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BEHAVIOUR OF SWEET CORN HYBRIDS GROWN AT DIFFERENT DENSITIES

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Abstract

This paper presents research results of the Luduş, Mureş county on the influence of planting density (45,000, 60,000 and 75,000 plants / ha) on growth, development and production potential of four sweet corn hybrids of different origins. Data showed that culture density did not influence the conduct of any of the hybrids analyzed phenophases. Growing season ranged from 67-76 days, the earliest being hybrid Prima compared to H 702 (from Australia) which was delayed by nine days. In the average ear weight were recorded higher values for densities of 60,000 plants / ha, respectively 45,000 plants / ha, with a maximum on hybrid H 702 (400 g / ear). Lowest values were recorded for hybrid Prima grown at a density of 75,000 plants / ha (300 g / ear). The ears production varied differently compared with ear weight. Thus, there were higher mean values for density of 60,000 plants / ha, respectively 75,000 plants / ha, with a maximum of 29.36 t / ha in hybrid H 702. The lowest production was recorded in hybrid Prima on density of 45,000 plants / ha (17.94 t/ ha).

Key words: *development, growing, hybrid, Luduş, production.*

INTRODUCTION

Sweet corn, *Zea mays*, var. *rugosa* (Bonaf), convar. Saccharata Koprn (Sturt) is native to submountainous area of Peru and Bolivia, secondary center is Mexico and is one of the most popular vegetable crops in the United States and Canada [2]. In the U.S. is on second place like consumption volume after tomato and on seventh place like share between fresh vegetables [3]. Sweet corn is different by other types of corn by presence of a gene or genes that alter starch synthesis in endosperm [4].

The edible part of this plant is immature grain consists of endosperm and ovary wall. The sugar is the main component of taste for sweet corn. Taste is also determined by flavour, especially the bouquet that it appears during boiling of ears. Sweet corn is considered to be a real source of food, witch has proved to have a high caloric content and nutritional value compared to the usual corn. At technological maturity, seeds contain 25-27% dry matter, 14-15% carbohydrates, 5-5.5% protein, 0.75% fat, aminoacids, significant amounts of vitamins: C, B, PP, E and minerals (K, P, Ca, Mg, Fe) [5].

Sweet corn is used in food industry as raw material for canning, but it is also eaten fresh in the milk stage as boiled corn or in the preparation of different corn mashes, garnishes for steaks, stewed fruits, cream-soups of corn and flour from sugar corn is in the composition of various pastries [2, 6].

In Europe, significant areas are cultivated in France, Italy and Spain.

In our country sweet corn began to grow much later because of the fact that people used cultivars of corn for grain consumption, which is consumed during milk – wax stage, boiled or fried.

Recently, sweet corn began to be sold in supermarkets as fresh or preserved vegetable and because this product is known and appreciated by customers, explains the need for further studies on the development of technological measures to allow expansion of this culture in Romania.

The paper presents results of researches at Luduş, Mureş county concerning the influence of density on the growth,

development and productive potential of four hybrids of sweet corn.

MATERIAL AND METHOD

Experience was held in 2011 in Luduş, Mureş county. The trial was bifactorial, fitted by the method of subdivided parcels into four repetitions. The factor A was density of the culture, with three graduations (45,000, 60,000 and 75,000 plants/ha) and the factor B – hybrids, four graduations (Prima, Deliciul verii, Boston, H702) (Table 1).

During the experiment, it was realized many observations, measurements and determinations, which were used specific working methods namely (Photo 1):

Phenological determinations: sowing date, date of emerging, date of anthesis, date of silk emergence and date of harvest; calculation of number of days for each phenological phase and of the vegetation period.

Morphometric determinations: number of cobs/plant, length of cobs, number of rows of grains/cobs, number of grains/ rows. The determinations were made by variants and repetitions, on 10 plants by each plot.

Production potential was determined by recording the number of ears/plant, their average mass and calculation of the average production/plants or ha, for each variant studied. The results were interpreted statistically by analysis of variance [1].

The technology used in the experiences was selected from the literature for sweet corn [2, 5], except the density which was differentiated according to experimental variants.

Sweet corn harvesting occurs when they reach the maturity stage of consumption (milk-wax stage) when the cob is hard, well covered by leaves (sheets), and silk became brown and dry.

