remove boiling water, choose induction technology

Altitude and atmospheric pressure influence boiling water, including in the test tube

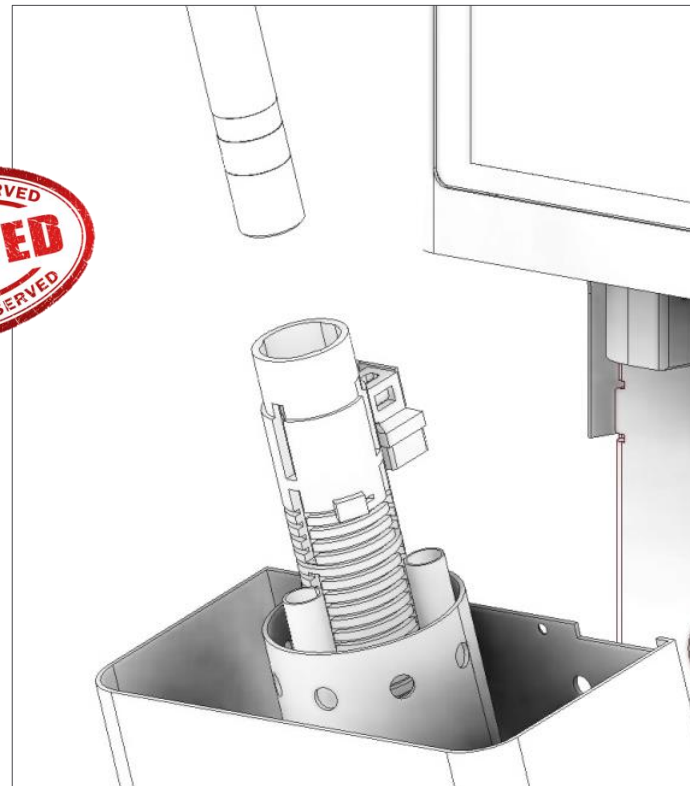
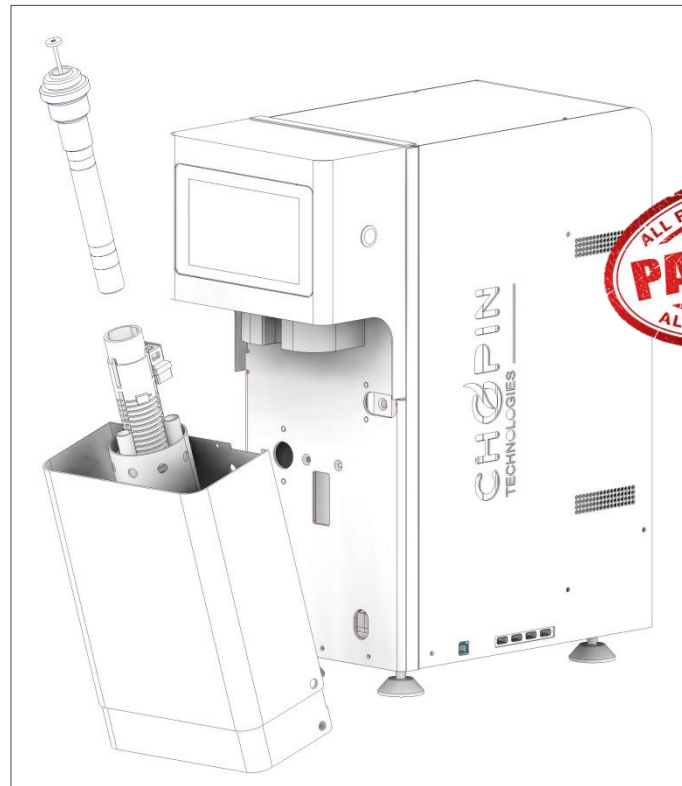
- Objective 2/ Find a way to correct results according to these parameters

Protect users from any hazard (boiling water, glass tubes...)

