DRYDOWN COEFFICIENT ANALYSIS IN SOME COMMERCIAL CORN HYBRIDS

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Abstract

The concept of drydown or loss of water from the corn grain has been little studied in Romania. Hybrid seed manufacturer's recommendations are not always complete in terms of water loss rate of the grain, than may cause additional costs for farmers, represented by drying after harvest. Choosing a hybrid for a farm must also consider the possibilities of artificial drying, if the selection does not considering an analysis of the rate of water loss of the grain. Also having knowledge about the rhytm of loss of water from grain grown hybrids, we can expect early harvest and a harvest schedul. Based on these considerations, in the spring of 2015, in the village Lovrin, Timisoara, was placed an experimental field that was aimed to evaluate the rate of water loss of the corn grain. It was analyzed a set of 18 commercial hybrids in Romania, assigned in groups of maturity FAO 260-510. Moisture determinations occurred in the first phase to identify physiological maturity stage (humidity 30%) of 3 in 3 days (black layer). Subsequently, determinations were made daily up to a humidity of 15% for each hybrid. Results indicate a percentage of water loss from the grain from 0.28 to 1.1% daily depending on the hybrid. Thus, early hybrids lose water more uniformly than late hybrids (0.58%/day and 0.86%/day). Immediately after reaching physiological maturity, the rate of water loss from early grain hybrids is slower than late hybrids values being 0.47%/day and 0.79%/day respectively. With the synthesis of dry matter in kernel of physiological mautiry value for technological maturity (15%), the rate of water loss in grain presenting values of 0.38%/day for early hybrids and 0.43%/day for late hybrids. Another aspect experimentation was seized after concluding that hybrids flint grain lose water more slowly than dent grain hybrids, averaged 0.33%/day and 0.73%/day respectively.

Key words: drydown, later loss in corn, black layer

Corn kernels lose moisture through the grain filling period due to a combination of evaporative water loss and accumulation of kernel dry matter. Corn that is mature will have a "black layer" that appears at the base of the kernel. The appearance of this black layer designates the end of dry matter accumulation (Geyer A., Thomison P., 2006). Although corn is harvested at high grain moistures for silage and seed corn, ideal harvest moistures for field corn range from 15 to 20% (R. Elmore, L. Abendroth, 2007). Several factors impact the rate of dry down: weather, hybrid, planting date, and ear characteristics.

On average, typical seasonal drying rates range from 0.4 to 0.8% moisture loss per day (B. de Jager *et al,* 2004; Brooking I.R., 1990; Duncan W.G., Hatfield A.L., 1964). If the fall months vary from normal in terms of temperature or moisture, the rate of dry down will differ. For example, wet and cool weather will delay drying.

Up to Hellevang K.J., 2004, they have recorded seasonal dry down rates less than 0.3 % per day. On the other hand, warm dry weather speeds drying rates. Kernels could lose up to 1.0% moisture per day. Considering that corn at maturity has about 30% water content it can be easily take 14-25 days for grain moisture of 15% (Filipenco A. *et al,* 2013). Tarter *et al* (2004) and Goodman M.M. (2005), report that tropical germplasm, when directly introduced in temperate environments, has high grain moisture content at harvest.

Typical for cobs corn hybrids are important in the rate of loss of water from grain. They have a larger effect when outside conditions are unfavorable to a rapid loss of water (Sweeney P.M. et all., 1994).

- *The number and thickness of husk leaves*. "A good cob dressed" can lead to a slower loss of water from grain.
- *Senescence of husk leaves*. The faster dryed of husk leaves may favors a rapid loss of water.
- *The "covered" of the ear*. A cob well covered, compact, losing harder water than a cob with husk lax, allowing a "breathing".
- *Position the ear*. It is preferable to have a semibent cob, allowing drainage of rainwater. Erected maturity cobs are not desirable, that may accumulate water from rainfall. Total bent ears

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favors their fall from husks, the losses can be sometimes significant.

- *Properties of pericarp*. A flint lose water harder than a dent grain.

