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ORIGINAL ARTICLE

Differences in drying down of maize kernels related to fertilizers treatments

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ABSTRACT
The kernel filling process is related to reduce moisture content, and both have affected by host factors. The time of maturity depends on the moisture content of maize kernels. This study was the effect of moisture of maize kernel in different fertilizer treatments in Debrecen. The flowing hybrids involved FAO340 and FAO410 in four replications and six treatments (T0 (N:0, P2O5:0, K2O:0), T1(N:30, P2O5:23, K2O:27), T2(N:60, P2O5:46, K2O:54), T3(N:90, P2O5:69, K2O:81), T4 (N:120, P2O5:92, K2O:108), T5(N:150, P2O5:115, K2O:135)). The moisture content depends significantly on the weather factor according to our studies this is the case also in other regions. There was a maximum water phase in the first stage from 110th to 120th days (15th until 24 August) in H340 and H410 too. Kernels had been the highest moisture content in this stage. Results showed that with the increasing amount of fertilizer would require more time the amount of moisture loss or dry matter stabilization. Overall, the traits related to the harvest time in the fourth treatment or level of fertilizer (T4) have the highest amount in this field, so there was need more time for the stabilization dry matter in treatment or fertilizers to best yield.
Keyword: Moisture content, Maize, Regression model, Drying down.

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INTRODUCTION

Whereas the maize reaches the physiological phase of maturity, it has about 30% moisture content. There are many factors (genotype, weather, soil, etc.) that can affect how quickly corn dries down in the field after reaching maturity. The warm and dry weather can increase the drying speed, while the wet and cold weather can slow it down. Also, if the sowing date has a late time, corn products tend to dry more slowly. Kernels lose moisture through the grain-filling period due to a combination of evaporative water loss and accumulation of kernel dry matter. Corn plants channel photosynthetic into the kernels during the grain fill period, increasing kernel dry weight [8].

Fertilizer consumption is especially nitrogen and phosphorus on maize higher than other crops. The corn cultivation showed from fertile lands gives an excellent crop. While it is not very successful in poor and low lands, so this point should be considered in choosing a place to grow corn. The researchers reported under the influence of NPK fertilizers increased value in the quantitative and qualitative corn characteristics [19, 20, 15].

Maturity is signified by the formation of an abscission layer at the base of the kernel. The maturity forms the hard starch layer reaches the base of the kernel. Kernel dry weight does not increase after this point. Corn may dry one point of moisture per day or more under desirable conditions. Conversely, corn may not dry at all on a cool in the rainy day [32].

The drying down rate is an important factor that includes ear, hybrids, weather, and planting date. Moisture content is drying per day in typical seasonal in 0.4 to 0.8. The maximum phases of losing up moisture per day were 0.10 on grain per day. In normal temperature exists differences between the fall months. Speeds drying rates relevant to warm dry weather too. [1]. The rate of water lost in hybrids tested, which indicates the range of regression lines. The process of losing water, the genetic base

determines the completion of kernel filling. Water shortages cause problems in physiological processes [23]. Path analysis showed a positive interaction between nucleation filling rate and percentage decrease in water percent, meaning that if the nucleation rate increased, water loss would be faster. The drying process of the black layer to harvest, dynamics, and duration of water greatly depend on climatic factors Hicks *et al.* [14]; Dobos [9]; Dobos and Szabó [10]. Water deficiency reduces dry matter accumulation rate and delays maturity [28, 29].

Water percentage is an important key parameter in define cereals kernels weight, the water, and dry matter, balance in growing kernels. The kernels water content responded to important information on grain growth and limitation condition, whereas reducing to the source-sink during the filling grain period [31, 7, 30, 25, 26, 27, 4, 6, 12, 22, 13, 11].

Increasing yield and water utilization in cereals could be by nutrient supplies [18, 23, 24]. If using low nutrient supplies, irrigation could be increasing moisture content in grain hybrids [20] Mousavi et al showed that in a similar condition about nutrient supplies the Armagnac cultivar loses more moisture content in the intensive drying down phase and, so it could be upon that the produced dry matter is more than in the case of the Sushi cultivar [19]. Physiological maturity is followed by a balance dry matter loss. FAO 380 hybrid had the highest weight at the time of physiological maturity lost most of its dry weight; therefore, FAO490 and FAO340 had higher values at the time of harvesting [3]. The objective of this study was the evaluation of the moisture content and morphological traits in harvest time on H340 and H410 by six treatment of fertilizer in Debrecen Hungary.