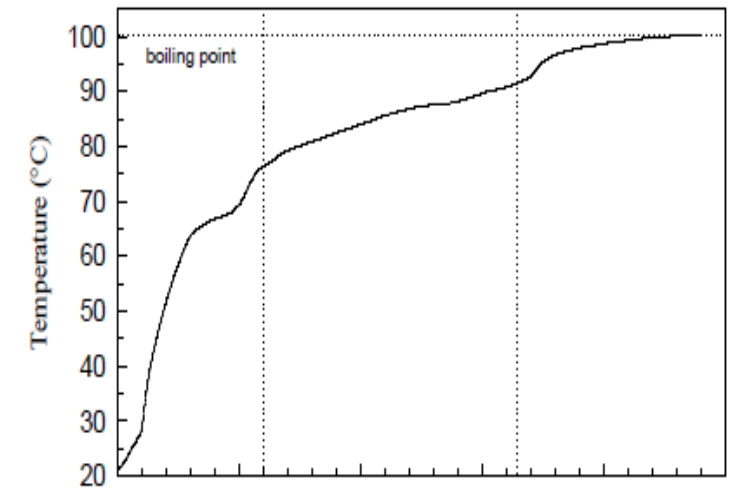
- Objective 3/ Improve user safety

Objective 1/

Remove boiling water, choose induction Technology – Technics-



Kinetics Study



Source : USDA

- No need to check the water bath level / add water
- Heating profile is set to exactly mimic the temperature gradient of a standard falling number device → get the same results

Objective 1/

Remove boiling water, choose induction Technology – Advantages-



- No need to connect Amylab FN to a cooling circuit (faucet)!
- No need for a cooling tower!
- **Only 110V or 220V power is required!**
- No release of steam nor heat in the lab!
- Warming-up time is 2 times faster!



Objective 1/

Remove boiling water, choose induction Technology – Advantages-

- New tubes made of aluminum
 - No more breakable glassware
- Bottom removable test tube
 - Easily and quickly remove starch gel from the tube



Objective 2/

Find a way to correct results according to Altitude and atmospheric pressure

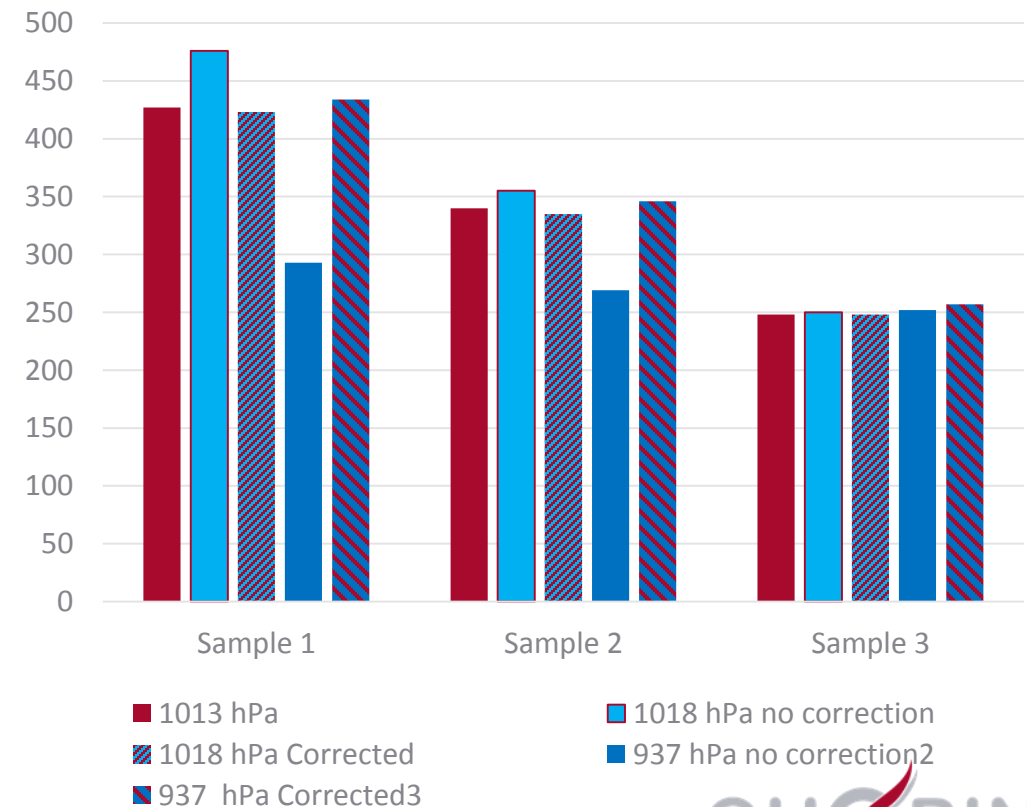
Correction according to site altitude

(Correction coefficient installed at device's setup)