Conform to Reid L.M. *et al.,* 2010, **e**xternal factors can positively or negatively influence the rate of loss of water from grain. Thus, the positive factors that favor water loss grain are: sunlight intensity, temperature at ground level, air temperature, wind speed and evapotranspiration. Negative impact on the rate of water loss of the grain may be: air relative humidity, soil moisture and plant density.

MATERIAL AND METHOD

Study guidelines

A field experiment in a split-plot design, with three replicates, was conducted in 2015, at the Agro Marincus SRL, Lovrin, Timis. (45°59`07.2``N, 20°45`19.0``W). Precursory plant was winter wheat (fertilized with complex 2:1:1, 600 kg/ha). Date sowing took place on 05/05/2015 and harvests were held according to established protocol. Basic fertilization took place in seedbed preparation with 200 kg/ha, with complex 2:1:1. During the growing season was carried out a single tillage that has been applied a dose of 200 kg/ha 2:1:1. To combat pathogens, it was applied at a dose of 1.2 l/ha fungicide Opera, with foliar fertilization with 1.5 l/ha YaraVita Zintrac. Weed control was performed by herbicide Nicosulfuros 40g / l and 600g SDMA acid from 2.4D l/ha.

The experimental protocol on moisture determinations had two phases, as follows:

1. Transitions field of 3 in 3 days to assess physiological maturity stage. When a variety was noted, transitioning field from two in two days to determine the exact humidity of 30%.

2. After a maturity of 30 %, daily passage for determining the rate of loss of water from the grain, to maturity of 15 %.

For moisture determinations were harvested five cobs for each determination in each set; seeds were mixed making a sample to be analyzed. Moisture content was determined using the analyzer Pfeuffer E50.

Materials

Hybrids analyzed are from group of maturity FAO 260-510. Of these, 15 hybrids are dent grain and 3 are flint grain. At the 15% moisture were harvested 10 cobs of each variant for analyzing biometric cob. After flowering-silking period, when vegetative stage stopped, were determined by measuring the 10 plants for each variant, plant size and height of insertion of ear (*table 1*).

Climate conditions

The climate of Lovrin zone is temperate continental one, with shades of excessively during the summer. Excessivity climate is due to very high temperatures during the day, from early morning until after sunset. Often, the high temperatures associated with the heat (*figure 1*). The hail storms are often too.

The soil where the trial was conducted is a cambic chernozem in class 2 source of evaluation according to the National Research-Development Institute for Soil Science and Agricultural Chemistry Environmental Protection (ICPA).

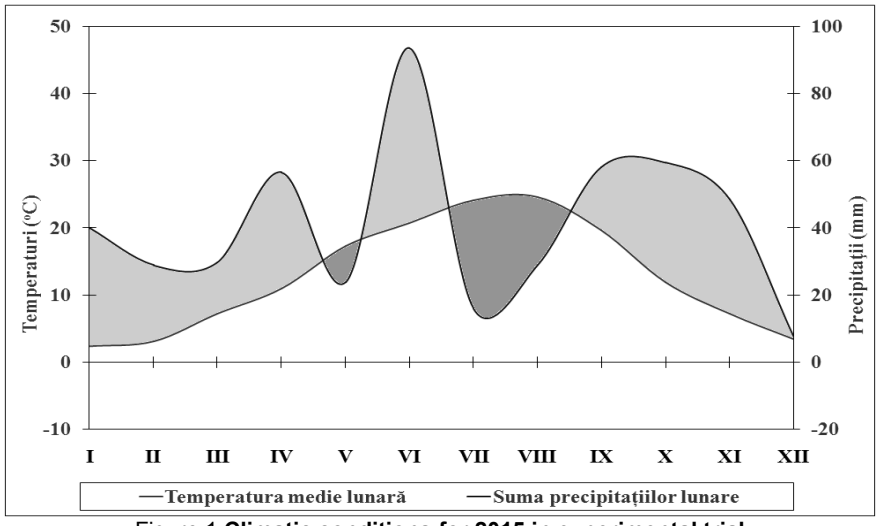

Figure 1 **Climatic conditions for 2015 in experimental trial**

RESULTS AND DISCUSSION

The main limiting factor is the temperature in corn production. In 2015, during the growing season of maize, constant heat on a widely varied values ranging from 6°C at night to 38°C during the day. During the growing season corn accumulate a growing number of thermal units (GDU) differently depending on minimum and maximum temperatures recorded during the day (Cavalieri A.J. and Smith O.S., 1985).

