Three different genotypes of maize hybrids yield response to sowing date and plant density changes

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Abstract: The small plot-field experiment was set up on chernozem soil at the Látókép research area of the University of Debrecen in four replications. The aim of the experiment was to set-up different genotypes of maize hybrids to study the effect of sowing date and plant density. The experimental plots were planted by a Gaspardo planters machine. We harvested the experiment with a SAMPO plot harvester that can determine their exact plot yield weight. We determined the moisture content and corrected the yield to 14% moisture. The results were processed using the SPSS 19.0 and Microsoft Excel programs. Single-factor analysis of variance and Pearson's correlation analysis was performed. We examined the following hybrids SY Arioso (FAO 300), P9486 (FAO 360), DKC4943 (FAO 410). The experiment was set up in three different plant densities. These were 60,-76,-90 thousand plant ha^{-1}. We used three different sowing date early, average and late. We observed that DKC 4943 hybrid had the highest amount of yield (13,6 tons ha^{-1})at the second sowing date (April 1). The second biggest yield was produced by the early sowing time (April 1). It was close the same amount of yield in the 76 thousand plant ha^{-1}. It was (13,5 tons ha^{-1}). The late sowing date (May 5) has lowest amount of yield. In our experiment SY Arioso had the lowest amount of yield in every sowing date in the 60 plant ha^{-1} plant density.

Keywords: maize, sowing date, plant density,

Introduction

The great variability of the climate is the biggest risk factors in the crop production (Nagy, 2006). Maize is the most important crop in the agriculture of Hungary. The corn is the most profitable plant in the arable production. Therefore it is very important to deal with the tasks of the versatile maize production in the future (Pepó and Sárvári, 2004). As an effect of global climate change the sowing date of some important plant can be changed. The optimal sowing date is very important work process in crop production. That's because the adaptability of maize is limited. The maize produce much less yield in dry crop year than in average or wet weather condition. (Bene et al, 2014). The sowing is the most important work process of a successful growing season. The mistakes what made in the sowing cannot be fixed in the following (Fűzy, 2005). To determine the optimal sowing we know several process. The big growers take many factors into account but the average opinion is the same. The early planting of corn is the best because the high risk of the changing weather (Menyhért 1985), (Sárvári és Futó 2001). Maize needs 300 liter of water to produce 1 kg of dry material. Therefore it is very important to determine the optimal plant density (Pepó 2012), (Szabó, 2012). The yield is lower if the density is less or more than optimal. In the 20th century agricultural workers thought that lower plant density was better because each plant grown bigger. This attitude has changed for now. (Pálovics, 2006.). Now it is necessary to determine the optimal sowing date and plant density of each type of maize hybrids. That's because these are very modern hybrids and the different genetic background need different growing condition (Molnár és Sárvári 2005).

Materials and methods

The field experiment was carried out at Látókép research area of the University of Debrecen on chernozem soil. Soil of the research area is of good agricultural condition, medium

hard soil with medium humus content and good neutral level. Water supplies of the soil are favorable. We examined three important hybrids of Hungary what were SY ARIOSO (FAO 300), P9486 (FAO 360), DKC4943 (FAO 410). The experiment was set in three different plant densities 60, -76, -90 thousand plants ha^{-1}. The Experiment was set in three sowing dates. Early sowing date: April 1, average: April 21, late sowing: May 5 number of replication was 4. The results were presented in the average of the replications. The fore crop was winter wheat. The experiment was set in one nutrient level. The fertilizer was dispensed in spring. The amount of N was 108 kg ha^{-1} (in Pétisó). We planted with a modern Gaspardo corn planter with GPS technology and harvested the plot with a special SAMPO plot harvester. The results of the experiment was analyzed by SPSS 19.0 and Microsoft Excel. Data was analyzed with single-factor analysis of variance and Pearson's correlation analysis. The meteorological factors are shown in *Table 1*.

