YIELD POTENTIAL EVALUATION IN CORRELATION WITH QUALITY CROP INDICES OF MAIZE HYBRIDS GROWN IN IALOMIȚA COUNTY

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Abstract: *Maize (Zea mays L.) is the most important cereal grown in Romania and is produced all over the country under diverse climate and environment conditions. Besides all these environmental factors (temperature, precipitation, fertilization, etc.), the used hybrids play an important role to establish the final production and quality parameters. The experimental research was carried out in the agricultural year 2017 in Grindu and Gheorghe-Doja communes in Ialomița County, using four hybrids: Pioneer* ***P9903*** *(FAO 360, mid-early),* ***P9537*** *(FAO 350, mid-early) and Dow Seeds* ***DA Sonka*** *(FAO 380, mid-early),* ***DS 0336C*** *(FAO 320, early). The research objective was to determine the influence of the hybrids on the following indices: yield, % kernel/cob, 1000 kernel weight (TKW), starch and crude protein content, and also to establish a correlations between yield capacity and quality indices for tested hybrids. All maize hybrids were have been cultivated under the same fertilisation conditions. In order to achieve the necessary data, some soil analysis were performed (soil pH, phosphorus and potasssium mobile forms, humus) ans also plant analysis (dry matter, total nitrogen content, crude protein and starch content). The experimental results indicated that the* ***DA Sonka*** *(mid-early) and* ***DS 0336C*** *(early) hybrids had the best performance on yield capacity due to a very high production potential and also provided a high crude protein content.* ***P9903*** *(mid-early) and* ***P9537*** *(mid-early) hybrids have higher starch content compared to* ***DA Sonka*** *hybrid who had the lowest value. Among the four tested hybrids under the described pedoclimatic conditions, the recommended hybrid is* ***DA Sonka****, because it has the highest protein content (a very important indicator of crop quality) and also was highlighted with the highest yield. The conclusions of the research underline the importance of choosing the optimal hybrid in order to obtain a high quality crops with high yields.*

Key words: *crude protein, hybrids, maize, starch, yield components*

INTRODUCTION

Maize (*Zea mays*), also called corn, is native to Central America and was cultivated 7000 years ago by Native Americans who transformed maize into an important source of food. Maize contains approximately 72% starch, 10% protein, and 4% fat, being one of the most consumed crop in the world. It is processed into a large variety of food and industrial products, including starch, sweeteners, oil, beverages, glue, industrial alcohol, and fuel ethanol (RANUM et al., 2014). Maize is the most important cereal grown in Romania and is produced all over the country under diverse climate and environment conditions. According to an economic analysis on maize market during 2010-2014, Romania ranks on the first place among European Union contries regarding cultivated area with maize and in our country, this crop present the highest average production in comparison with other cereals (SOARE AND DOBRE, 2016).

Maize provides the highest yields on fertile, deep, clay-sandy soils that allows the development of a powerful root system capable of supplying the plant with water and nutrients at optimal levels (ION, 2010). Maize is a high nutrient consuming crop and it is proven that fertilization influences yield and crop quality. Accordingly, there are many researches that sustain the importance of fertilization (AILINCĂI ET AL., 2007; NIȚĂ ET AL., 2007; MARKOVIC ET AL., 2017; SZMIGIEL ET AL., 2013) and irrigation (DOMUȚA ET AL., 2004; DOMUȚA, 2016;

KARASU ET AL., 2015; MADJAR ET AL., 2017; MARKOVIC ET AL., 2017), as well. Thus, a study (NIȚĂ ET AL., 2007) evidence that nitrogen fertilization produce protein increase from 11.23% for a nitrogen rate of N_{100} to 11.94% for a nitrogen rate of N_{200} and to 12.74% for N_{300} level.

Regarding water regime, maize has high requirements, but it is also a drought-resistant plant. Specific consumption is between 230-440 mm. The optimal precipitation levels are from 60-80 mm in May, 100-120 mm in June, 100-120 mm in July and 60-80 mm in August (ROMAN ET AL., 2011). Moreover, to obtain high yields, it has been stated that maize plants need 200-300 mm rainfall from 10 leaves stage to 50% whole plant humidity (HĂLMĂJAN ET AL., 2017).