Theoretical predictions inclined to anticipate the rate of loss of water from grain according to this indicator. So, when GDU daily amount is around 12, the rate of water loss in grain is 0.5%. The situations in which the daily amount GDU is located around 17, the amount of water lost from the grain is 0.6%, while values of 22 GDU day lead to a rate to slow water loss of the grain, the 0.75%/day (Lana M.R. *et al,* 2014).

In a study undertaken in 2015 have been determined using Duncan test for differences between the versions on silk and physiological maturity. We also configured data in a range of 2 weeks from silky to physiological maturity, which was established corn moisture level, as outlined in *table 2*.

Thus, they highlighted the number of days from vegetative emergence to flowered-silk and from vegetative emergence to physiological maturity (30% moisture). Duncan test confirms both silking data and for physiological maturity, also, that the maturity group has significant influence over these periods. The earliest hybrids silky faster than later hybrids, amount of GDU being lower than those last mentioned.

The results are confirmed by Hellevang K, 2004, which states that hybrids FAO 260-340 GDU 1350 are required for the onset of flowering, grain filling beginning of 1890 and 2710 GDU to reach physiological maturity. For hybrids 350-550, 1350-1375 GDU needed early flowering and 2790-2870 GDU to physiological maturity

Table 1

The characteristics of studied hybrids

Hybrid	FAO*	Kernel type**	Plant height (cm)	Ear insertion (cm)	No of rows/ear	No of seeds/row	Ear length (cm)	Yield grain/cob (%)
Hyb1S	290	D	229	113	16	41	19.9	0.87
Hyb2E	350	F	251	102	18	34	19.6	0.81
Hyb3P	350	D	252	93	18	37	20.8	0.82
Hyb4L	380	D	261	89	20	41	21.2	0.83
Hyb5D	450	D	260	87	18	35	20	0.81
Hyb6O	430	D	273	91	18	45	21.8	0.84
Hyb7M	400	D	262	105	18	41	23.8	0.81
Hyb8SA	490	D	253	90	18	37	23.2	0.80
Hyb9M	400	F	248	111	18	33	18.3	0.77
Hyb10P	310	D	257	98	16	38	20.6	0.86
Hyb11K	350	D	252	98	16	35	21.8	0.81
Hyb12M	400	D	256	97	16	30	18.2	0.86
Hyb13O	400	D	278	103	14	39	21.5	0.83
Hyb14A	490	D	253	113	18	39	21.6	0.83
Hyb15L	510	D	271	102	14	39	20.8	0.80
Hyb16C	260	D	268	109	18	35	21.5	0.86
Hyb17E	350	F	263	98	16	37	21.8	0.84
Hyb18R	340	D	259	108	18	37	19.5	0.85

*FAO-conform to seeds provider; **D-dent; F-flint

Weeks sampling to identify moisture from the cob bring more information to farmers in the Lovrin area. Knowing this data the farmers can prepare a plan for irrigation, so grain filling to be done faster and in a greater amount. The rate of water loss in grain after physiological maturity is strongly influenced by the rate of accumulation of dry matter during flowering - physiological maturity.

Evaluating the days on which a hybrid reach physiological maturity and the difference between them and the days to flowering - silking, conditions of excessively in period of August-September, when there were high temperatures lead to reducing the filling grain and default the rate of water loss of the grain, as can be seen in *figure 2*.

The corn hybrids with flint pericarp lose hardest water at physiological maturity of grain. Water losses of the grain are 0.33% and 0.46% for hybrids and Hyb9M, respectively Hyb17E. With special purpose in food or feed for higher protein content (up to producers of these 2 hybrids), productions were 5.8 t/ha, respectively 8.57 t/ha.

