EFFECT OF PLANT DENSITY ON THE MAIN PHYSICAL AND CHEMICAL INDICATORS OF SOME MAIZE HYBRIDS CULTIVATED IN THE ARAD PLAIN

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Abstract: *Of world production of corn about 6 to 10% is used in various industries. Thus maize is processed wet, dry and fermentative. By all these methods, from corn to obtain some basic products that are used to obtain more than 3500 products with uses in a man but also in animal nutrition.*
Variability of chemical composition of maize grain is given by the combined actions of the following factors: soil, climate, agricultural technique, local conditions of nutrition, conditioning and storage. The present study proposes to examine the production quality hybrid maize seeds from 6 to determine optimum sowing density.
Experience was located on a typical mold soil in the territory Plain Arad, Şemlac. In terms of physical characteristics, soil that was placed experience, providing favorable conditions for growing the plant Zea mays.
Bifactorial experience is that factor analysis, factor I is the biological material certified corn hybrids, Pioneer brand: Pr37M34, Pr36R10, Pr37N01, Florencia, Pr35F38, Pr35T06 - hybrids of groups FAO 450-500, and factor II is given sowing densities: 40,000 plants / ha, 55,000 plants / ha, 70,000 plants / ha.
The main physico-chemical indicators of the 6 grains of corn hybrids were determined in laboratory discipline Plant Growing: "Testing of the seed and plant material". Moisture, hectoliter mass, mass of 1000 grains, the percentage content of protein, starch and oil of maize grains were determined with analyzers NIR, which is the optimal solution for precise and rapid analysis of whole cereal grains and oilseeds.
Correlations were established between the physical evidence - chemical and density studied hybrids of maize plants. As the sowing density of three variants applied hybrids take the study as influencing indices of maize, but differently.
Results of this study are part of a doctoral program, with the theme: "Research on the influence of sowing density on production and its quality from 6 corn hybrids, climatic conditions of Plain Arad" scholarship program funded by the European Social din Pilot Program Fund to support research doctoral scholars, under contract POSDRU/6/1.5/2 USAMVB Timisoara, under the distinguished University Professor Dr. Valeriu Tabară

Key words: *corn hybrids, Plant density, Protein, fat content, starch, HM, Mas of 1,000 grains*

INTRODUCTION

In Romania, maize covers the largest areas, particularly in peasant households. Knowing and applying ways of increasing maize crop yield is a constant improtant concern for cultivators. Maximum valorisation of the biological potential of maize hybrids asks for a study at differetn densities in optimal cultivation technologies to prevent negative effects.

The goal of the present paper is to determine optimal plant density in six simple maize hybrids in order to obtain amximum crop yield per ha.

MATERIAL AND METHOD

The persent study aims at disseminating experimental results of the doctoral cycle for a duration of three years. Experimental data are orientative, and they represent only the first experimental year, 2009.

In order to test Pioneer maize hybrdis in the field, we set, in the Arad Plain – Şemlac area, a bi-factorial experiment in which experimental factors were: factor A – six Pioneer

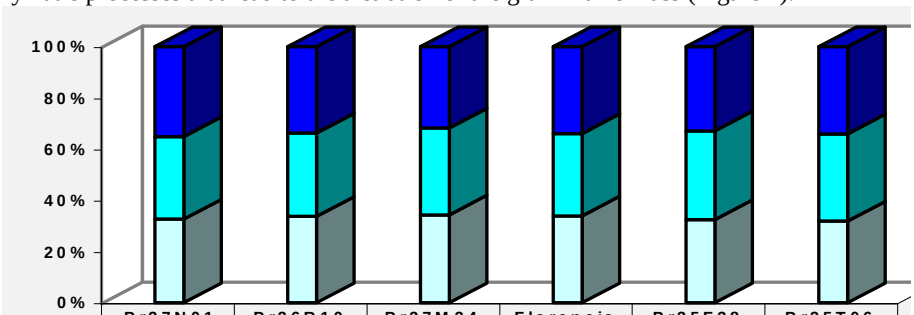
maize hybrids: a_1 – Pr37M34, a_2 – Pr37N01, a_3 – Pr36R10, a_4 – Pr35F38, a_5 – Florencia, a_6 – Pr35T06, factor B – plant density in maize with three garduations: b_1 – 40,000 plants/ha, b_2 – 55,000 plants/ha, b_3 – 70,000 plants/ha. Harvesting of the maize hybrids crops was done upon technical maturity.

Research aim at establishing an optimal plant density meant to produce maximal crop yields. To do so, we monitored maize crop yield quality in the sic Pionerr maize hybrids.