The research carried out in agricultural year 2017 in Grindu and Gheorghe-Doja communes from Ialomița County had following objectives: (**i**) the investigation of variability of maize production indices (yield, % kernel/cob, 1000 kernel weight), (**ii**) the investigation of variability of maize quality indices (starch and protein contents) and (**iii**) development of correlations between yield capacity and quality indices for maize tested hybrids.

MATERIAL AND METHODS

1. Experiment location

The experimental research was carried out in the agricultural year 2017 and it followed the variability of the production capacity and the quality of the harvest for some maize hybrids cultivated under the pedoclimatic conditions in Grindu and Gheorghe-Doja locations in Ialomița County. As geographic positioning, both Gheorghe Doja and Grindu villages are situated in Ialomița County which is part of Wallachian Plain. The eastern area is characterized by hot summers and cold winters (Cofas et al., 2014).

The soil a typical chernozem, with lute-clay texture in the first part of the profile and becomes loose to its base, to the sandy-clay. The depth of groundwater is over 10 m.

2. Maize hybrids used in experiment are depicted in table 1.

Table 1

Presentation of maize hybrids

Maize hybrids	Classification	Plant density	Reference
P9903	FAO 360, mid-early	65.000 plants/ha	www.pioneer.com
P9537	FAO 350, mid-early	65.000 plants/ha	
DA Sonka	FAO 380, mid-early	60.000 plants/ha	www.msdssearch.dow.com
DS 0336C	FAO 320, early	60.000 plants/ha	

3. Fertilization scheme is presented in table 2.

Table 2

Fertilization program

Period of time	Fertilizer	Dose
Early March	NH_4NO_3	200 kg/ha
Early April	NPK 18:46:0	100 kg/ha
Late April	NPK 12:12:12	100 kg/ha

4. Soil and plant analyses, methods and instrumentation are presented in table 3.

Table 3

Presentation of soil and plant analyses

Soil agrochemical characterization		
Analyses	**Method**	**Apparatus**
pH_{H2O} (1:2.5)	potentiometry	Hanna pH-meter
Moisture	gravimetry	Binder oven
Potassium (mobile form), K_{AL}	flame emission spectrometry	Sherwood 410
Phosphorus (mobile form), P_{AL}	spectrophotometry	CECIL 2041 spectrometer
Humus content	Walkley-Black-Gogoaşă	-
Plant analyses		
Dry matter content	gravimetry	Binder oven
Total nitrogen (for protein content)	Kjeldahl method	Digesdahl system Hach, Gerhardt Vapodest
Starch content	polarimetry	PLRS-200 polarimeter

RESULTS AND DISCUSSION

The results of the analyses presented in table 4 were compared with limits presented in literature (MADJAR R., 2008).

Table 4

The results of agrochemical mapping

Hybrid	**Soil reaction**		**Soil humus and nutrient supply**					
			Humus		Posphorus		Potasium	
	pH	Soil reaction	%	Level	P_{AL} ppm	Level	K_{AL} ppm	Level
P9903	5.88	Slightly acidic	2.71	Medium	22.25	Medium	240	High
P9537	6.04	Slightly acidic	2.94	Medium	34.96	Medium	260	High
DA Sonka	7.73	Slightly alkaline	2.59	Medium	45.24	High	280	Very high
DS 0336C	7.51	Slightly alkaline	2.88	Medium	63.78	High	220	High

Influence of the hybrid on the yield

Both **DA Sonka** (mid-early) and **DS 0336C** (early) hybrids had the best performance due to a very high production potential, good braking and drought resistance, with 170.91% and 142.85% compared to the last one of the four tested hybrids (**P9537**). The variance analysis shows significant differences on the yield (kg/ha) with values of 4790 kg/ha for **DA Sonka**, 2895 kg/ha for **DS 0336C** and 1885 kg/ha for the **P9903** hybrid, differences compared to the lowest yield, 6755 kg/ha for the **P9537** hybrid (Table 5).