Table 1. The design of experience – Luduş 2011

Experience	Hybrid	Technological features		
		Method	Planting scheme (cm)	Density
Behaviour of sweet corn hybrids grown at different densities	Prima Deliciul verii Boston H702	sown directly	70/32 70/24 70/19	45,000 60,000 75,000

RESULTS AND DISCUSSIONS

The weather in Luduş, county Mureş in the vegetation period of year 2011 (April – August) coresponding to requirements of sweet corn, the warmest period was August.

Concerning the hidrological regime, the biggest quantity of precipitations was in June. The results concerning the influence of density of the culture on the phenological phases (phenophases) at sweet corn hybrids has been presented in Table 2.

It can be observed that density has no influence to phenophases at any hybrids. The length of period needed to reach each phenophase depends on hybrid. Also, the vegetation period depends by hybrid and it was of 67-76 days (from emerging to harvest). The earliest hybrid was Prima (67 days) and the latest was H702 (76 days).

Photo 1. Observation on the sweet corn variants

Table 2. The results concerning the influence of density of the culture on the phenological phases at some sweet corn hybrids Luduş - 2011

Density plants/ha	Specification	Phenological phases *				Vegetation period **
		Emergence	Anthesis	Silk emergence	Harvest	
45,000	Prima	14	58	61	81	67
	Deliciul verii	14	65	66	88	74
	Boston	16	65	67	89	73
	H702	16	68	70	92	76
	Average	15	64	66	87.5	72.5
60,000	Prima	14	57	60	81	67
	Deliciul verii	14	65	66	88	74
	Boston	16	65	67	89	73
	H702	16	68	70	92	76
	Average	15	64	66	88	73
75,000	Prima	14	58	61	81	67
	Deliciul verii	14	65	66	88	74
	Boston	16	65	67	89	73
	H702	16	68	70	92	76
	Average	15	64	66	87.5	72.5

*Days number from sowing (sowing time 10 May 2011);
**Days number from emergence to harvest.

The density influenced the elements which determine the production potential at sweet corn. The number of cobs/plant varied generally between 1-1.2 and only for H 702 varied from 1.5 at 45,000 plants/ha to 1.2 at 75,000 plants/ha. In the ear morphometry, it was noted that only one parameter varied – length of cob - which was between 17.3 cm (75,000 plants/ha) - 19.3 cm (45,000 plants/ha) (average values). H 702 was noted by the largest size cobs at all densities (Table 3).

Table 3. Morphometric characteristics of ears for different hybrids of sweet corn Luduş - 2011

Density	Hybrids	No. of cobs/plant	Ear length (cm)	Ear diameter (cm)	No.of rows	No. of grains /row
A1 (45,000)	Prima	1.1	17	4.00	12	36.7
	Deliciul verii	1.2	18	4.00	14	42.9
	Boston	1.1	21	4.00	16	37.5
	H702	1.5	21	4.00	20	42.7
	Average	1.2	19,3	4,00	16	38.3
A2 (60,000)	Prima	1.0	16	4.00	12	36
	Deliciul verii	1.1	16	4.00	16	36
	Boston	1.2	19	4.00	16	36
	H702	1.3	20	4.00	20	43
	Average	1.1	18	4.00	16	38
A3 (75,000)	Prima	1.1	14	4.00	12	37.5
	Deliciul verii	1.1	16	4.00	16	41.3
	Boston	1.1	19	4.00	16	41.9
	H702	1.2	20	4.00	20	42
	Average	1.1	17.3	4.00	16	40.7

In the weather conditions of 2011, at Luduş, Mureş county, average mass of ears was influenced by density. The biggest average mass was at density of 60,000 plants/ha (370g) and the smallest one at 75,000 plants/ha (309 g) (Table 4, Photo 2). Foreign hybrids has superior average mass compared to Romanian hybrids. On the first place was H702 at 60,000 plants/ha with an average mass by 400 g, which surpass the average value of the experience by 8.1%. On the last place was hybrid Prima at 75,000 plants/ha with an average mass of cob by 300 g, with 2.9% under experience average.

Hybrids studied were differentiated by weight components of the ear to its total mass.