MATERIAL AND METHODS

In this study, the experimental plot held at the University of Debrecen, and the experiment carried out in the Centre for Agricultural Sciences, Institute of Crop Sciences at Látókép. The site was located in Eastern-Hungary, 15 km from Debrecen in the Hajdúság loess region and its soil is calcareous chernozem of the experimental well culture-state, medium-hard loam. Its humus content is medium, 2.8 %, its pH value is almost neutral, pH Kcl=6.2. The soil had good water management characteristics. The hybrids were examined in the experiment H340(FAO 340) and H410(FAO 410). Sowing performed on the 24th in April 2018 in a long term experiment. The hybrids were sown with a seed number of 72 000 plants/ha and this study applied to the Six fertilization treatments (Table 1). The daily precipitation sum is determined by local measurements, while the daily radiation and temperature data provided by the agricultural monitoring center of Debrecen University. Among the agrometeorological parameters, an analysis made of the precipitation during the growing season. The total rainfall was from May until October 291 mm. The precipitation value was before the 2018 growing season 341 mm in the winter period. The weather of April had a pleasing effect on the partly dry and warm but near to average of precipitation April until May (93.9 mm) on the dried seedbed condition. There was any problem with germination because of them had the good condition of soil and precipitation too. There were favorable precipitation and temperature during the growing season, then providing ideal condition for corn development, growth, and yield formation(fig 1).

Table 1: Fertilizer treatment used of long-term experiment

TREATMENT	N	P2O5	K2O	TOTAL
(T0) (CONTROL)	0	0	0	0
(T1)	30	23	27	80
(T2)	60	46	54	160
(T3)	90	69	81	240
(T4)	120	92	108	320
(T5)	150	115	135	400

To determine moisture content, we taken samples per 3 or 4 days in the following days: 15th, 18th, 21st, 25th, 28th, 31st August 2ed, 5th, 8th, 11st, 14th, 18th September. In the course of sampling, the weight of one hundred grains from the middle section of 4 ears was measured in each treatment. Weight of one hundred grains measured before and after drying by the device. All samples were put on the laboratory in 100 C. Harvesting was the 18th of September 2018. Evaluation statistics used by Minitab and MS Excel software.

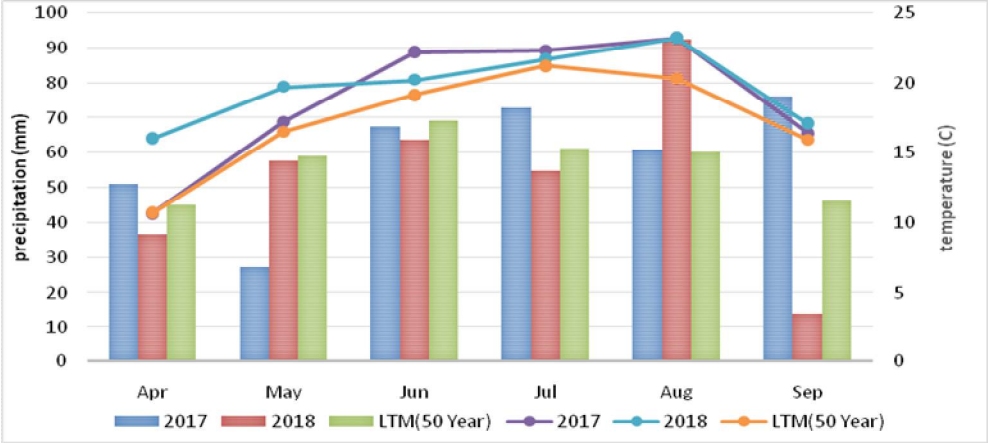

Figure 1: monthly mean temperature and precipitation in 2017 and 2018

RESULTS AND DISCUSSION

There was maximum moisture content in the first stage (the milk stage) from 110th to 120th days (15th until the 24th of August) for FOA340 hybrid and FAO410 hybrid. The grain contains the highest moisture content in this stage. The grain of the T2 and T4 lost moisture faster than in the other treatment. Also, the phase of intensive drying down (the second phase) was in the H340 from 120th to 140th days (24th of August until 13rd of September) and 120th to 135th days (24th of August until 8th of September) on the H410 too. The H340 (in T2 and T4) loses moisture longer and moisture content so it can conclude that it produces more dry matter than the H410 (in T4). The phase of physical drying down was 140th to 145th days (13rd until 18th of September) on the H340 and 135th to 145th days (8th until 18th of September) on the H410 too. There are drying periods longer in T2 and T4 on the H340 also, there was higher moisture content with 410 on T4 (figures 2,3).