Table 5

Influence of the hybrid on maize yield (kg/ha)

Hybrid	**Yield, kg/ha**
P9903	c8640
P9537	d6755
DA Sonka	a11545
DS 0336C	b9650
LSD 5%=168* kg/ha ; LSD 1%=254kg/ha; LSD 0.1%=408kg/ha	

There were made interpretations by LSD 5% indicated in the table by *

Influence of the hybrid on % kernels/cob

DA Sonka and **P9903** hybrids had the best performance with 103.4% and 102.27% kernels/cob respectively, compared with the last of the four tested hybrids (**DS 0336C**). The variance analysis does not indicate significant differences on the influence of the hybrid on %kernels/cob (Table 6).

Table 6

Influence of the hybrid on % kernels/cob

Hybrid	%kernels/cob
P9903	a90
P9537	a89
DA Sonka	a91
DS 0336C	a88
LSD 5%=3.01* %; LSD 1%=4.54%; LSD 0.1%=7.29 %	

There were made interpretations by LSD 5% indicated in the table by *

Influence of the hybrid on 1000 kernel weight (TKW)

The **P9903** and **P9537** ybrids had the best performance due to a very high production potential with 1000 kernel weight bigger with 119.37% and 116.56% than the last one of the four tested hybrids (**DS 0336C**). The variance analysis shows significant differences on hybrid influence on 1000 kernel weight, with differences of 62g for **P9903**, 53g for **P9537** and 8g for **DA Sonka** hybrid, differences calculated from the lowest obtained 1000 kernel weight, 320 g for the **DS 0336C** hybrid (Table 7).

Table 7

Influence of cultivated hybrid on 1000 kernel weight

Hybrid	TKW g
P9903	a382
P9537	b373
DA Sonka	c328
DS 0336C	d320
LSD 5%=5.99* g; LSD 1%=9.08g; LSD 0.1%=14.59 g	

There were made interpretations by LSD 5% indicated in the table by *

Influence of the hybrid on starch and crude protein content

The **P9903** and **P9537** hybrids had the best performance due to a very high starch content (%) with 107.13% and 103.13% higher values compared to the last of the tested hybrids (**DA Sonka**) (Table 8). The variance analysis shows significant differences of hybrid influence on starch content (%), with differences of 5% for **P9903**, 2.2% for **P9537** and 1.1% for the **DS0336C** hybrid compared with the lowest starch content value (70.1% for the DA Sonka hybrid).

Regarding the crude protein content, **DA Sonka** and **DS 0336C** hybrids had the best performance due to a high protein content, 103.72% and respectively 102.87% compared to the last one of the tested hybrids, **P9537**, with a content of 9.4% crude protein. The variance

analysis does not indicate significant differences on the influence of the hybrid on protein content (%) (Table 8).

Table 8

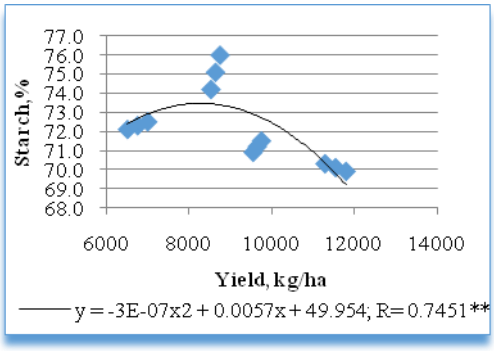
Influence of the hybrid on starch and crude protein content

Hybrid	Starch %	Crude Protein %
P9903	a75.1	a9.60
P9537	b72.3	a9.40
DA Sonka	d70.1	a9.75
DS 0336C	c71.2	a9.67
	LSD 5%=0.90* %; LSD 1%=1.37%; LSD 0.1%=2.21 %	LSD 5%=0.47* %; LSD 1%=0.72%; LSD 0.1%= 1.16%