TABLE 1
ALTITUDE-CORRECTED FN VALUES FOR WHEAT AT
DIFFERENT LABORATORY ALTITUDES (FT. ABOVE SEA LEVEL)

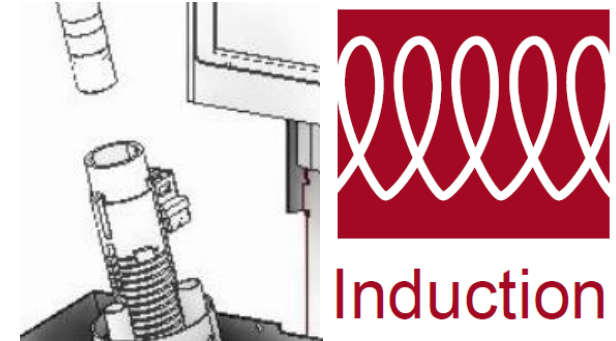
FALLING NUMBER	ALTITUDE (FT. ABOVE SEA LEVEL)						
TEST RESULTS	2000	2500	3000	3500	4000	4500	5000
450	421	411	401	391	379	367	355
455	426	416	406	395	384	372	359
460	431	421	411	400	388	376	363
465	436	426	416	405	393	380	367
470	441	431	421	409	397	384	371
475	446	436	425	414	402	389	375
480	451	441	430	419	406	393	379
485	456	446	435	423	411	397	383
490	461	451	440	428	415	401	387
495	466	456	445	433	420	406	391
500	471	461	450	437	424	410	395

Correction according to actual atmospheric pressure (built in sensor)



Objective 3/ Improve user safety

- No boiling water bath!
 - **Lower risk of burns**
- No breakable glass tubes!
 - **Lower risk of injuries**



3/ Improve user safety

What happens if the test tube stays on the machine at the end of the test?

