INFLUENCE OF PLANTS DENSITY ON PRODUCTIVITY OF CORN FOR SILAGE IN THE CONDITIONS OF DEPRESSION JIJIA - BAHLUI

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Abstract

Corn silage is the most efficient way of feeding the animals during the grazing period, with a very high degree of consumability. The success of corn silage cultivation depends largely on the proper choice of hybrid, but also on the pedoclimatic conditions of the crop area. The characteristics and the suitability of the hybrid have an important role in the maize culture for silage, but in order to obtain superior productions from a qualitative and quantitative point of view, the technological elements and their application must be respected. The density of corn crop for silage is considered the most important technological element. All the improvements of the maize crop, the introduction of the most productive maize hybrids, the fertilization, the irrigation, etc., have led to new levels of production, changing each time the optimum plants density. The research was conducted in 2018 in the pedoclimatic conditions corresponding to the Depression Jijia – Bahlui. Three experimental factors were studied, as followed: the influence of plants density, the distance between the rows and the hybrid on the production of dry matter (DM). The obtained results showed that the technological factors (the density of plants and the distance between rows) caused changes in the biomass production, the quantity of dry matter being influenced by the hybrid, as well as the plants density and the distance between rows. As the density of plants per hectare increases, the amount of dry matter decreases thus registering at all three densities, reduced production differences.

Key words: maize hybrids, corn silage, dry matter production, row spacing

Corn is one of the most important cultivated plants that has a special role in the food of humans and animals. The success of a corn crop for silage involves some requirements that refer to establishing the optimum plants of density, choosing the hybrids, as well as the correct choice of the technological elements (Roth G.W. and Heinrichs A.J., 2017).

Corn silage provides high palatability with relatively constant quality and higher energy content than other forages (Oliveira I.L. *et al*, 2017). Chaudhary D.P. *et al*, 2013, argue that corn silage has a rapid growth, producing a very high quantity of biomass and of high quality. It contains sufficient amounts of protein and minerals and has a high digestibility compared to other forages.

The density of plants as a factor of production is important and influences the production of dry matter in the silage maize crop (Vîntu V. *et al*, 2010). The susceptibility to corn silage depends on several factors, among which: the choice of cultivated hybrid, climatic conditions, plants densities, relations between cultural, quantitative and generative factors (Ceclan O.A., 2010). Numerous studies showed that maize crop density is considered the most important technological element in maize crop for silage (Çarpici Budakli E. *et al*, 2010; Ramezani M. *et al*, 2011; Ferreira G. *et al*, 2014; Mandić V. *et al*, 2015; Sharifi R.S. and Namvar A., 2016).

Cañadas Á. *et al*, 2016, show that increasing the density of plants in corn cultivation for silage resulted in thinner and longer stems. According to the results, the highest production of dry matter was recorded at the plants density, of 125.000 plants·ha^{-1} with a production increase of 20.11% higher than the density of 65.500 plants·ha^{-1}. Ferreira G. and Teets C.L., 2017, show that increasing the density of plants increases the production of fodder by affecting the nutritional quality minimally. All the improvements of the corn crop, had led to new levels of production, changing each time the optimum plants density.

The study followed the production of dry matter on the surface unit and its modification depending on the density of plants, hybrid and the distance between rows.

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MATERIAL AND METHOD

The studies were conducted in 2018 in Moldavian Forest Steppe. From the administrative point of view, the area under study is located in the Iasi county, on the coordinates (47°02' North latitude and 27°22' East longitude).

From the climatic point of view, the territory belongs to the temperate-continental climate zone under the influence of Atlantic and Euro-Asian anti-cyclones. The year of experience was characterized by normal weather conditions, no extreme weather phenomenes were recorded during the whole vegetation period of the experience. The soil corresponds to the forest steppe zone types and is a cambic chernozem, formed on clay deposits. The research has followed the influence of plants density, distance between rows and three maize hybrids on the production of dry matter in the maize for silage. In order to attain the proposed objectives, a polyfactorial experience was set up. The experiment was established, with a design type 2x3x3, arranged in subdivided plots in three replications, which have a 22,4 m^2. The factors were as follows: A - distance between rows, with two graduations (a_1 - 70 cm between rows and a_2 - 50 cm between rows), B - cultivated maize hybrid, with three graduations (b_1 - H_1, b_2 - H_2 and b_3 - H_3) and C - plants density, with three graduations (c_1 – 70,000 plants·ha^{-1}, c_2 – 83,000 plants·ha^{-1} and c_3 – 100,000 plants·ha^{-1}).