Physical and chemical tests of the present study were done in the "Seed and vegetal material quality etsting laboratory" using last-generation equipment: the number of seeds of the SC2 model to determine the mass of 1,000 grains, NIR analysers: Granomat Pfeuffer to determine moisture and OmegAnalyzer G – for an accurate and quick analysis of the entire grain from the point of view of protein, starch, and fat contents of the caryops. The laboratory is within the Department of Agricultural Technologies of the Faculty of Agriculture of the Banat University of Agricultural Sxceince and Veterinary Medicine in Timişoara.

RESULTS AND DISCUSSION

Maize grain moisture should not be above 14(12)-16%; otherwise, during perservation, there are biochemical processes related to respiration acceleration, followed by enzymatic processes that lead to the aletration of the grain maize mass (Figure 1).



	Pr37N01	Pr36R10	Pr37M34	Florencia	Pr35F38	Pr35T06
70000	10.1	9.3	8.9	9.5	9.2	9.4
55000	9.3	9	9.5	9	9.7	9.4
40000	9.4	9.3	9.6	9.5	9.1	8.8

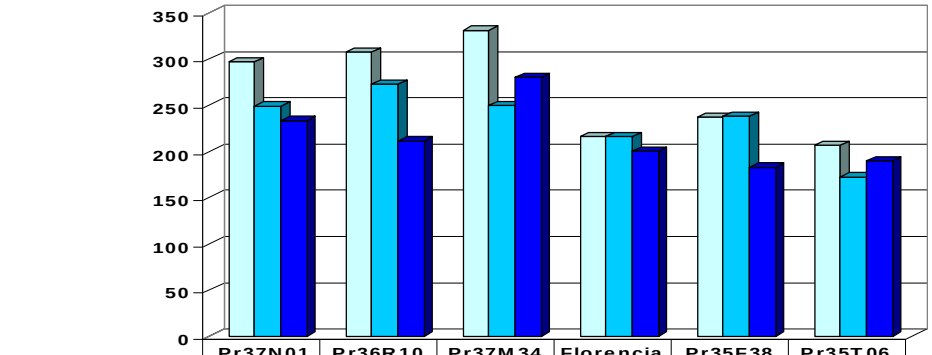
Fig.1: Assessing maize quality depending on the maize hybrid and on plant density for the quality indicator "MOISTURE"

In the laboratory, we determined the main physical features that play a determining role on crop yield (mass of 1,000 grains) and quality (hectolitrci mass). Both featuers are influenced by the etchnology applied and by soil and climate conditions of the crop.

The values of the mass of 1,000 grains and of hectolitric mass we studied under the imapct of plant density are shown in Figures 2 and 3. Analysing the values of the mass of 1,000 grains we can see that it vareid widely. The highest value of the mass of 1,000 grains depending on the maize hybrid and on the number of plants epr ha is in the simple semi-late maize hybrid Pr37M34 (Ribeira): 331.06 g for a plant density of 40,000 plants/ha, follwoed by the simple semi-late maize hybrid Pr36R10: 307.67 g for a plant density of 40,000 plants/ha, and the simple semi-late maize hybrid Pr37N01: 296.96 g.

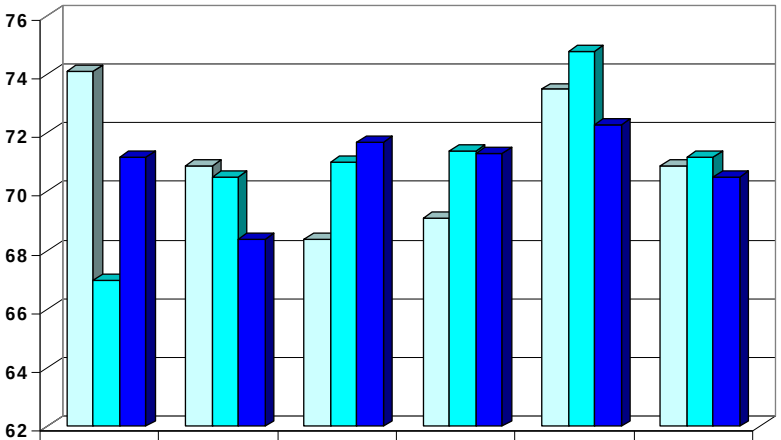
Hectolitric mass is of some importance for milling productivity and is strongly influenced by the technology applied and by soil and climate conditions. The value of hectolitric mass is negatively influenecd by unfavourable environmental conditions. The value

of hectolitric mass depends on grain moisture at the time the former is determined. High grain moisture deetrmines a erduction of the hectolitric mass. Maesureemnts of the mass of 1,000 grains and of hectolitric mass in the six maize hybrids were made when maize grain moisture was below 10%.



