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SUGAR CORN HYBRIDS PRODUCTIVITY OF DIFFERENT RIPENESS GROUPS DEPENDING ON PLANTS STANDING DENSITY

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It is established the effect of planting density on biometric parameters, tilling capacity, leaf area, individual plant productivity of different ripeness groups of sugar corn – Spocusa, Surprise, Glamour and Kabanets SV.

***Keywords:** sugar corn, hybrid, ripeness group, plant height, leaf area, individual productivity, crop capacity.*

When the corn growing it is important the predetermined seeding rate for the forming of the optimum plant standing density on the sown area to the implementation of the genetic potential by the crop, the good assimilation of the nutrients and to obtain the high yield [1, 2].

Conditions of plant growth and development in crops depend on the density of planting. D. S. Filov [3], V. S. Tsykov [4], V. A. Gulidova, L. D. Chesnokova [5] and other researchers pay their attention on the necessity of the optimal sowing density forming of different biotypes of corn. The sugar corn for the morfobiological features is different from the forage crop, so to obtain high and sustainable yields of milky ripeness heads is important to develop a cultivation technology, adapted to a specific soil and climatic zone.

In the field experiments of Genichesk experiment station (south steppe) more crop yield of the conditioned ears of Delicatesna sort without irrigation (average for 1991–1993 was 2380 kg/ha) was obtained at the plants density of 20 thousand plants / ha, but in terms of irrigation (4960 kg/ha) at 80 thousand plants/ha [6].

According to the researches, which were carried out at 1997–1999 in the experimental farm of the Institute of grain farming (northern steppe), sugar corn early ripening variety Delikatesna (7060 kg / ha) and middle early-ripe variety Aromatna (8510 kg/ha) at the preharvest plants density of 50 thousand plants/ha, mid-ripening variety Apetitna (8060 kg/ha) – at 40 thousand plants/ha formed the highest crop yield of ears without wrappers in the phase of milky ripeness [7].

In recent years, the selectionists have created new hybrids of sugar corn, but it is necessary to set the parameters of the optimal plants standing density for more fully realization of their potential productive capabilities.

The purpose of research is to establish the optimal parameters of preharvest planting density of sugar corn hybrids of different ripeness groups in northern Ukrainian steppe subzone.

Experiments were carried out during 2008–2010 at Dnipropetrovs'k experimental station of the Institute of vegetable and melon growing NAAS of Ukraine, it was studied the productivity of sugar corn hybrids, depending on the plants standing density. It was two-factor experiment. The first factor was hybrids: Spokusa, Surprise, Glamour and Kabanets SV, the second factor was plants standing density: 30, 40, 50 and 60 thousand plants/ha. Corn was grown in rotation after spring barley. Stubble-field was removed to a depth of 6–8 cm by disk plough-harrow LDH-5 with MTZ-82 traction. The dose of mineral fertilizer $N_{60}P_{60}K_{60}$ kg/ha was brought scattered under the basic tillage. The plowing was to a depth of 25–27 cm by plow PLN-3-35 in the unit of tractor MTZ-80. In early spring the field was harrowed by the spike-tooth harrows BZTS-1 with tractor MTZ-80. The first cultivation was carried out at a depth of 8–10 cm by cultivator CPN-4 with MTZ-82 traction, before sowing the soil was worked to a depth of 6–8 cm. The sowing was manually. During the care of crops it had been two row cultivations with the cultivator CRN-4, 2 to a depth of 6–8 cm and 8–10 cm and two hand-weeding in the shelterbelts. Discount square area was 10 m^2, a six-time replication.

The soil of the experimental grounds was the mould humus, middle loamy. The humus level was 40–45 cm, transition level was 45–80 cm. Humus content in the arable (0–30 cm)

layer was 3,1 %. The lowest moisture content in the plow layer was 24,4 %, in the 0–60 cm layer was 23,8 %. The level of the groundwater was 8–9 m.

During the studies it is used the conventional methods, methodological recommendations of the Institute of grain farming [8] and the Institute of vegetable and melon growing [9].

The weather conditions during the vegetation period of 2008 were characterized by high temperature in July (37,0 ºC) and August (40,5 ºC). During April – August it was fallen 582.9 mm of rain, at middle long-term indexes was 385.7 mm. During the growing season of 2009 (April – August) it was fallen only 262 mm of rain, or 68 % of the rate. The average temperature in June and July exceeded the norm by 2,4–3,0 ºC. The growing season in 2010 was characterized by high maximum temperatures: in May was 33,5 ºC, in June was 36,0 ºC, in July was 38,0 ºC, and in August was 41,0 ºC. During the growing season) it was fallen 289 mm of rain, at a rate of 385,7 mm.

In average per years of research the plant height of the middle-early ripe Surprise hybrid was bigger at 8 cm compared with the early-ripe Spokusa hybrid, the other the middle-early ripe hybrid – Glamour, for this indicator is practically no different from early-ripe hybrid. The highest plants were mid-season hybrid Kabanets SV plants, they were 38 cm higher than early-ripe hybrid plants.

Sugar corn hybrids not equally react to thickening of crops. With increasing of standing density the plant height of the early-ripe Spokusa hybrid increased by 3–5 cm, middle-early Glamour hybrid – 4–6 cm, this factor of the Surprise hybrid was the biggest for standing density 40 t/ha. Depending on the density of crop the plants height is unchanged (table 1).

The greatest height of the lower corncobs binding was in 2008 and appreciably decreased in 2009 and 2010. The plants' thickening has almost no effect on this rate. On average over three years the height of the corncobs binding of Kabanets SV hybrid was at 22–26 cm higher compared to other hybrids.