Table 1. The amount of meteorological parameters in the examined crop years (Debrecen, 2015)

Months		April	May	June	July	August	September	October	Total/Average
Precipitation (mm)	30 year's average	42.4	58.8	79.5	65.7	60.7	38.0	31.8	**376.9**
	2015	21.9	52.9	60.5	35.6	84.0	48.9	86.6	**390.4**
	Difference	-20.5	-5.9	-19.0	-30.1	23.3	10.9	54.8	**13.5**
Temperature (°C)	30 year's average	10.7	15.8	18.8	20.3	19.6	15.8	10.3	**15.9**
	2015	10.1	15.8	19.9	22.9	23.3	17.8	11.2	**17.3**
	Difference	-0.6	0.0	1.1	2.6	3.7	2.0	0.9	**1.4**

Results and discussion

On the *Figue 1.* we show the amount of yield in the average of replications. Based on the amount of yield we found that the highest yield was produced by the DKC 4943 hybrid in the three sowing date. The second highest yield was produced by the P9486 in early, average and late sowing date. The SY Arioso produced the less yield in the late sowing date. In our experiment in the early sowing date the hybrids have higher yield in 90 thousand ha^{-1} plant density. Here increasing the plant density increased the yield. In later sowing plant like much more the less plant density. In the early sowing date the plants in the 90 thousand ha^{-1}.plot reach the highest amount of yield. In the average sowing date every hybrid reach close the same high amount of yield in the 75 thousand ha^{-1} plant density. The plant density growing is decreasing the amount of yield at the late sowing date. Here the plants produced the highest yield in 60 thousand ha^{-1} plant density and produced the less in 90 thousand ha^{-1}.

Analyzing the data's with the single factor variance, we found the significant difference between the early and late sowing date and between the average and late sowing date *(Figure1.).* This result confirm the Pearson correlation result. During the experiment the difference between each plant density shows great different therefore we all cases can be justified statistically. We analyzed each sowing date differently because this way we get realistic result.

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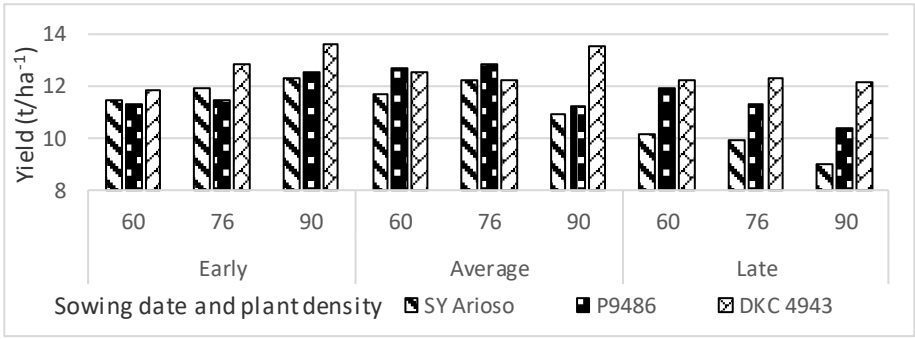

		Yield
$LSD_{5\%}$ Sowing date		*0,71*
$LSD_{5\%}$ Plant density		*0,67*
$LSD_{5\%}$ Hybrid	*V1*	*0,94*
	V2	*1,17*
	V3	*1,62*

Figure 1. The effect of the sowing date and plant density in different genotype on maize hybrid grain yield (2015)

In analyzing the Pearson correlation values below *(Table 2)*, 0,3 characterized weak correlations, values between 0,3 to 0,5 mean medium, in between 0,5 to 0,7 the correlations was strong, while in the case of the correlation over 0,7 mean very strong correlation. Analyzing the data's we experienced negative moderately strong connection between the sowing time and yield *(Table2)*. So delaying the sowing we can measure yield decreasing. There is no statistical different between the plant density and yield.

