THE EFFECTS OF PLANT DENSITY AND ROW SPACING ON THE EAR HEIGHT OF MAIZE HYBRIDS OF DIFFERENT VEGETATION TIME AND GENOTYPE

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Abstract

The determination of ear height is an important factor in terms of lodging resistance, lodging, and harvest after all. During our research, we have found that as an effect of plant number increase, ear height increased. The maize hybrids response to the increasing of plant number in a hybrid specific manner.

The small plot experiment was set in 2013 at the Látókép Experimental Farm of the Centre for Agricultural and Applied Economic Sciences of the University of Debrecen, on lime-coated chernozem soil in four replications. The ear heights of the maize hybrids were studied at three plant density (50, 70, and 90 thousand plants ha^{-1}) and two row spacing (45 and 76 cm). During the experiment, we have investigated the development of the ear heights of five maize hybrids of different vegetation time and genotype: Sarolta (FAO 290), P 9175 (FAO 330), Reseda/P 37M81 (FAO 360), DKC 4490 (FAO 380) and SY Afinity (FAO 470).

Key words: maize, plant density, row spacing, ear height, genotype.

INTRODUCTION

Maize is one of the most significant cultivated plants in the Hungarian field crop production. Among field crops, maize and wheat are the ones produced on the largest areas. In Hungary, maize is produced on 1.1-1.2 million hectares with a yield average of 4-7 t ha^{-1}. The yield and crop safety of maize are influenced by several biological and agrotechnical factors. Out of the agrotechnical elements, the investigation of plant density increase of maize hybrids is of special importance, which is influenced by the abilities of the production area and the selected hybrid.

Gyenes-Hegyi et al. (2002) found that with an incrase in plant density there was also incrase in the height of the main ear height, which was in the lowest position (93 cm) on plants grown at a density of 45 thousand plants ha^{-1} and 6 cm higher (99 cm) in the 65 and 85 thousand plants ha^{-1} treatments, which did not differ significantly from each other in their experiment. Gözübenli (2010) concluded that the plant height increased as the plant density increased, the highest ears (93.5 cm) were measured at 120,000 plant ha^{-1} and the shortest ear heights (88.2 cm) were at 80,000 plant ha^{-1} density. Silva et al. (2007) found that the plant density did not influence the ear height.

Rutger and Crowder (1967) studied the ear heights at 40, 50, 60, 70, and 80 thousand plants ha^{-1}. With the increase of the plant number, ear heights also increased. Similarly, Hassan (2000) found that plant and ear heights increased with the increase of the plant number.

MATERIAL AND METHODS

The small plot experiment was set in 2013 at the Látókép Experimental Farm of the Centre for Agricultural and Applied Economic Sciences of the University of Debrecen, on lime-coated chernozem soil in four replications. We measured the ear height in two replications, 22. July 2013. The final heights of the maize hybrids were studied at three plant density (50, 70, and 90 thousand ha^{-1}) and two row spacing (45 and 76 cm). During the experiment, we have investigated the development of the final ear heights of five maize hybrids of different vegetation time and genotype: Sarolta (FAO 290), P 9175 (FAO 330), Reseda/P 37M81 (FAO 360), DKC 4490 (FAO 380) and SY Afinity (FAO 470). During the study, we have selected and measured five plants of average height per plot. The results were evaluated by Microsoft Excel.

Table 1 lists the precipitation amounts fell in 2013 until the measurements and the monthly average temperatures. The precipitation amounts in April and May as well as the temperature values exceeded the 30-year averages. The precipitation amounts fell in June and July were far below the 30-year averages.

Table 1

The values of monthly average temperatures and precipitation amounts in 2013 (Debrecen, 2013).

	April	**May**	**June**	**July**
Monthly average temperature (^{O}C)	12.0	16.6	19.6	21.2
Temperature (^{O}C) 30-year average	10.7	15.8	18.7	20.3
Precipitation (mm)	48.0	68.7	30.8	15.6
Precipitation (mm) 30-year average	42.4	58.8	79.5	65.7

RESULTS AND DISCUSSION

We have investigated the ear height values of maize hybrids of various genotype and vegetation time in the case of various plant numbers and row spacing in a small-plot experiment.

As an effect of plant number increase, the ear heights increased. In the case of row spacing of both 45 and 76 cm, we have found the highest ear

height values in the densest stock (90 thousand plants ha^{-1}). The values were as follows: 129.76 cm in the case of 45 cm row spacing, while 139.36 cm in the case of 76 cm, in the average of the hybrids (Table 2). In the case of the 45 cm row spacing, we have measured the lowest value (120.32 cm) at the plant number of 70 thousand plants ha^{-1}; the ear height was above it with 0.95 cm at 50 thousand plants ha^{-1}. In the case of the 76 cm row spacing, the lowest value (126.74 cm) was measured at 50 thousand plants ha^{-1}; the ear height was above it with 3.06 cm at 70 thousand plants ha^{-1}. The increase of ear height caused by the plant number could be explained by the elongation of the maize plants. The height of the individuals increase as a consequence of the competition for light.