The assessment of layering capacity of plants showed that more epicormic branches of sugar corn hybrids plants were formed in moisture favorable 2008 and 2010, in 2009 there were less. On average over the three years the layering capacity of all hybrids was higher at density of 30 thousand plants/ha, while it decreased with planting thickening. Spokusa hybrid formed the most quantity of the epicormic branches.

1. Influence of standing density on height and layering capacity of plants, on clamping height of the lowest corncob (average for 2008–2010)

Hybrid	Standing density, thousand plants/ha	Plant height, cm	Clamping height of the lowest corncob, cm	Layering capacity of plants, pieces
Spokusa	30	162	28	2,3
	40	163	27	2,0
	50	165	28	1,5
	60	167	29	1,2
Surprise	30	168	28	1,5
	40	172	30	1,2
	50	171	29	1,0
	60	170	31	0,7
Glamour	30	158	30	2,0
	40	163	30	1,7
	50	162	30	1,4
	60	164	32	1,1
Kabanets SV	30	202	52	1,2
	40	203	53	0,9
	50	201	52	0,4
	60	203	54	0,3

In our experiments, the leaf area of one plant depended on the weather conditions during the study, the characteristics of hybrids and planting density (table 2).

2. Leaf area, depending on the density of planting (average for 2008–2010)

Hybrid	Standing density, thousand plants/ha	Leaf area of one plant, dm^2	Leaf area per 1 ha, thousand m^2
Spokusa	30	18,1	5,4
	60	15,5	9,3
Surprise	30	28,9	8,7
	60	24,9	15,0
Glamour	30	25,2	7,5
	60	22,5	13,5
Kabanets SV	30	47,4	14,2
	60	41,4	24,9

In 2008, the weather conditions was the best for the formation of the assimilation surface, the leaf area was at 1,5–3,5 times higher compared with 2009. The best conditions for the formation of the leaf area were formed by the standing density of plants 30 t/ha, the increasing of plants density resulted in a decrease of the assimilation surface area.

As per 1 ha of crop the leaf area surface appreciably increased at the thickening, which can be explained by the fact that with density increasing the leaf area of one plant decreased less than the plants density increased.

In our experiments, the number of productive ears in terms of 100 plants depends on the weather conditions. In 2008, the hybrids formed in 1,7–1,8 times more corncobs than in 2009. In all years of research by crop thickening the individual plant productivity decreased (table 3).

On average over the three years at standing density 30 th/ha more productive plants were the mid-early Surprise hybrid and mid-season Kabanets SV hybrid. The crop thickening from 30 to 40 thousand/ha resulted in a decrease of the number of ears by 8–13 pieces. Within these limits, the Glamour hybrid reaction was more visible. With further crop thickening (to 50 t/ha) the number of ears reduced by 3–6 pieces.

3. Influence of plants standing density on sugar corn productivity (average for 2008–2010)

Hybrid (A)	Standing density, thousand plants/ha (B)	Number of productive ears per 100 plants, pieces	Yield of ears without covers, t/ha
Spokusa	30	110	6,19
	40	102	6,15
	50	98	6,98
	60	94	6,85
Surprise	30	114	5,56
	40	105	6,13
	50	92	5,80
	60	89	5,25
Glamour	30	109	4,39
	40	96	5,19
	50	90	5,19
	60	87	5,14
Kabanets SV	30	115	6,19
	40	107	6,53
	50	102	6,37
	60	95	6,21
$LSD_{0,05}$, pieces	A	3,0–2,8	0,232–0,063
	B	3,0–2,8	0,234–0,065
	AB	6,0–5,6	0,476–0,138

Thus, the individual plant productivity depended on the weather conditions during the study, on plants standing density and biological characteristics of hybrids.

As a result of our experiments it was revealed that the early-ripe Spokusa hybrid in 2008 and 2010 conditions the highest yield of cobs with milky stage grain formed by plants standing density of 60 t/ha, in 2009 – at 50 t/ha. The cobs yield of the mid-early Surprise hybrid in 2008 and 2009 was greater in the plants standing density of 40 and 50 thousand/ha respectively, in 2010 by these plants standing density the harvest was almost the same. The reaction to the plants standing density during the studied years of the middle-early Glamour hybrid and the mid-season Kabanets SV hybrid was something different.

On average over the three years the optimum preharvest plants standing density of the early-ripe Spokusa hybrid is 50 t/ha. When the density was 30 and 40 t/ha the yield cobs with grain milky stage decreased by 0,79 and 0,83 t/ha respectively, and significantly lower (by 0,13 t/ha) was by 60 t/ha. The mid-early Surprise hybrid formed the highest yield by 40 t/ha plants standing density, a decrease or an increase of the density resulted to lower yields at 0,33–0,88 t/ha.

The middle-early Glamour hybrid less react to the plants standing density. By 40 and 50 t/ha the average yield of cobs was similar and virtually unchanged at 60 t/ha. The mid-season Kabanets SV hybrid formed the highest yield of ears by the plants standing density of 40 t/ha, be the others densities the yield decreased at 0,16–0,34 t/ha.

Thus, the optimum preharvest plants standing density of the early-ripe Spokusa hybrid is 50 th/ha, for the mid-early Surprise hybrid and Glamour hybrid is 40 and 50 t/ha respectively, for the mid-season Kabanets SV is 40 th plants/ha.

Conclusions. The optimum preharvest plants standing density of the early-ripe Spokusa hybrid is 50 t/ha, which formed the yield of 6,98 t/ha. Surprise hybrid formed the highest yield (6,13 t/ha) by the plants standing density of 40 t/ha. For Glamour hybrid the optimum preharvest plants standing density is 40 and 50 t/ha (crop yield was 5,19 t/ha). The average yield of Kabanets SV hybrid by 40 t/ha plants standing density was the highest and was 6,53 t/ha.

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