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## RHEOLOGY – INSTRUMENTATION AND APPLICATION TO QUALITY BREEDING OF RYE

### ABSTRACT

It succeeded in developing a breeding relevant analytical tool for evaluation of meal and starch quality of single rye plants concerning their swelling, gelatinization and pasting characteristics. The pros and cons of well tried and new developed rheological devices and methods were examined closely.

*Key words:* enzymes, gelatinization, rye, viscosity

### INTRODUCTION

Rheological methods are used to characterize swelling and gelatinization properties of rye meal as well as often used as indirect methods to determine the activity of  $\alpha$ -amylase in rye as important quality characteristic for estimation of pre- and postharvest sprouting damages (FLAMME, W. *et al.*, 1998).

Different applications of rye in food, feed and non-food require varieties with specific qualities. To achieve a rapid breeding progress in this field rye forms have to be selected at early breeding stages. Prerequisites for that are breeding relevant methods which allow the investigation of single plants.

Correlations between well tried and new developed rheological methods were calculated.

Results of rheological investigations of a broad assortment of rye varieties are shown.

## MATERIAL AND METHODS

Grain samples of rye were obtained from the experimental field of the Institute for Stress Physiology and Quality of Raw Material in Groß Lüsewitz. The grains were ground using a falling number mill (Fa. PERTEN INSTRUMENTS).

The following devices are used for rheological investigations:

- Viscograph (Fa. BRABENDER) equipped with a 700 cmg cartridge
- Falling Number measuring system 1300 (Fa. PERTEN INSTRUMENTS)
- Rheotest (Fa. MEDINGEN) (Flamme. *et al.*, 1985)
- Rotation viscometer (Fa. PHYSICA) with Rheolab MC 100 and modified measuring system MS-ME 3 (Flamme 1997)

## RESULTS

Different devices for breeding relevant rheological investigations were tested. The Rheotest and the rotation viscometer have been proved to be the best equipment, because: very low sample amounts are needed; the differentiation of samples is very good with high reproducibility of the values; the time consuming for one determination is acceptable.

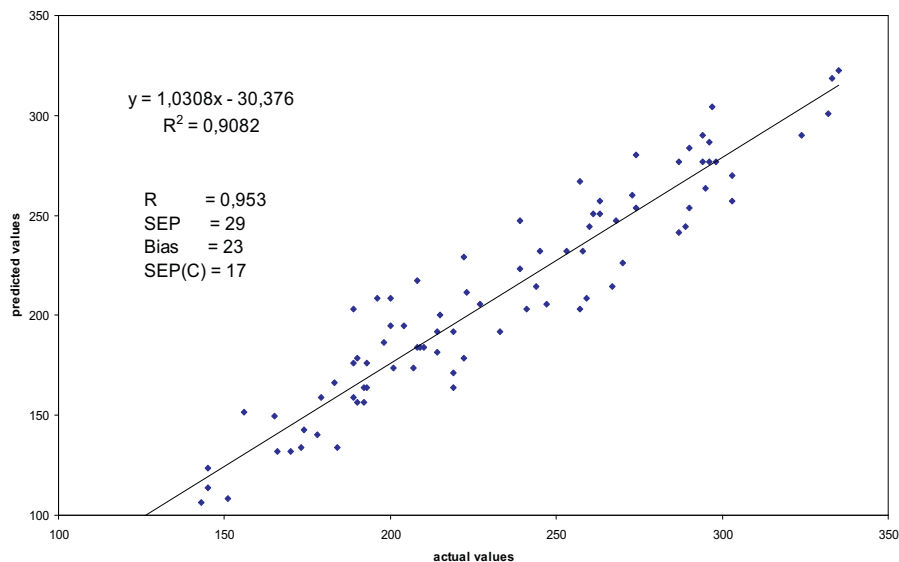


Fig. 1 Prediction of Falling Number of rye, calculated from gelatinization maximum of Rheotest