There was also significant difference between the plant numbers of 70 and 90 thousand/ha at the row distance of 45 cm in the case of the hybrids DKC 4490, and SY Afinity; while in the case of the hybrids Sarolta, P 9175 and DKC 4490 at 76 cm.

While in the case of row distance of 45 cm, the height valued varies between 120.32 and 129.6 cm, at 76 cm, the range was 126.74-139.36 cm. In the case of the two row distances, the cause of the height difference could be the different production areas.

Table 2

The effects of plant number and row spacing on the ear height of maize (cm) (Debrecen, 2013).

	Sarolta	**P 9175**	**Reseda**	**DKC 4490**	**SY Afinity**	**Hibridek átlaga**
Plant density	**Row spacing (45 cm)**					
50 thousand plants ha^{-1}	116.20	109.40	126.55	114.90	139.30	121.27
70 thousand plants ha^{-1}	110.70	120.20	128.40	108.20	134.10	120.32
90 thousand plants ha^{-1}	121.95	125.00	130.20	123.25	148.40	129.76
	Row spacing (76 cm)					
50 thousand plants ha^{-1}	121.00	125.60	132.50	116.60	138.00	126.74
70 thousand plants ha^{-1}	124.30	126.20	143.70	109.40	145.40	129.80
90 thousand plants ha^{-1}	137.50	137.50	148.00	121.50	152.30	139.36
LSD 5% (A)	12.68	9.98	13.86	11.95	8.58	-
LSD 5% (B)	10.35	8.15	11.32	9.76	7.00	-
LSD 5% (AxB)	17.93	14.12	19.61	16.90	12.13	-

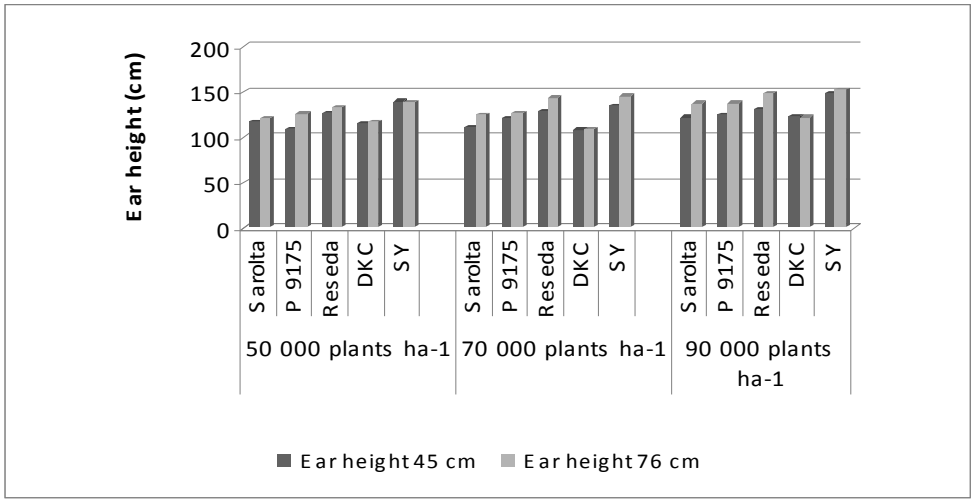

Fig. 1. The effects of plant number and row spacing on the ear height of maize (Debrecen, 2013).

Maize hybrids respond variously to the increase of the plant number (Figure 1). The ear height increased with the increase of the length of the vegetation period in the case of all hybrids, except DKC 4490. The highest ear height values were measured in the case of SY Afinity (FAO 470), the hybrid of the longest vegetation period. The values varied between 134.10 and 148.40 cm at the row spacing of 45 cm, while the range was 138.00-152.30 cm at 76 cm.

CONCLUSIONS

The ear height of the maize hybrids increased with the increase of plant number. The highest ear height values were measured at the highest plant number (90 thousand ha^{-1}) in the case of both row spacing. We have measured the highest ear height values both in the cases of the row spacing of 45 and 76 cm, 129.76 cm and 139.36 cm, in the average of the hybrids, respectively. The increase of the ear heights by the plant number could be caused by the elongation of the maize plants because of the competition for light. We have measured the highest ear height values in the case of the hybrid of the longest vegetation time, SY Afinity; the ear height values varied between 139.30 and 148.40 cm in the case of the 45 cm row spacing, while between 138.00 and 152.30 cm in the case of 76 cm, at various plant numbers.

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