	Pr37N01	Pr36R10	Pr37M34	Florencia	Pr35F38	Pr35T06
MMB (g) 40000	296,96	307,67	331,06	215,77	236,63	206,44
MMB(g) 55000	249,05	272,64	249,82	216,2	238,01	172,3
MMB(g) 70000	233,21	211,24	279,7	200,15	182,98	189,42

Fig.2: Assessing maize quality depending on the maize hybrid and on plant density for the quality indicator "MASS OF 1,000 GRAINS"



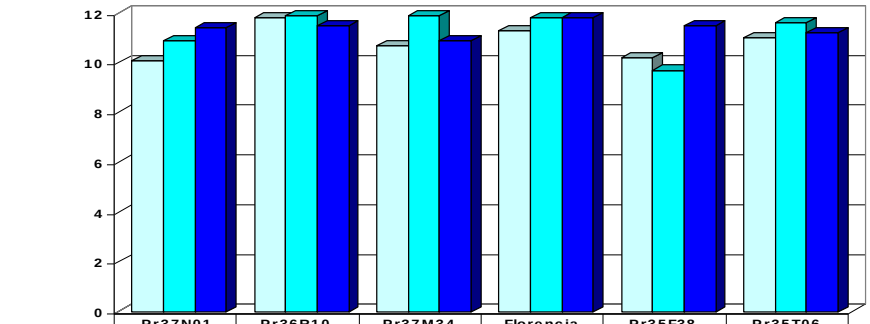
	Pr37N01	Pr36R10	Pr37M34	Florencia	Pr35F38	Pr35T06
MH(kg/hl) 40000	74,1	70,9	68,4	69,1	73,5	70,9
MH(kg/hl) 55000	67	70,5	71	71,4	74,8	71,2
MH(kg/hl) 70000	71,2	68,4	71,7	71,3	72,3	70,5

Fig.3: Assessing maize quality depending on the maize hybrid and on plant density for the quality indicator "HECTOLITRIC MASS"

High moisture in the soil and air results in starch-rich, low-protein grains and vice-versa. When maize is sowed more often, then the soil water reserve is sooner depleted: the

results are the similar to those due to low moisture, laeding to a decrease of starch content percentiles, to an increase of the protein content and to a slight increase of fat content (Velican 1957).

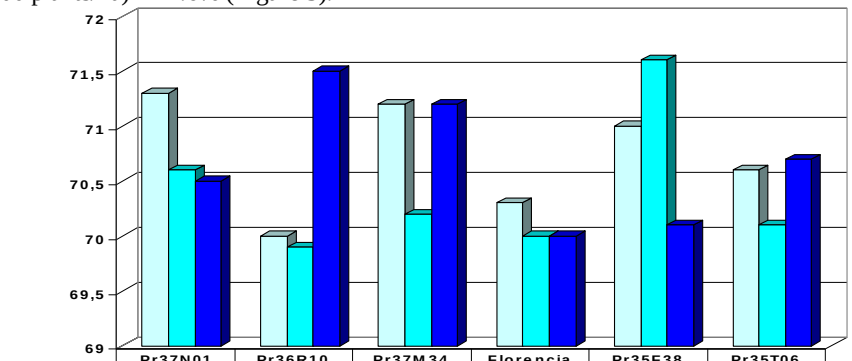
For the maize hybrids we studied in the soil and climate conditions of the Arad Plain in 2009, it is worth noting the higher protein content for a plant density of 70,000 plants/ha: an average of 11.37% compared to the average of the protein content of 11.30% for a plant density of 55,000 plants/ha, i.e. an average of the protein content of 10.85% for a plant density of 40,000 plants/ha (Figure 4).



	Pr37N01	Pr36R10	Pr37M34	Florencia	Pr35F38	Pr35T06
P% 40000	10,1	11,8	10,7	11,3	10,2	11
P% 55000	10,9	11,9	11,9	11,8	9,7	11,6
P% 70000	11,4	11,5	10,9	11,8	11,5	11,2

Fig.4: Assessing maize quality depending on the maize hybrid and on plant plant density for the quality indicator "PROTEIN"

The highest starch content is in the maize hybrid Pr35F38: 71.6% for a plant density of 40,000 plants/ha, followed by the maize hybrid Pr36R10 with a starch content: 71.5% for a plant density of 70,000 plants/ha; and 71.3% for a plant density of 40,000 plants/ha. To note that there are evry small differences between the values of starch content depending on maize hybrid and starch content depending on plant density, the limits of variation of starch content depending on plant density being: 69.9% (in the maize hybrid Pr36R10 for a plant density of 55,000 plants/ha) – 71.6% (Figure 5).