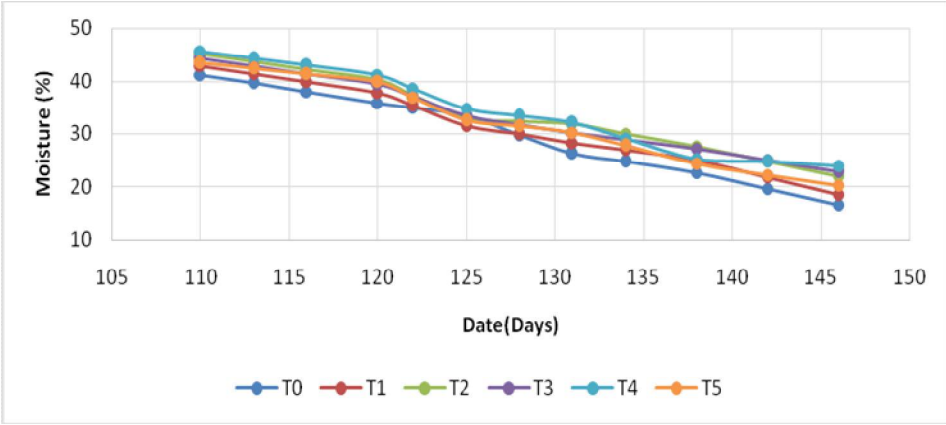

Figure 2 Phase of drying down for Fao410 in different fertilizer treatments 2018

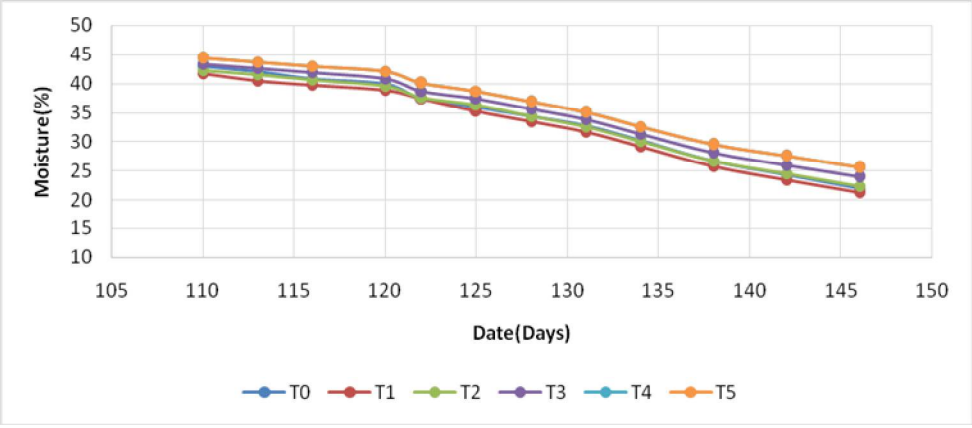

Figure 3 Phase of drying down for Fao340 in different fertilizer treatments 2018

In regression, the goal 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. The next step was to examine how the location affected the drying dynamics in the H410 and H340 hybrids. The drying down rate was similar together in hybrids, which had suitable kernel hybrids in fertilizer treatment. In regression analysis on FAO340 hybrid, the determination coefficient was around 0.98. Also, on the FAO410 hybrid, the coefficient of determination was around 0.97. The determination coefficient explained the total drying down the water movement amount. (table 2).

Table 2 Drying down dynamic of maize hybrids with different genotype in the intensive phase (Debrecen, 2018)

	Regression equation	R^2
T0 H410	y = -2.2428x + 44.758	R^2 = 0.98
T1 H410	y = -2.682x + 47.019	R^2 = 0.99
T2 H410	y = -2.4151x + 48.711	R^2 = 0.97
T3 H410	y = -2.2137x + 47.611	R^2 = 0.98
T4 H410	y = -2.1724x + 48.741	R^2 = 0.99
T5 H410	y = -2.219x + 47.095	R^2 = 0.99
T0 H340	y = -1.9378x + 46.672	R^2 = 0.97
T1 H340	y = -1.8993x + 45.489	R^2 = 0.97
T2 H340	y = -1.8713x + 46.182	R^2 = 0.97
T3 H340	y = -1.8296x + 47.131	R^2 = 0.97
T4 H340	y = -1.7895x + 48.174	R^2 = 0.97
T5 H340	y = -1.8392x + 45.747	R^2 = 0.97