The precursor culture was rape, the experience being in the second year of research in the same location. In the autumn, a basic fertilization of 200 kg·ha^{-1} ($N_{18}P_{46}$) was carried out and in the pre-sowing seedbed was fertilized throughout the experiment with 200 kg·ha^{-1} of urea (N_{46}).

Production was expressed in dry matter (DM); the results were statisticaly analyzed by the analyses of variance and limit differences.

RESULTS AND DISCUSSIONS

From the analysis of the influence of the distance between rows on the production of dry matter (*table 1*), it appears that the distance between rows had influenced insignificantly the production of dry matter. Thus, reducing the interval between plants to 50 cm resulted in the highest production of 15.71 Mg·ha^{-1} DM, the increase being 9.9% compared to the control variant. The lowest production, of 14.29 Mg·ha^{-1} DM was recorded in the control variant, respectively at the distance between rows of 70 cm. From the analysis of the influence of the hybrid on the production of dry matter (*table 2*), it appears that the genotypes analyzed behaved differently, the differences from the control (b_1-H_1) being very insignificant and distinctly significant.
Within the experience, in 2018, the H_3 hybrid adapted best to the pedoclimatic conditions in the studied area, achieving the highest production of dry matter, of 18.49 Mg·ha^{-1} DM, with a production increase of 33.7% compared to the control variant (b_1 -H_1), the difference being a distinctly significant one. The lowest production, of 12.68 Mg·ha^{-1} DM was recorded in the H_2 hybrid, recording a lower output than the control variant (*table 2*).

As a result of the improvement brought to the corn crop, the introduction of more productive hybrids, fertilization, irrigation, the density of the crop is considered the most valuable technological element.

Considering the separate influence of the plants density on the dry matter production in the studied maize hybrids, average dry matter productions with values between 13.94 Mg·ha^{-1} DM at the density of 83000 plants·ha^{-1} and 16.23 Mg·ha^{-1} DM at the density of 70000 plants·ha^{-1} (*table 3*).

Table 1

Influence of distance between maize plants rows on dry matter production

Experimental plot	DM production (Mg·ha^{-1})	Diferences		Statistical significance
		Mg·ha^{-1}	%	
a_1 - 70 cm between rows (c)	14.29	Control	100	Control
a_2 - 50 cm between rows	15.71	1.42	109.9	ns
	LSD 5%	*2.14*		
	LSD 1%	*3.56*		
	LSD 0.1%	*6.65*		

Table 2

Influence of maize hybrid on dry matter production

Experimental plot	DM production (Mg·ha^{-1})	Diferences		Statistical significance
		Mg·ha^{-1}	%	
b_1 - H_1 (control)	13.83	Control	100	Control
b_2 - H_2	12.68	-1.15	91.7	ns
b_3 - H_3	18.49	4.66	133.7	**
	LSD 5%	*2.51*		
	LSD 1%	*4.17*		
	LSD 0.1%	*7.79*		

The increase of the density from 70000 plants·ha^{-1} to 100000 plants·ha^{-1} has caused a significant increase in the production of dry matter. Of the studied variants, the density of 70000 plants·ha^{-1} determined to obtain the highest production of dry matter, respectively of 16.23 Mg·ha^{-1} DM.

Analyzing the influence of the studied factors (the distance between rows, the density of plants and the cultivated hybrid) on the production of dry matter (*table 4*), it is found that the values of production of maize for silage, are different depending on the hybrid, and on the same hybrid, depending on the density of plants and the distance between the rows. Thus, at the distance of 70 cm between rows, at all three density plants studied, the hybrids recorded different values of the production of dry matter in relation to the control variant (*table 4*), the highest production of dry matter, of 19.26 Mg·ha^{-1} DM being recorded at the interaction between a_1 - 70 cm x b_3 - H_3 x c_3 – 70000 plants·ha^{-1}, with a very significant difference compared to the control.

As can be seen (*table 4*), at the distance between rows of 70 cm, the values of the dry matter production registered a slight decrease with the increase of the density in all the three hybrids, with positive and negative differences compared to the control (*table 4*).