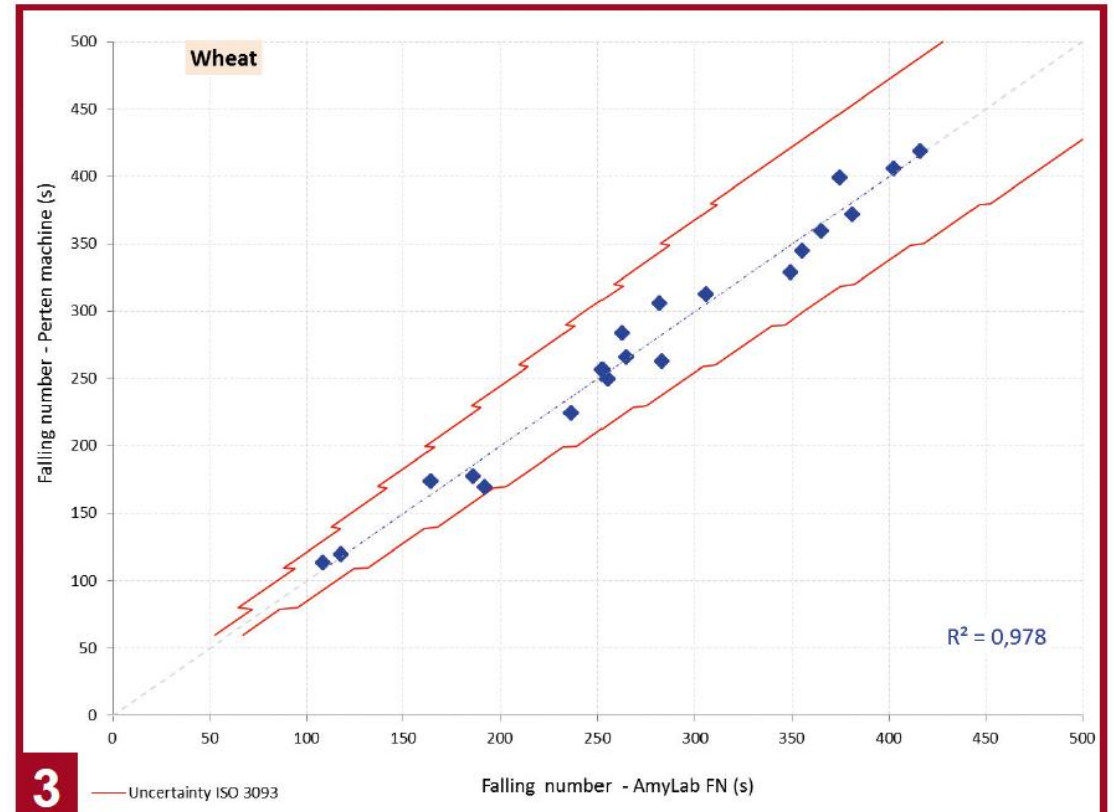
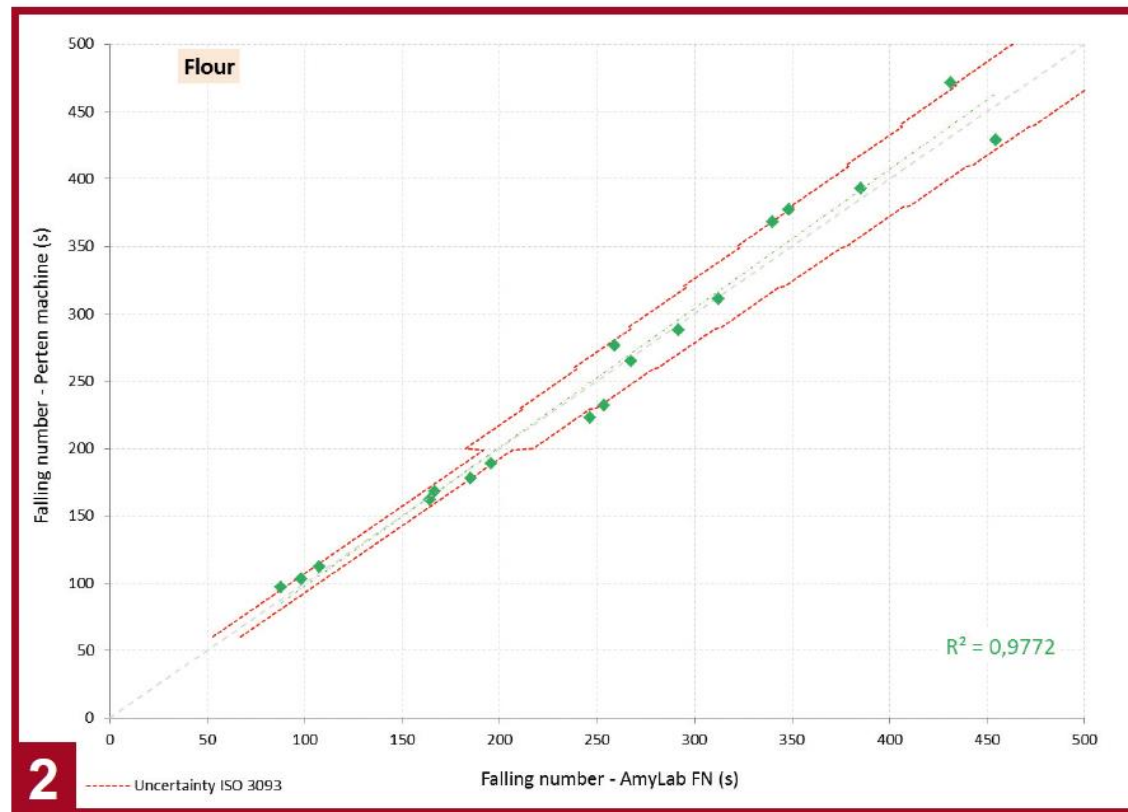


- Heating stops when test is ended
 - No possible overheating
- Tube is cooled down to 60°C before gate opens

Amylab FN RESULTS

Hagberg falling number method

- Accurate prediction of Hagberg falling number compared to devices on the field





And what about proposing a **new** way of measuring falling number?