The foreign hybrids was better than Romanian ones, with highest percentage (81.3%) of the ear without sheets from the total mass of the ear for hybrid H702 at 75,000 plants/ha, followed by Boston at 45,000 plants/ha (80.6%).

Concerning the average mass of cobs/plant, the behaviour of the hybrids was different, this fact explains by the different number of the cobs/plant. On the first place was H702 at all densities with the biggest value by 570 g/plant at 45,000 plants/ha. The smallest value (330 g/plant) was registered at hybrid Prima (75,000 plants/ha).

The average production for 45,000 plants/ha was surpassed by other two densities with very significant differences (Table 5).

Table 4. Influence of density of the culture on average mass of the ear at sweet corn hybrids, Luduş, 2011

Specification	The average mass(g)					The average mass g/plant
	Total ear+covering leaves	from which:				
		Ear (g)	% from total ear	covering leaves (g)	% from total ear	
45,000						
Average	362.5	275	75.9	87.5	24.1	435
Prima	360	250	69.4	110	30.6	396
Deliciul verii	350	260	74.3	90	25.7	420
Boston	360	290	80.6	70	19.4	396
H 702	380	300	78.9	80	21.1	570
60,000						
Average	370	255	69	115	31	407
Prima	340	240	71	100	29	340
Deliciul verii	360	240	67	120	33	396
Boston	380	260	68	120	31	456
H 702	400	280	70	120	30	520
75.000						
Average	309	225	72.8	84	27.2	340
Prima	300	200	66.7	100	33.3	330
Deliciul verii	310	210	67.7	100	33.3	341
Boston	306	230	75.2	76	24.8	337
H 702	320	260	81.3	60	18.7	384

Table 5. The influence of density on the sweet corn production, Luduş, 2011

Density	Average production (kg/ha)	(%)	Differences (kg)	Significance
a1(45,000)	20296.6	100.0		-
a2(60,000)	24973.9	123.0	4677.3	***
a3(75,000)	24757.1	122.0	4460.5	***
DL 5%			1089.6	
DL1%			1649.9	
DL 0.1%			2650.6	

If we discuss about the influence of the hybrid on the cobs production it can be observed that all hybrids surpass the hybrid Prima with very significant differences (Table 6).

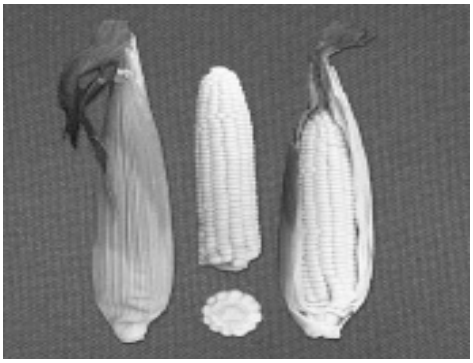

Photo 2. View of ear (cob) with and without sheets

Table 6. The influence of hybrid on the sweet corn production, Luduş, 2011

Density	Average production (kg/ha)	(%)	Differences (kg)	Significance
b1 -Prima	20,441.9	100.0	-	-
b2 – Deliciul verii	22,739.0	111.2	2,297.1	***
b3 - Boston	22,792.8	111.5	2,350.8	***
b4 -H702	27,396.5	134.0	6,954.6	***
DL 5%			678.2	
DL1%			916.4	
DL 0.1%			1,220.8	

Concerning the influence of hybrids on the sweet corn production at 45,000 plants/ha, it can be observed that hybrid H702 has the biggest production and surpass the hybrid Prima (control) with very significant difference (40.5% and 7,261 kg). The following ones was Deliciul verii which surpass the control with significant difference (8.5%, 1,520 kg) and Boston which realise insignificant difference (3.7%, 655.5 kg). At the density of 60,000 plants/ha all hybrids surpass the control with very significant differences and the biggest difference was at H702 (42.7%, 8,782.8 kg). At 75,000 plants/ ha only H702 surpass the control with very significant difference (21.1%, 4,820 kg) and the other two hybrids has significant differences (Table 7).