Table 3

Influence of plants density on dry matter production

Experimental plot	DM production (Mg·ha^{-1})	Diferences		Statistical significance
		Mg·ha^{-1}	%	
c_1- 70000 plants·ha^{-1} (c)	16.23	Control	100	Control
c_2- 83000 plants·ha^{-1}	14.83	-1.40	91.4	ns
c_3- 100000 plants·ha^{-1}	13.94	-2.29	85.9	ns
	LSD 5%	*2.48*		
	LSD 1%	*4.10*		
	LSD 0.1%	*7.67*		

Table 4

Influence of interaction between experimental factors on dry matter production

Experimental plot			Dry matter production (Mg·ha^{-1})	Diferences		Statistical significance
				Mg·ha^{-1}	%	
a_1 - 70 cm between rows (c)	b_1 - H_1 (c)	c_1 - 70000 plants·ha^{-1}(c)	14.97	Control	100	Control
		c_2 - 83000 plants·ha^{-1}	12.59	-2.38	84.1	o
		c_3 - 100000 plants·ha^{-1}	11.98	-2.99	80.0	oo
	b_2-H_2	c_1 - 70000 plants·ha^{-1}	12.37	-2.60	82.6	oo
		c_2 - 83000 plants·ha^{-1}	12.21	-2.76	81.6	oo
		c_3 - 100000 plants·ha^{-1}	11.65	-3.32	77.8	ooo
	b_3 - H_3	c_1 - 70000 plants·ha^{-1}	19.26	4.29	128.7	***
		c_2 - 83000 plants·ha^{-1}	17.58	2.61	117.4	**
		c_3 - 100000 plants·ha^{-1}	16.01	1.04	106.9	ns
a_2 - 50 cm between rows	b_1 - H_1	c_1 - 70000 plants·ha^{-1}	16.32	1.35	109.0	ns
		c_2 - 83000 plants·ha^{-1}	13.85	-1.12	92.5	ns
		c_3 - 100000 plants·ha^{-1}	13.30	-1.67	88.8	ns
	b_2-H_2	c_1 - 70000 plants·ha^{-1}	13.48	-1.49	90.1	ns
		c_2 - 83000 plants·ha^{-1}	13.43	-1.54	89.7	ns
		c_3 - 100000 plants·ha^{-1}	12.93	-2.04	86.4	o
	b_3 - H_3	c_1 - 70000 plants·ha^{-1}	20.99	6.02	140.2	***
		c_2 - 83000 plants·ha^{-1}	19.34	4.37	129.2	***
		c_3 - 100000 plants·ha^{-1}	17.77	2.80	118.7	**
			LSD 5%	*1.88*		
			LSD 1%	*2.52*		
			LSD 0.1%	*3.32*		

The distance between rows of 50 cm, caused a slight increase in the production of dry matter in most variants compared to the distance between rows of 70 cm, the values obtained being different depending on the plants density, with insignificant differences, distinctly significant and very significant compared to the control variant (*table 4*). Thus, at the distance of 50 cm between rows, the studied hybrids recorded higher values of dry matter production, the highest production, of 20.99 Mg·ha^{-1} DM being recorded at the interaction between a_2 - 50 cm x b_1 - H_3 x c_1-70000 plants·ha^{-1}, with a very significant difference compared to the control. Also, high values of the

dry matter production, of 19.34 Mg·ha^{-1} DM and 17.77 Mg·ha^{-1} DM respectively were recorded in the same H_3 hybrid at the density of 83000 plants·ha^{-1}, as well as in the interaction between a_2 - 50 cm x b_3 - H_3 x c_3 – 100000 plants·ha^{-1}, the differences being distinct and very significant compared to the control. According to the data obtained, it can be seen that the plants of density and the distance between the rows significantly influenced the production of dry matter (*table 4*).

CONCLUSIONS

The success of maize for silage crop implies some requirements that refer to establishing the optimum plants of density, choosing the hybrids, choosing the technological works and establishing the optimal harvest time.

The density of corn crop for silage is considered the most important technological element.

The obtained results showed that the technological factors (the density of plants and the distance between rows) caused changes in the biomass production, the quantity of dry matter being influenced by the hybrid, as well as the plants density and the distance between rows. Sowing corn for silage at a distance of 50 cm between rows, compared to 70 cm, increased the production of dry matter.

As the density of plants per hectare increases, the amount of dry matter decreases thus registering at all three densities, reduced production differences.

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