Amylab FN – 1 device, 2 test methods

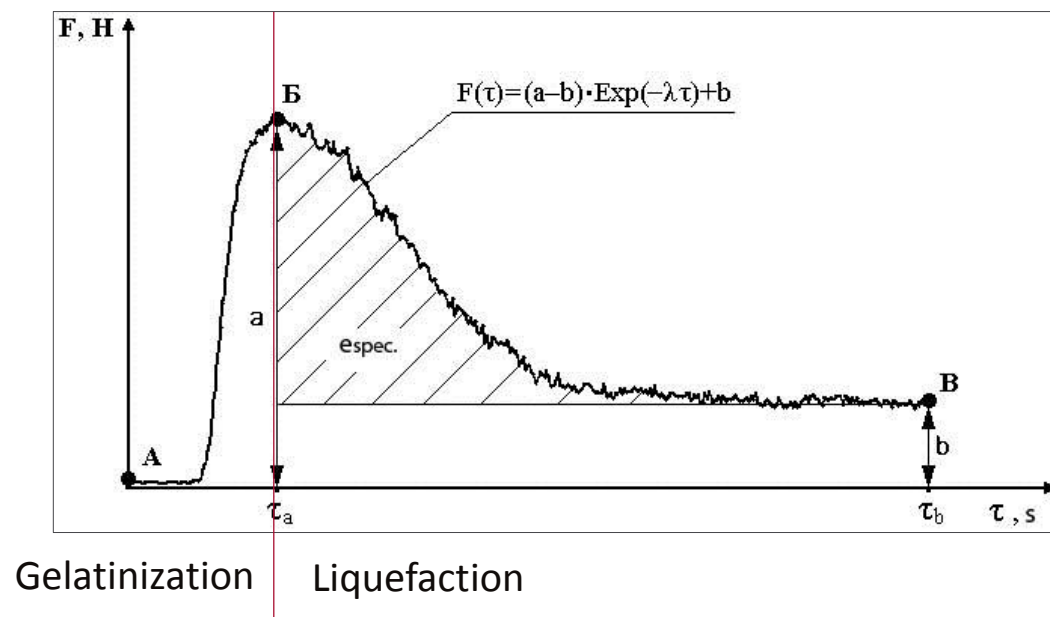
- **HAGBERG** Falling Number method

- **NEW** Faster Testogram method



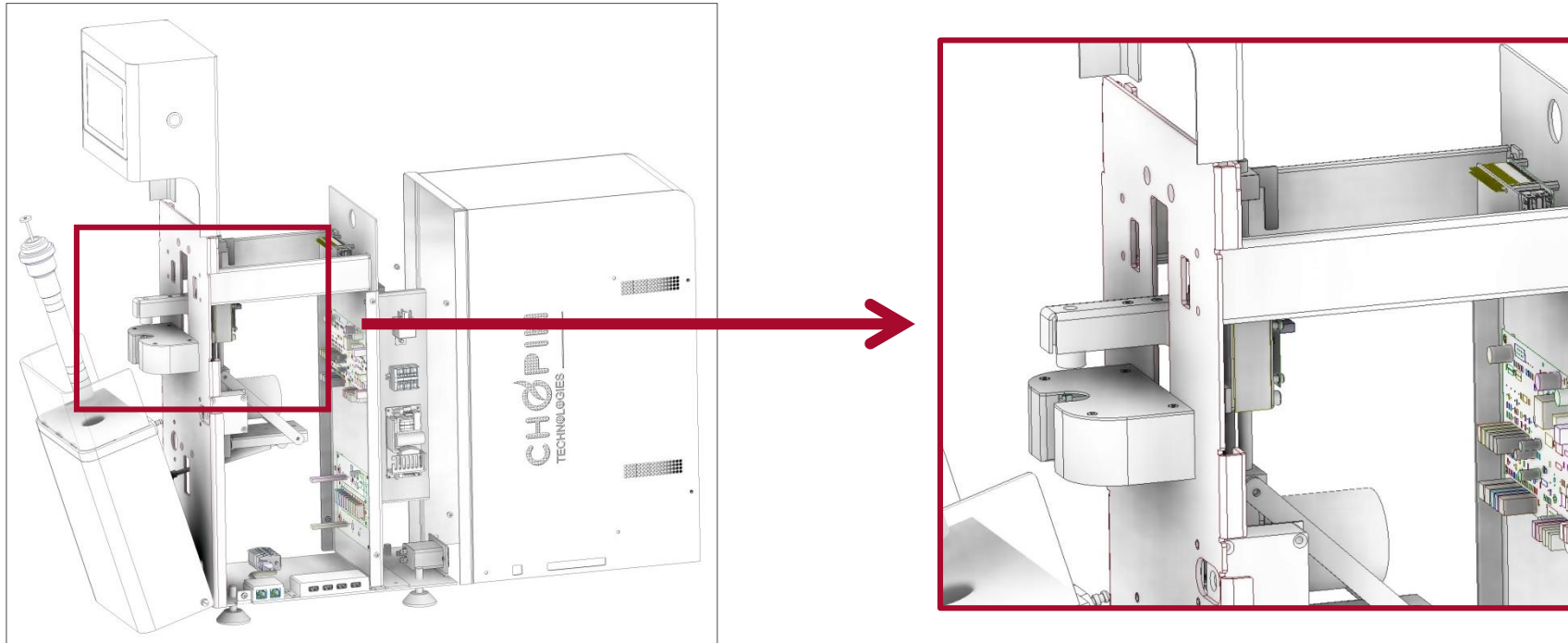
Amylab FN – What is the Testogram method?

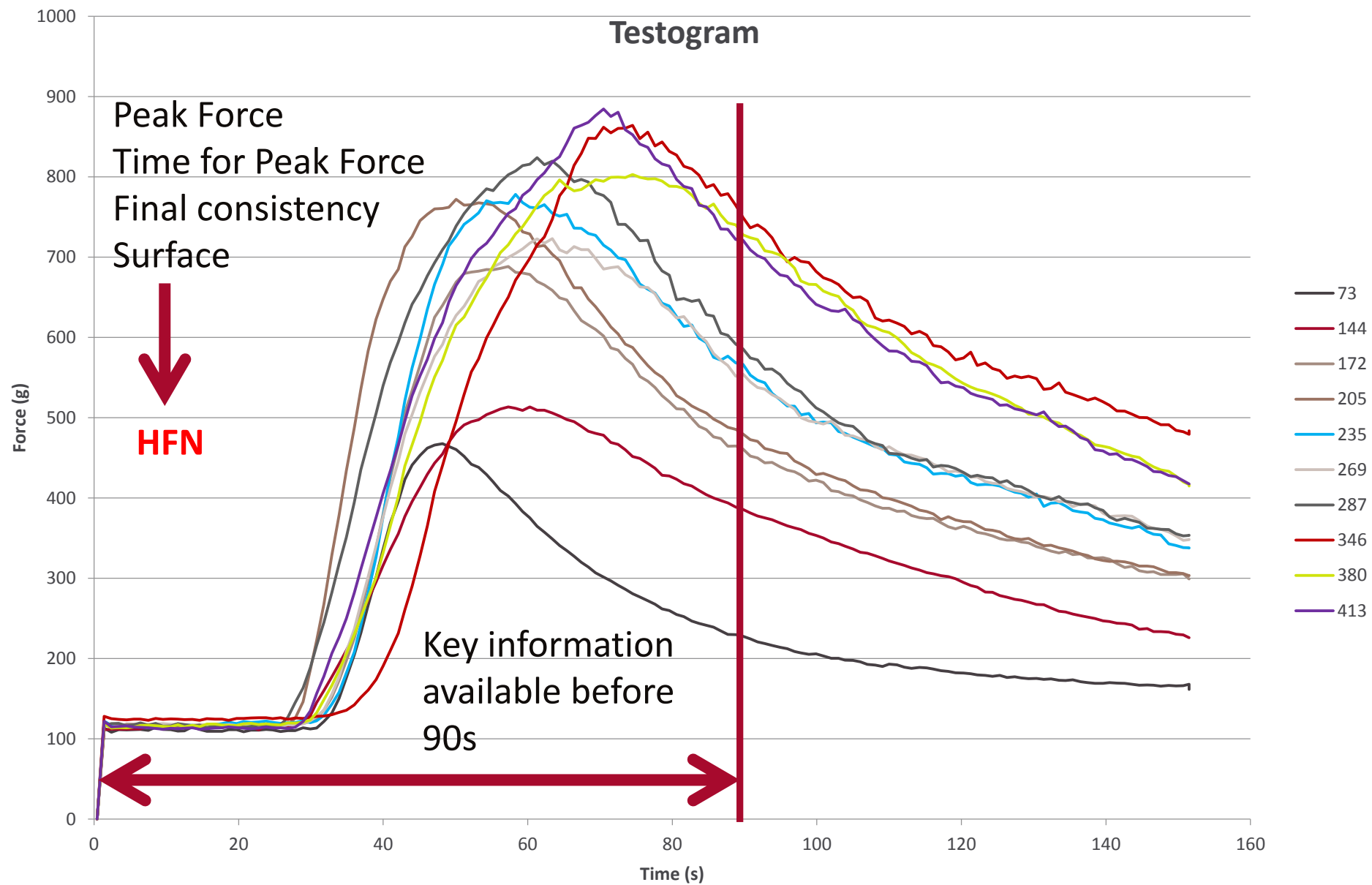
- First reported in 1997 by Pr. Valery Chernykh
- Principle = **measure the viscosity during 90 seconds of shaking**
 - Starch gelatinization, enzymatic hydrolysis (liquefaction) occurs within the *first two minutes*
 - High consistency = low amylase activity