Table 2. Correlation between the analyzed parameters (2015)

	Yield
Sowing date	-0,388(**)
Plant density	-0,007(NS)

(*) Correlation is significant at the $SzD_{5\%}$- level (**)Correlation is significant at the $SzD_{1\%}$- level (NS) Non significant

In the experiment the highest yield was produced by the DKC4943 in the early and average sowing date in the 90 thousand ha^{-1} plant density (13.6 t/ha^{-1}). The second best hybrid was the P9486. This hybrid reach their maximum yield in the average sowing date in 76 thousand plant ha^{-1} plant density (12.9 t/ha^{-1}). The third hybrid was the SY Arioso which reach their top yield in the early sowing date in 90 thousand plant ha^{-1}.

Conclusions

In our experiment there was three different sowing date and three plant density. We use three different hybrid from three genotype. The highest yield was produced by the DKC 4943 in all sowing dates. The second best was the P9486 and the third was the SY

Arioso. Analyzing the data we found difference between the three sowing date. We have significant difference between the early and late and average and late sowing. The sowing date significantly decreased the yield of maize. We measure difference between the three plant densities but the statistics can't confirm that. In the first sowing date the 90 thousand plant ha^{-1} plant density is better than the others. In our experiment the 76 thousand plant ha^{-1} plant density was the best in average and late sowing. In the late sowing the lower plant density was better. That's because the plants haven't got enough water in the soil at the case of late sowing. Therefore they have to drain the water from each other. Earlier sowing produce yield as good as average sowing. Therefore, early sowing can be recommended to prevent atmospheric summer's drought in Hungary. This way we can achieve greater crop safety.

References

Bene, E. Sárvári, M., Futó, Z.: A vetésidő hatása három eltérő tenyészidejű kukoricahibrid mennyiségi és egyes minőségi paramétereire.Növénytermelés 63 (4), 5-23., 2014. DOI: http://dx.doi.org/10.1556/novenyterm.59.2010.4.5

Fűzy J. (2005) A kukorica vetése a gyakorlatban. Agrofórum extra 9. 59. http://dx.doi.org/10.1556/agrokem.54.2005.1-2.14

Menyhért, Z. (1985) A kukoricatermesztés kézikönyve. Mezőgazdasági kiadó, Budapest. 273-278. DOI: http://dx.doi.org/10.1163/18763308-90000026

Molnár, Zs. – Sárvári, M. (2005) A vetésidő és a tőszám hatása a kukoricahibridek termésére. Agrártudományi Közlemények 16. Különszám DOI: http://dx.doi.org/10.1556/novenyterm.59.2010.3.3

Nagy J. (2006): A vízellátás hatása a korai (FAO 300-399) éréscsoportba tartozó kukorica hibridek termésére öntözés nélküli termesztésben. Növénytermelés. 55. 1-2. 103-112. DOI: http://dx.doi.org/10.1556/novenyterm.59.2010.4.5

Pálovics B. (2006) Tőszám hatása a kukorica hibridek termésére. Agrártudományi közlemények 2006/23 50-51. DOI: http://dx.doi.org/10.1556/novenyterm.58.2009.3.3

Pepó P. (2012) Tartalékok a kukorica agrotechnikájában. Agrofórum Extra 47. 5-11. DOI: http://dx.doi.org/10.1556/novenyterm.60.2011.4.6

Pepó.P Sárvári M. (2004) Mezőgazdaságtudomány Agrárgazdasági modellek Integrált agrárgazdasági modellek a XXI. század mezőgazdaságában. 65. DOI: http://dx.doi.org/10.7896/zsk.1501

Sárvári, M. – Futó, Z. (2001) A vetésidő hatása a különböző genetikai adottságú kukoricahibridek termésére. Növénytermelés, 50.1:43-60 DOI: http://dx.doi.org/10.1556/novenyterm.59.2010.3.3

Szabó Sz. (2012) A Kukorica aszályreakciói és annak élettani háttere. Agronapló 2012/12. 18. DOI: http://dx.doi.org/10.14232/phd.597

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