Research conducted by Milomi F. *et al.*, 2013, confirms that flint hybrids are less productive than dente ones, average productions in 2001-2004 being 6.20 t/ha, respectively 6.39 t/ha in favor of dent hybrids.

Table 2

Evaluating cob moisture during the filling of grain; silking and physiological date

Genotype	FAO	Silking date*	Cob moisture value				Physiological maturity**
			Week 1	Week 3	Week 5	Week 8	
Hyb1S	290	58 a	60.8 abcd	50.4 cd	39.6 de	30.7 h	114 a
Hyb2E	350	59 b	61.4 cde	50.2 cd	38.8 def	27.9 d	113 a
Hyb3P	350	60 bc	61.2 bcde	50 cd	38.6 de	27.7 c	114 a
Hyb4L	380	61 cd	61.8 bcde	50.6 cd	39.2 def	28.3 d	116 b
Hyb5D	450	67 g	59.8 a	48.6 ab	37.2 c	26.3 ab	120 ef
Hyb6O	430	66 fg	61.7 bcde	50.5 cd	39.1 def	28.2 d	119 de
Hyb7M	400	63 e	62.8 ef	51.6 d	40.2 h	29.3 def	119 de
Hyb8SA	490	69 h	61.2 bcde	47.7 a	33.8 a	25.6 abc	120 ef
Hyb9M	400	65 f	63.1 f	51.9 d	40.5 fgh	29.6 fgh	121 f
Hyb10P	310	61 cd	62.5 ef	52.1 d	41.3 i	32.4 i	117 bc
Hyb11K	350	62 de	62.8 def	51.6 d	40.2 gh	29.3 efg	118 d
Hyb12M	400	66 f	62.4 ef	51.2 d	39.8 efg	28.9 de	121 f
Hyb13O	400	63 e	63.2 f	52 d	40.6 h	29.7 fgh	119 de
Hyb14A	490	70 hi	62.7 ef	49.2 ab	35.3 b	27.1 bc	124 g
Hyb15L	510	71 i	61.7 cde	48.2 ab	34.3 a	26.1 a	124 g
Hyb16C	260	56 a	59.9 ab	49.5 bc	38.7 d	29.8 fgh	112 a
Hyb17E	350	60 bc	60.1 abcd	48.9 ab	37.5 c	26.6 abc	113 a
Hyb18R	340	62 de	60 abc	49.6 bc	38.8 d	29.9 gh	118 cd

*number of days from emergence until 50% of the plants with silk;
**number of days from emergence until physiological maturity (30% moisture)
***the same letter means that there is no significat differences between values conform to Duncan test

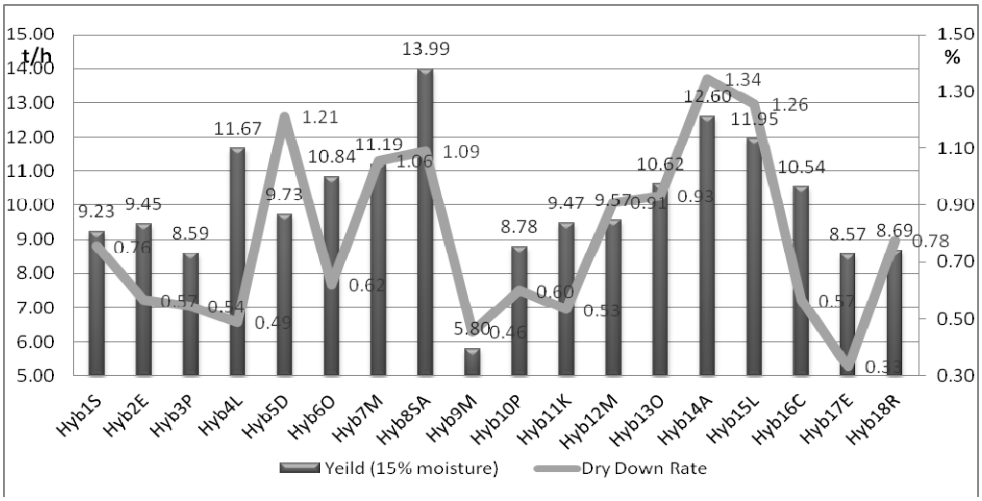

Figure 2 **Yield obtained (t/ha) and daily dry down rate (%)**

An interesting thing to come into effect noted in research Planinica, Serbia by staff previously mentioned, is that in the years to incidents climate (drought and excessive rainfall), flint hybrids appear to be more tolerant of the vagaries of weather.