Table 7. The influence of hybrids on the sweet corn production at same density, Luduş, 2011

Density	Average production (kg/ha)	(%)	Differences (kg)	Significance
a1b1	17,937.5	100.0	-	-
a1b2	19,457.5	108.5	1,520.0	*
a1b3	18,593.0	103.7	655.5	-
a1b4	25,198.5	140.5	7,261.0	***
a2b1	20,575.8	100.0	-	-
a2b2	24,401.0	118.6	3,825.3	***
a2b3	25,560.3	124.2	4,984.5	***
a2b4	29,358.5	142.7	8,782.8	***
a3b1	22,812.5	100.0	-	-
a3b2	24,358.5	106.8	1,546.0	*
a3b3	24,225.0	106.2	1,412.5	*
a3b4	27,632.5	121.1	4,820.0	***
DL 5%			1,174.7	
DL 1%			1,587.3	
DL 0.1%			2,114.5	

If we consider both factors (density and hybrid), it can be observed that hybrid H702 behave uniform and surpass the other hybrids at all densities with very significant differences (Table 8).

Table 8. The influence of density and hybrid on the sweet corn production, Luduş, 2011

Variant	Average production (kg/ha)	(%)	Differences (kg)	Significance	Variant	Average production (kg/ha)	(%)	Differences (kg)	Significance
a1b1	17,937.5	100.0	-	-	a1b3	18,593.0	100.0	-	-
a2b1	20,575.8	114.7	2,638.3	**	a2b1	20,575.8	110.7	1,982.8	**
a2b2	24,401.0	136.0	6,463.5	***	a2b2	24,401.0	131.2	5,808.0	***
a2b3	25,560.3	142.5	7,622.8	***	a2b3	25,560.3	137.5	6,967.3	***
a2b4	29,358.5	163.7	11,421.0	***	a2b4	29,358.5	157.9	10,765.5	***
a1b2	19,457.5	100.0	-	-	a1b4	25,198.5	100.0	-	-
a2b1	20,575.8	105.7	1,118.3	-	a2b1	20,575.8	81.7	-4,622.8	000
a2b2	24,401.0	125.4	4,943.5	***	a2b2	24,401.0	96.8	-797.5	-
a2b3	25,560.3	131.4	6,102.8	***	a2b3	25,560.3	101.4	361.8	-
a2b4	29,358.5	150.9	9,901.0	***	a2b4	29,358.5	116.5	4,160.0	***
a1b1	17,937.5	100.0	-	-	a1b3	18,593.0	100.0	-	-
a3b1	22,812.5	127.2	4,875.0	***	a3b1	22,812.5	122.7	4,219.5	***
a3b2	24,358.5	135.8	6,421.0	***	a3b2	24,358.5	131.0	5,765.5	***
a3b3	24,225.0	135.1	6,287.5	***	a3b3	24,225.0	130.3	5,632.0	***
a3b4	27,632.5	154.0	9,695.0	***	a3b4	27,632.5	148.6	9,039.5	***
a1b2	19,457.5	100.0	-	-	a1b4	25,198.5	100.0	-	-
a3b1	22,812.5	117.2	3,355.0	***	a3b1	22,812.5	90.5	-2,386.0	00
a3b2	24,358.5	125.2	4,901.0	***	a3b2	24,358.5	96.7	-840.0	-
a3b3	24,225.0	124.5	4,767.5	***	a3b3	24,225.0	96.1	-973.5	-
a3b4	27,632.5	142.0	8,175.0	***	a3b4	27,632.5	109.7	2,434.0	**
DL 5%			1,309.0		DL 5%			1,309.0	
DL 1%			1,873.4		DL 1%			1,873.4	
DL 0.1%			2,761.9		DL 0.1%			2,761.9	

The productivity elments was in direct relation with the sweet corn production of cobs. The correlation between the average number of cobs/plant and the average production of cobs it was distinct significant for density of 45,000 plants/ha (r = 0.9935), significant for 60,000 plants/ha (r = 0.9819), respectively insignificant (r = 0.9395) for 75,000 plants/ha (Fig. 1, 2, 3).

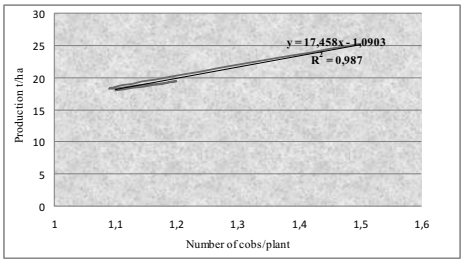

Fig. 1. Correlation between the number of cobs/plant and production (45,000 plants/ha).