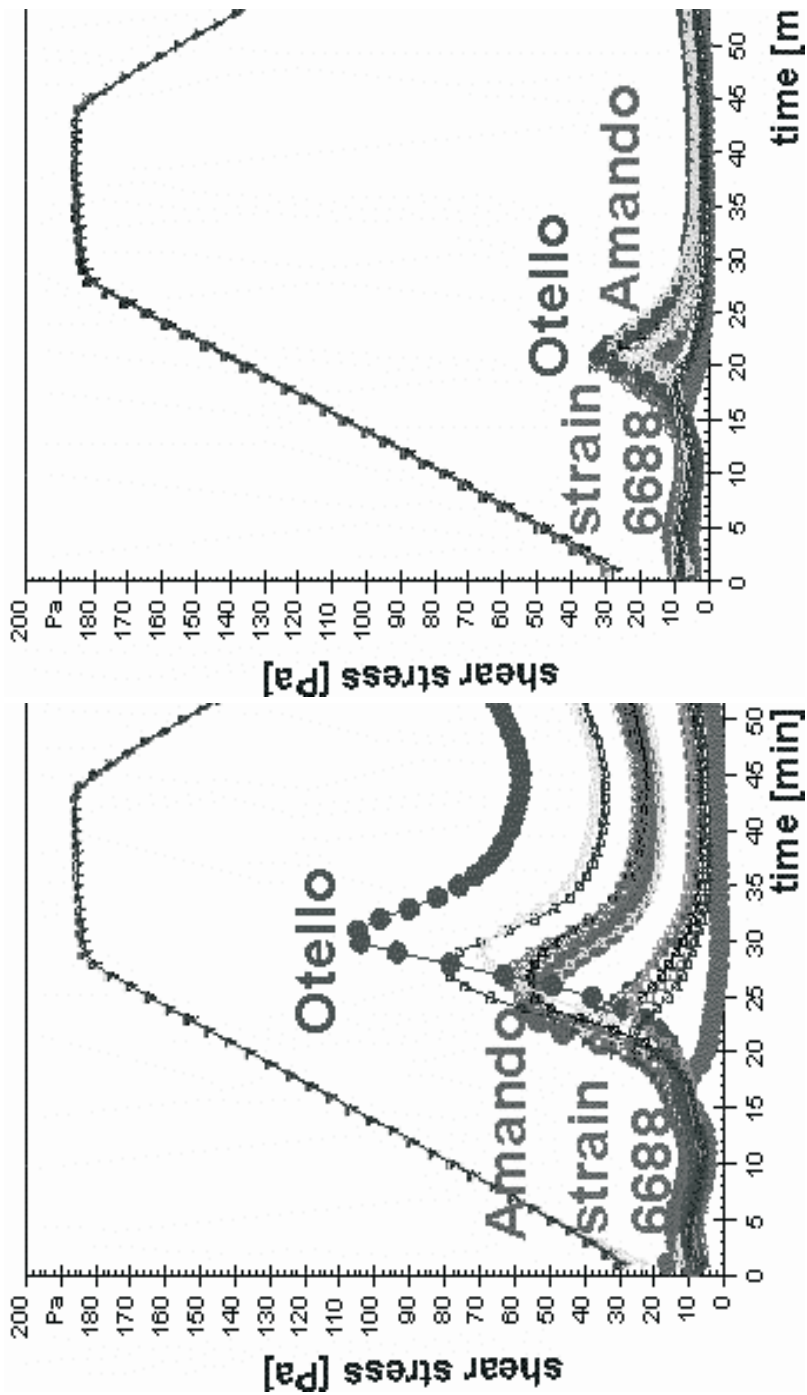


Fig. 2 Gelatinization cycle curves and pasting properties of rye, harvested at different times

The gelatinization maxima (Rheotest) correlate high with values of the Falling Number ( $r^2 = 0.976$ , number = 72). Therefore it is possible to predict the Falling Number and to compare the data of the Falling Number with other data in the past. The Falling Number can be predicted with a relatively low standard error of prediction (Fig. 1). Sometimes it is not enough to determine the Falling Number. High rainfall during harvest time causes sprouting damages to rye. Samples of this rye can not be differentiated with the Falling Number because the Falling Number reaches the limit at 62 s.

By using the first gelatinization maximum of the Rheotest it is possible to classify sprouting samples with a Falling Number of 62 s.

The rotary viscometer is applicable to measure swelling, gelatinization and pasting properties of rye meal suspensions. The gelatinization properties are clearly affected by the variety (Fig. 2). The variety Otello shows the highest and the strain 6688 the lowest maximum of gelatinization. An increase of enzyme activities during overripeness affects the gelatinization maximum to a great extent.

#### CONCLUSIONS

Rheological properties of rye samples with sprouting damages can be better classified with a Rheotest than with the Falling Number system. The rotary viscometer (Fa. PHYSICA) with modified measuring system is a suitable equipment to investigate rheological properties of rye at early breeding stages. The swelling properties and the gelatinization properties of rye meal can be measured with very low amounts of material.

Physical defined viscosities are obtained and the flow behaviour can be determined under different shear rates.

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