In terms of corn, in Romania the loses of water from grain at physiological maturity rather

quickly, allowing early harvesting and preparing the ground for sowing grain cereals, wheat-corn-wheat rotation is most commonly used by romanian farmers.

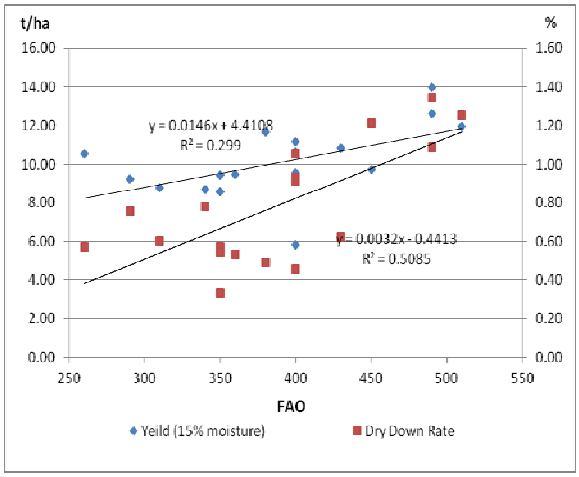

Figure 3 **Correlation between yield, DDR and FAO group in experimental trial**

The chart in figure 3 clearly observe positive correlations between yield capacity for hybrids and water loss rate of grain from them, according to the FAO maturity group. The yield capacity of hybrids FAO group is influenced, but not significantly.

This becomes an important in choosing a hybrid maize genetic fingerprint, that is more important than FAO chosen group.

If productivity is greatly influenced, FAO group becomes more influential in water losses of the grain. Thus, a hybrid corn loses water faster than another, if it belongs to a group of lesser maturity. This becomes important especially for large farms where harvesting can organize phased knowing this element and preventing a delay in the works fall and even the vagaries of the weather.

The graphical representation of the results emphasizes individual exceptions of hybrids tested. The good results of the rate of water loss in grain is assigned to FAO 450-510 range, while hybrids of FAO 350-450 maturity values shows the rate of water loss of the grain on a larger scale.

Clustered near linear axis, hybrids FAO 250-350 shows small amplitudes, insignificant statistically. Thus, the analysis of correlation coefficient, that originates with increasing maturity group hybrids grown in the Lovrin area, individual value increases and the rate of water loss of the grain, but the difference is not significant. Explanation of this correlation is based on the fact that the physiological maturity of 30% to 15% technological maturity, a late hybrid has the ability to lose water faster than a hybrid or early-early.

The results show a consistent intuitive hypothesis primary, but the difference makes the filling time of the grains immediately after flowering–silking and up to physiological maturity of 30%, individual values making exceptions (such as grain glassy losing water harder than dent hybrids).

CONCLUSIONS

In local conditions of Romania, the loses of water from grain at physiological maturity rather quickly, allowing early harvesting and preparing the ground for sowing grain cereals, wheat-corn-wheat rotation is most commonly used by romanian farmers.

The corn hybrids with flint pericarp lose harder water at physiological maturity of grain. There is a positive correlation between yield and water loss rate of grain, according to the FAO maturity group. The yield is influenced by FAO group, but not significantly.

Duncan test confirms both silking data and for physiological maturity, also, that the maturity group has significant influence over these periods. The earliest hybrids silky faster than later hybrids, amount of GDU being lower than those last mentioned.

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ACKNOWLEGMENTS

This study was conducted as a motivation of collaboration with APPR (Romanian Association of Corn Producers), showing a deciding factor in choosing a corn hybrid.

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