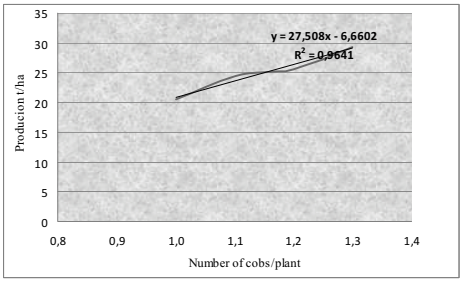

Fig. 2. Correlation between the number of cobs/plant and production (60,000 plants/ha).

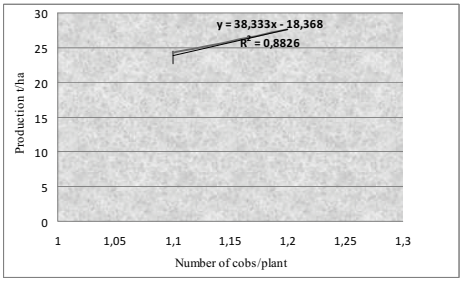

Fig. 3. Correlation between the number of cobs/plant and production (75,000 plants/ha)

The correlation between the average mass of the ear and the average production of ears/ ha was insignificant for the density of 45,000 plants/ha (r = 0.7183) and significant for 60,000 plants/ha (r = 0.9819), respectively 75,000 plants/ha (r = 0.978) (Fig. 4, 5, 6).

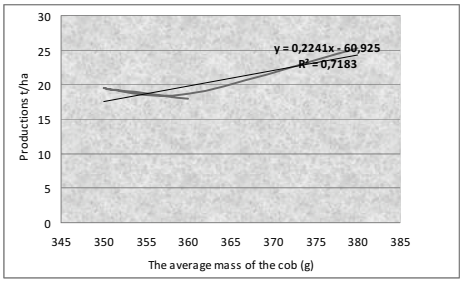

Fig. 4. Correlation between the average mass of the cob and production (45,000 plants/ha)

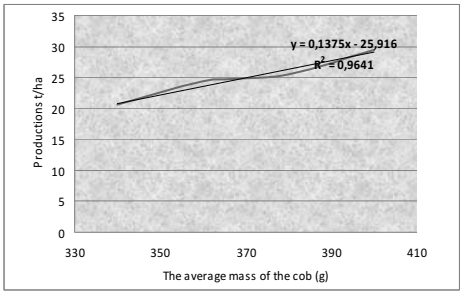

Fig. 5. Correlation between the average mass of the cob and production (60,000 plants/ha)

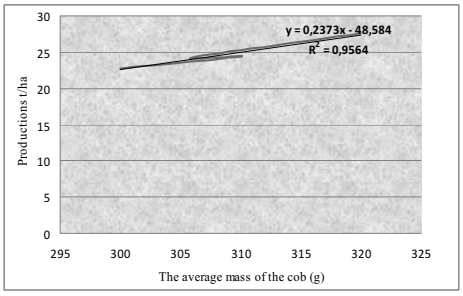

Fig. 6. Correlation between the average mass of the cob and production (75,000 plants/ha)

CONCLUSIONS

The density of culture does not influenced significant the display of phenophases.

The length of the ear decrease with the increasing of density and the diameter and the number of rows of grains/ cob remain at the same value.

The biggest value of trial average mass of the ear it was obtained at density of 60,000 plants/ha (370 g).

The rate of the trial average mass of the cobs without sheets from the total mass of the ear was the biggest at 45,000 plants/ha.

The average number of the ears/plant vary in small limits and decrease while the density increase from 1.2 ears/plant (45,000 plants/ha) to 1.1 ears/plant (75,000 plants/ha).

The average mass of cobs/plant decrease while the density increase from 435 g /plant (45,000 plants/ha) to 340 g /plant (75,000 plants/ha).

The best density was of 60,000 plants/ha, where it was registered the maximum value of 24,970 kg/ha.

From the analysis of the values of the correlation coefficient, it can be noted that only for the density of 60,000 plants/ha exists significant correlation between production and both productivity parameters (number of cobs/plant and average mass of cobs).

Concerning the results obtained in the vegetation conditions of 2011, it can be concluded that the optimum density of culture it was of 60,000 plants/ha.

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