The beta coefficient was negative values in the regression coefficient in all the equations that showed the loss trend of moisture in the seed that has the highest coefficient on the FAO410 hybrids in the first treatment from fertilizer (T1), the control treatment (T0) had for FAO340 hybrid. However, FAO340 and FAO410 hybrids exist the highest α in the fourth treatment fertilizer (T4). On the other hand, the highest level of moisture content was in the fourth treatment and the best yield at this treatment on FAO340 and FAO410 hybrids. According to the result, the increasing yield the fertilizer treatment and added time need to the dry matter stabilization. Hence, further investigations, in this case, will result in the appropriate for harvesting time and the dynamics of water. In general, it can be said that increasing the number of fertilizer doses in the hybrids need a longer period to reach moisture content for harvest time. The highest amount of moisture content was from harvest time on the fourth treatment compared to the other treatment. Also, the grain yield moisture had the highest value in the fourth treatment of fertilizer (T4) on the hybrids. The stem diameter plant was a higher value in the fourth treatment (T4) in hybrids than in the other treatment. In general, the highest amount of physiological traits was on the fourth treatment (T4) in hybrids (tables 3, 4, 5, 6).

Table 3 Phonological index of H410 hybrids on different fertilizer treatment Debrecen 2018

	T0	T1	T2	T3	T4	T5
Plant Height (cm)	238	256	275	256	272	265
Number of nodes	12	13	13	13	13	13
Stem Diameter (mm)	13	13	13	13	14	13
Number of leaves	12	13	13	13	13	13
Ear Length (cm)	18	20	21	19	21	19
Ear Diameter (mm)	45	45	45	46	46	45
Number of rows per ear	15	15	16	16	16	16
Number of column per ear	28	34	35	37	38	40

Table 4 Phonological Parameters of H340 hybrids on different fertilizer treatment Debrecen 2018

	T0	T1	T2	T3	T4	T5
Plant Height (cm)	210	221	242	264	278	271
Number of nodes	12	13	13	13	13	13
Stem Diameter (mm)	12	13	14	14	15	14
Number of leaves	13	13	13	13	13	13
Ear Length (cm)	21	19	21	20	21	20
Ear Diameter (mm)	44	45	46	44	45	46
Number of rows per ear	16	17	16	16	17	17
Number of column per ear	33	34	40	41	42	35

Table 5 Physiological maturity time Yield elements and result of H410 hybrids of various genotype Debrecen 2018

	T0	T1	T2	T3	T4	T5
One thousand grain weight(g)	294	324	330	320	314	326
Grain weight per ear(g)	107	168	185	191	199	195
Number of grains per ear(pcs)	370	506	626	605	607	588
Yield at 14% moisture content(t/ha)	2.11	3.67	3.81	4.64	4.67	4.49
Grain moisture at harvesting (%)	16	18	22	23	24	20
Cob weight (g)	19	27	28	29	31	30
Corn/Cob ratio %	82.15	84.04	84.86	84.55	84.46	84.54

Table 6 Physiological maturity time Yield elements and result of H340 hybrids of various genotype Debrecen 2018

	T0	T1	T2	T3	T4	T5
One thousand grain weight(g)	317	314	326	328	334	353
Grain weight per ear(g)	139	173	167	184	213	170
Number of grains per ear(pcs)	507	521	612	606	625	563
Yield at 14% moisture content(t/ha)	2.98	3.67	3.83	4.05	4.35	4.25
Grain moisture at harvesting (%)	21.91	21.20	22.33	23.89	25.52	22.27
Cob weight (g)	25	29	27	33	29	27
Corn/Cob ratio %	82.34	90.68	88.05	84.31	83.96	84.24

CONCLUSION

In this study, it found that both hybrids would require more time the amount of moisture loss or dry matter stabilization with an increasing amount of fertilizer. The highest amount of traits (Plant height, Ear Length, Grain weight per ear, Number of grains per ear, Number of rows per ear, Number of column per ear, Grain moisture at harvesting) were fourth treatment or level of fertilizer (T4), So needed more time for the stabilization of drying down in best yield on doses fertilizers. More investigation of the patterns of absorption and loss of water during seed filling and drying is necessary considering the importance of moisture content in the harvest.

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