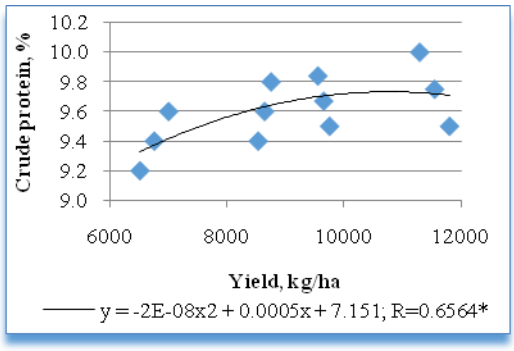
There were made interpretations by LSD 5% indicated in the table by *

Correlations between production components and quality indices for tested hybrids

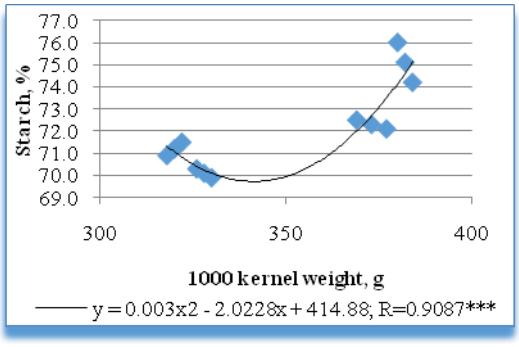
Between yield, 1000 kernel weight, production components and some quality indices such as starch, protein, there are correlations that determine the choice of a hybrid depending on the significance of the correlation.



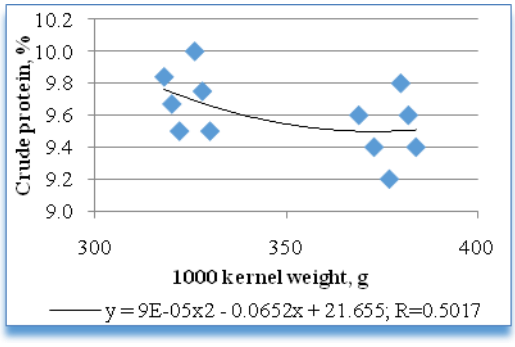
a. starch content and yield correlation



b. crude protein content and yield correlation



c. starch content and 1000 kernel weight correlation



d. crude protein content and 1000 kernel weight correlation

Figure 1. Correlations between production components and quality indices for tested hybrids

Maize starch content has a moderate correlation in signification with the yield, the correlation coefficient is R = 0.7451** (Figure 1, a). The crude protein content of maize correlates weak with the production capacity, the correlation coefficient is R = 0.6564* (Figure 1, b). Maize starch content has a strong correlation with 1000 kernel weight, the correlation coefficient is R = 0.9087*** (Figure 1, c). Regarding the correlation between the crude protein content of maize and 1000 kernel weight, the correlation coefficient R = 0.5017 was obtained, indicating a non -significant correlation (Figure 1, d).

CONCLUSIONS

On the basis of the researches undertaken during agricultural year 2017 in Ialomița County in order to evaluate the influence of the maize hybrids (P9903, P9537, DA Sonka, DS 0336C) on the yield components and quality ones, and also to establish correlations between yield capacity and quality indices for tested hybrids, it were obtained the conclusions detailed below.

1. The **DA Sonka** and **DS 0336C** hybrids had the best performance on yield capacity with an increase of 170.91 and 142.85%, due to a very high production potential and crude protein content (9.75% and 9.67% respectively), as evidenced by the positive significant correlation between the production component and the quality indices.
2. The **P9903** and **P9537** hybrids bring an yield differences of 5% and respectively 2.2% compared to the lowest obtained starch content (70.1%) for the **DA Sonka** hybrid, which is also confirmed by the significantly negative correlation between the starch content and the yield of the hybrids.
3. Between 1000 kernel weight, production components and some quality indices such as protein content, starch, there are correlations that determine the choice of a hybrid depending on the significance of the correlation.
4. Among the four hybrids tested under the described pedoclimatic conditions, the recommended hybrid is **DA Sonka** because it has the highest protein content of 9.75% and also was highlighted with the highest yield (11545 kg /ha).

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