Correlations between meteorological parameters and the water loss of maize from silking to harvesting

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Abstract. The University of Debrecen provides outstanding conditions for the development of "Smart Weather for Precision Agriculture" programs.

The reliability of research is provided by the Polyfactoral Long-term Field Experiments of Debrecen (hybrid x fertilisation x plant density x tillage x irrigation) established in 1983. Within this research program, it is possible to examine various crop cultures, cultivars and hybrids under changing natural, environmental and weather circumstances, as well as in different production technological alternatives.

According to our research results, the length of the generative phase is in correlation with the maximum water stock of the maize grain. Favourable water supply results in longer and more intensive dry matter incorporation in the maize grain. Water, as a component of the maize grain, has a significant effect on its physiological processes and the nutritional value of the grain. The active physiological processes prevail in the grain filling period and, following physiological maturity, the physical drying processes are active. Following the physiological maturity, weather factors (temperature, relative moisture content, wind speed) show close correlation with water loss rate. The knowledge of the genetic parameters of maize hybrids and the microclimatic values of the population is necessary to more accurately determine the date of harvesting and to achieve the set utilisation purpose (nutritional value, grain moisture).

Keywords. *Maize, grain moisture, water loss, meteorological conditions.*

Introduction

Bellini and Fusi (1961) claimed the 43-49 % of the total organic dry matter of the maize plant is stated in the kernel. The process of filling the kernels in is closely correlated with the loss of moisture content and both are influenced by a host of factors.

Maize hybrids have different genetic background. Their reaction is different to the effect of agrotechnical and ecological factors. There are significant differences between the natural nutrient extraction and nutrient conversion ability of hybrids (Sárvári and Bene, 2015).

Berzsenyi (2009) stated the yield increase is the result of physiological processes. The grain yield increase of maize is in close correlation with seasonal dry matter accumulation. Dry matter is incorporated into the grain yield during the grain filling period. Only a smaller part of dry matter incorporated before the silking period is remobilised into the grains. Hybrids with short ripening period accumulate half of all dry matter until silking and nearly the same amount until grain filling. Also, there is a difference between parental inbred lines in terms of phasal development. Compared with inbred lines, the grain filling period is longer in the case of hybrids.

Carter and Polenit (1973) claim that the maximum dry matter of the kernel ensues when the black layer appears in the kernel was a sign of physiological maturity.

Materials and Methods

The Agrometeorological Centre of the University was established in 1962 and is has been constantly providing meteorological services to university researchers and farmers.

In our research, based on the genetic parameters of the examined hybrids, we determined the heat sum necessary between silking and physiological maturity, as well as the correlations of intensive dry matter incorporation and intensive water loss. The growing degree days were calculated from daily maximum and minimum temperature values using classical equation (Gilmore and Rogers, 1958; Arnold 1960) and base temperature of 10°C.

One maize hybrid (FAO 480) was involved in the experiment. In order to determine dry matter content, two samples were taken per week. In the course of sampling the weight of 100 grains from the middle section of 4 ears was measured in 4 replications. Dry matter content was determined after drying to constant weight in a drying cabinet at 60 °C.

The amount of precipitation in the winter period prior to the 2017 growing season was more than 200 mm. The soil was saturated until its field capacity. The rather dry and warm March and April had a favourable effect, but there was no worthy amount of precipitation until the beginning of May due to the condition of the dried seedbed. Sowing was performed on the 5th of May 2017 in a randomised small plot experiment at a plant density of 70000 plants per hectare. There was favourable precipitation and temperature during the growing season, thereby providing ideal conditions for maize development. The total amount of precipitation in the summer period was 342 mm. Temperature was mostly above the average, but there was no long and extremely warm period. The positive temperature anomaly in July and August was close to 2 °C.

Results

The maize hybrid H480 reached its highest dry matter weight on the 90th day following silking and showed 306 g/ 1000 grains dry matter accumulation. In regression analysis, the coefficient

of explanation showed that the effect of day was 97 %.

According to our research results, the length of the generative phase is in correlation with the maximum water stock of the maize grain. Favourable water supply results in longer and more intensive dry matter incorporation in the maize grain. Water, as a component of the maize grain, has a significant effect on its physiological processes and the nutritional value of the grain. The active physiological processes prevail in the grain filling period and, following physiological maturity, the physical drying processes are active. Following the physiological maturity, weather factors (temperature, relative moisture content, wind speed) show close correlation with water loss rate. The knowledge of the genetic parameters of maize hybrids and the microclimatic values of the population is necessary to more accurately determine the date of harvesting and to achieve the set utilisation purpose (nutritional value, grain moisture).

Dry matter values decreased evenly and slightly following physiological maturity. According to our research results, it was established that physiological maturity is followed by a moderate dry matter loss. Until harvesting, the hybrid lost 40 g of its thousand grain mass weight in 29 days. The harvested yield of the hybrid was 12.16 t ha^{-1}. The grain moisture content at harvesting was 18.1 %.

Conclusion

Dry matter values decreased evenly and slightly following physiological maturity. According to our research results, it was established that physiological maturity is followed by a moderate dry matter loss. The aim of the regression line slope is to predict the behavior of the dependent variable with the knowledge of the values and characteristics of the independent variables using the regression line equation. Observations are evaluated for the correctness of the fitted model.

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