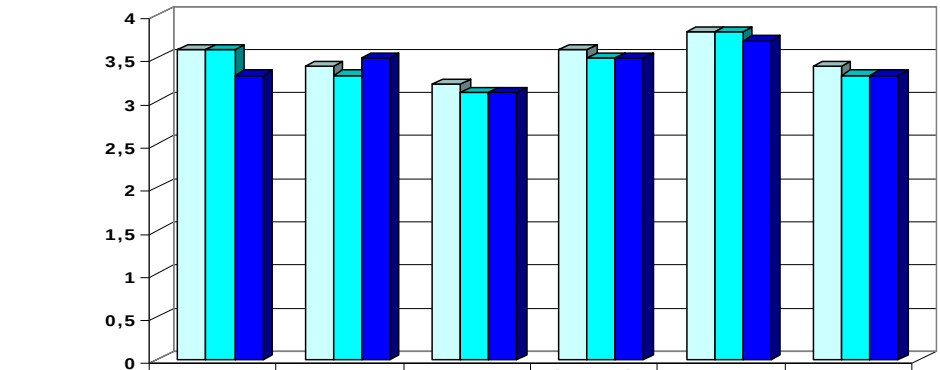


	Pr37N01	Pr36R10	Pr37M34	Florencia	Pr35F38	Pr35T06
A% 40000	71,3	70	71,2	70,3	71	70,6
A% 55000	70,6	69,9	70,2	70	71,6	70,1
A% 70000	70,5	71,5	71,2	70	70,1	70,7

Fig.5: Assessing maize quality depending on the maize hybrid and on plant density for the quality indicator "STARCH"

High soil moisture in the soil and air determines the fromation of grains that are poorer in fat and vice-versa. With the diminution of the distance, there is also a decrease of the protein content and (less regularly) a decrease of the fat content (Ioniță & Sluşanschi, cited by Săvulescu & Velican 1957).

Fat content in the six Pioneer maize hybrids with three garduations of palnt density per ha also avried within very low limits: 3.3% in the maize hybrid Pr37N01 for a plant density of 70,000 plants/ha and 3.8% in the maize hybrid Pr35F38 for plant densities of 40,000 plants/ha and 55,000 plants/ha.



	Pr37N01	Pr36R10	Pr37M34	Florencia	Pr35F38	Pr35T06
UI% 40000	3,6	3,4	3,2	3,6	3,8	3,4
UI% 55000	3,6	3,3	3,1	3,5	3,8	3,3
UI% 70000	3,3	3,5	3,1	3,5	3,7	3,3

Fig.6: Assessing maize quality depending on the maize hybrid and on plant density for the quality indicator "FAT"

CONCLUSIONS

Plant density in the cultivation technology of maize is one of the most dynamic crop yield factors.

Optimal plant density for maximum grain maize crop yield per area unit differs from one hybrid to another because of the significant interaction between hybrid and different plant densities.

The viability of the maize grain chemical composition is due to the combined actions of several factors: soil, climate, agricultural technique, local nutrition conditions, position of cob on the maize plant, fertilisers, conditioning and preservation (Farnham 2001; Widdicombe & Thelen 2002; Tokatlidis *et al*. 2005).

BIBLIOGRAPHY

1. DUNCAN, W.G., 1984 - *A theory to explain the relationship between corn population and grain yield.* Crop Science, 24: 1141-1145.
2. FARNHAM, D.E., 2001 - *Row spacing, plant density, and hybrid effects on corn grain yield and moisture*. Agronomy Journal, 93: 1049-1053
3. FASOULA, V.A, FASOULA, D.A., 2002 - *Principles underlying genetic improvement for high and stable crop yield potential.* Field Crops Research, 75: 191-209.
4. HAS, I., 2001 - *Priorităţi în ameliorarea hibrizilor de porumb timpurii*. Probl. genet. teor. aplic., XXXIII (1-2): 1-25.

5. MODARRES, A.M., HAMILTON, R.I., DIJAK, M., DWYER, L.M., STEWART, D.W., MATHER, D.E.,. SMITH, D.L., 1998 - *Plant population plant density effects on maize inbred lines grown in short-season environments*. Crop Science, 38: 104-108.
6. TOKATLIDIS, I.S., KOUTROUBAS, S.D., 2004 - *A review of maize hybrids' dependence on high plant populations and its implications for crop yield stability*. Field Crops Research, 88: 103-114
7. TOKATLIDIS, I.S., KOUTSIKA-SOTIRIOU, M., TAMOUTSIDIS, E., 2005 - *Benefits from using maize plant density-independent hybrids.* Maydica, 50: 9-17.
8. TROYER, A.F., 2001 - *Temperate corn – Background, behaviour, and breeding*. CRC Press Boca Raton London, New York, Washington, D.C.
9. WIDDICOMBE,W.D., THELEN, K.D., 2002 - *Row width and plant density effects on corn grain production in the northern Corn Belt.* Agronomy Journal, 94: 1020-1023.