Amylab FN – How does Testogram work?

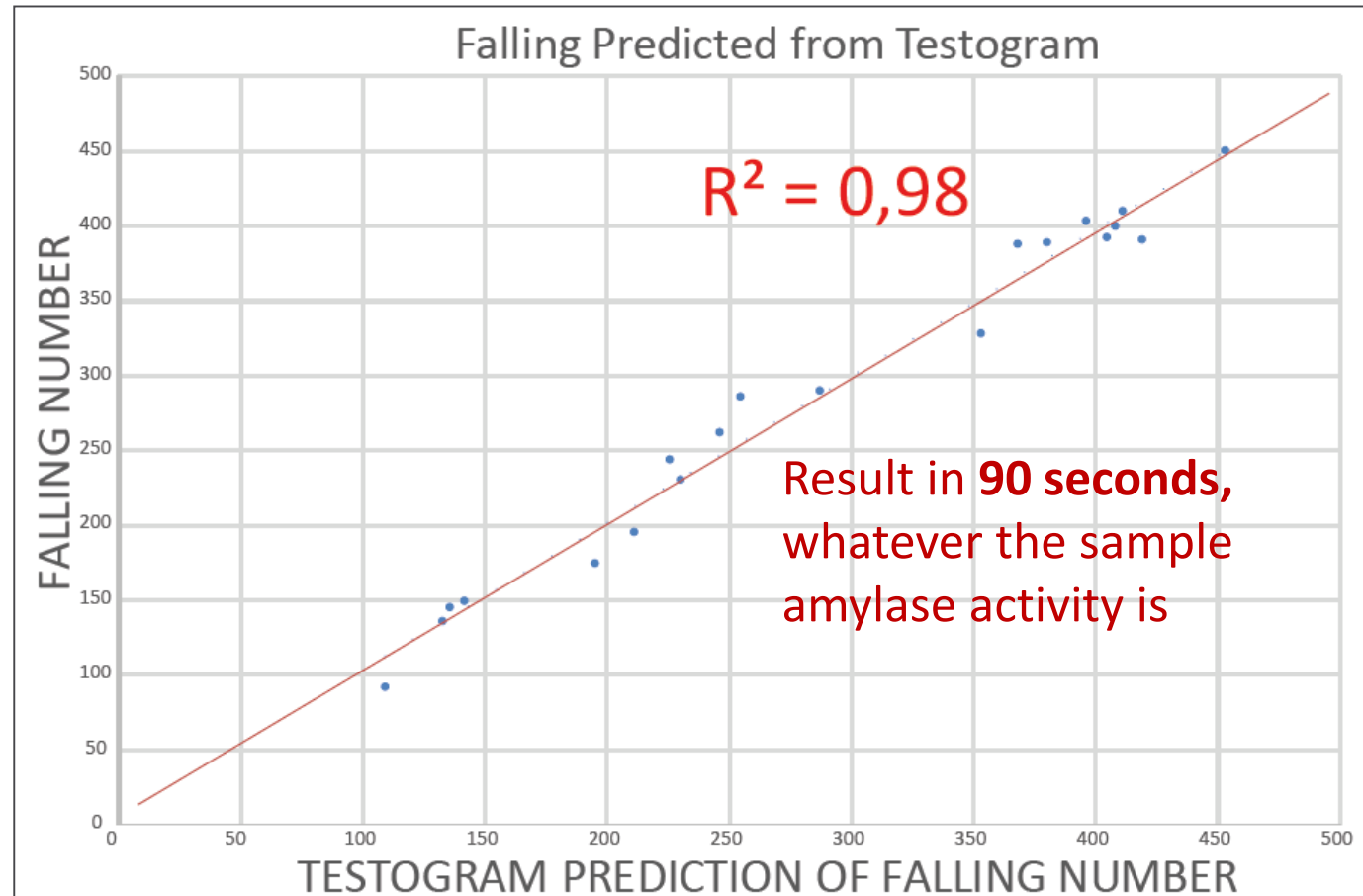
- Built-in force sensor





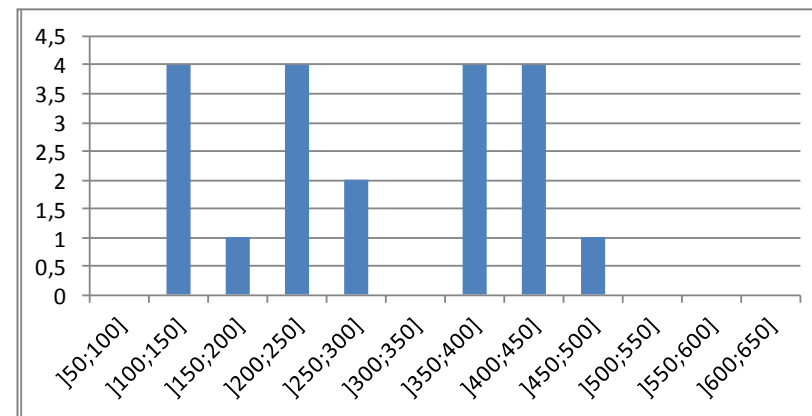
Amylab FN — Testogram method vs Hagberg method

- Accurate prediction of Hagberg falling number



Amylab FN – Save time with Testogram method

- Analysis of 20 samples
 - Total analysis time with falling number method = 5760 sec (96 min)
 - Total analysis time with Testogram method = 1800 sec (30 min)
 - **Total time saved = 66 min**



- Average time/sample:
 - Falling number = 288 sec (4.8 min)
 - Testogram = 90 sec (1.5 min)





CHOPIN
TECHNOLOGIES

Meet the beast
@Booth 9
😊

Acknowledgement

- Gregory Vericel (Marketing Dept, CHOPIN Technologies)
- Olivier Lebrun (Application Dept, CHOPIN Technologies)

A vertical photograph of several stalks of mature wheat or barley. The grains are a vibrant golden-yellow color, indicating they are ripe. The stalks are positioned vertically, with some showing the full head of grain and others showing the lower part. The background is a light, off-white surface with a subtle, mottled texture, possibly a piece of paper or a wall. The lighting is soft, highlighting the texture of the grains and the sheen of the stalks.