UDC 633.63:631.53.01.006.83:631.547.2/.3

THE UNIFORMITY OF PLACEMENT AND FEATURES OF PLANT GROWTH AND DEVELOPMENT DEPENDING ON DENSITY OF SUGAR BEET PLANTINGS

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In the process of sugar beet growing by the intensive technology, which provides the sowing on final density, the receiving of optimum plant density by the uniformity of placement is of great importance. Depending on the areas of sugar beet sowing in Ukraine, Institute of Bioenergy Crops and Sugar Beet recommended the optimum density of sugar beet per 1 ha before their harvesting: in subzone of sufficient humectation – 100-110 thousand / ha, in subzone of unstable humectation – 95-100 thousand/ha, in subzone of insufficient humectation – 90-95 thousand/ha of plants [1].

Sugar content and yield of sugar depend on the equable plants density. By the uniform plant placement in the rows and optimal density, form the roots of the same size and with the smaller deviations relative to the center line of the row and the surface of soil, which can significantly improve the quality of the harvest. According to the own researches on the initial stages of plants germination for obtaining the preset finite sufficient plantings density with the uniform distribution of plants in phytocenoses at this stage requires more than 80% of field sprouts, each of which provided the optimal nutrition area.

From the intervals between the plants in rows depends the mass of roots with intervals increase – the mass increases, but the density of plantings reduce. For the optimum correlation between the mass of roots and its density, the yield of sugar beet is the highest. With the decrease or increase of the optimal value of plant density, the yield reduces [2].

The uniformity of the sugar beet plant density is regulated by the seed sowing in the row at the preset interval and width of row spacing. The positive aspects of aligned seeding are very diverse. On the areas with a quick leaves closing in the rows, suppress the weeds growth and development, reduces the damage by aphids which are the carriers of the diseases. On the aligned sowings, haulm-gathering combine and root-gathering combine work better, and differences between the received samples in evaluation of the expected yield and quality of roots are much smaller. The quite significant advantage of uniform sowings is the obtaining the aligned roots by its size and form [3, 4]. The theoretical calculations show that with the uniform density of plants of 100 thousand /ha before harvest with sugar content of 17% and its weight of 1 kg each, you can get 7 t/ha of sugar. Based on this information, the research program provides the studying of plants growth and development features, the uniformity of their placement according to the different density of plants.

The research methodology. The goal of our researches was the definition of the maximum possible plant density in the conditions of unstable humectation that provides the highest yield of sugar. Researches were conducted in the area of

unstable humectation on the experimental field of Bila Tserkva National Agrarian University in subzone of unstable humectation of the Right-Bank Forest-Steppe of Ukraine in 2010-2012. The scheme of the experiment provides the formation of plants density until harvesting from 80-90 to 136-145 thousand/ha with the interval of 10 thousand/ha. On the control the density of plants was recommended for this zone of sugar beet seeding and was 91-100 thousand/ha. The seed of triploid hybrid of national selection Umanskyy MS 97 according to the scheme of research on the final density was sown. The accounting and monitoring were carried out according to methods of the Institute of Bioenergy Crops and Sugar Beet [5].

The results of researches. The growth is the increasing of weight of the plant. To the concept of development related qualitative changes which occure in the plant. The growth and development of plants are nonidentical concepts [6]. At the initial period of sugar beet plants growth and development the germination phase is distinguished, the phase of the fork and phases of the first, second, third, fourth and fifth pairs of real leaves.

It is established that in all variants with the plants density from 80-90 to 136-145 thousand /ha the seed germination was intense as on the 7th day (the initial stages of germination) and on day the 15th day (full sprouts) after sowing (Table 1).

1. The dynamics of sugar beet germination (average for 2010-2012)

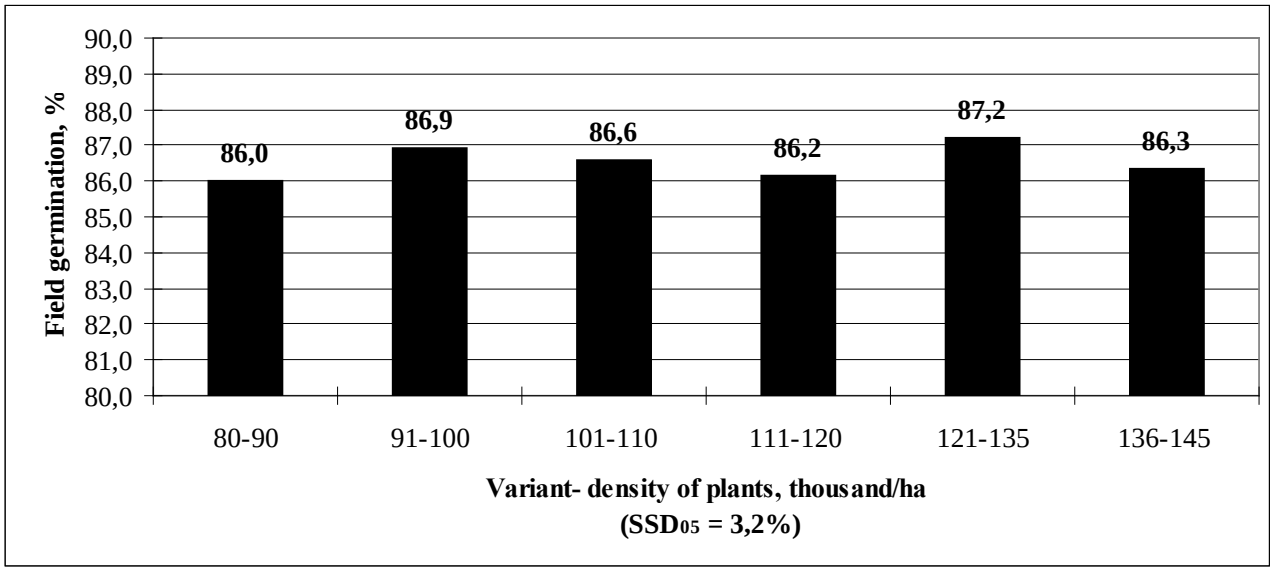
Variant – plant density, housand /ha	Number of sprouts on the day of accounting, pieces per 2 m								
	7th	8 th	9th	10th	11th	12th	13th	14th	15th
80-90	1,6	2,3	3,4	4,7	5,5	7,2	7,9	9,0	9,2
91-100 (control)	1,2	2,3	3,6	4,8	5,6	7,6	8,8	9,7	10,4
101-110	1,4	2,7	4,2	5,4	6,7	8,0	9,8	11,0	11,4
111-120	1,5	2,6	3,9	5,9	7,0	8,5	9,9	11,4	12,5
121-135	1,8	3,4	5,3	6,4	8,0	9,6	11,0	12,9	13,7
136-145	2,0	4,2	6,4	8,8	10,4	12,1	13,5	14,0	14,7

Thus, on the control variant with the plants density of 91-100 thousand/ha the number of sprouts on the 7th day was 1.6 pc, and on 15th day – 9.5 pc. On the variant with the density of sugar beet plants 136-145 thousand/ha the number of sprouts on the 7th day was 2.0 pc, on the day 15th – 16.6 pc.

On the initial stages of germination we observe that the actual number of sprouts that ascended on the 7th day at 1 m of row in the percentage correlation to the norm of seeding was different, but not significantly differed by increasing of plant density from 80-90 to 136-145 thousand/ha. Thus, by the density of plants 80-90 thousand /ha, the percentage correlation was – 29.9%, and by the density from 91-100 to 136-145 thousand /ha, it was slightly lower than from 20.1 to 23.6%. Since the intensity of germination in its early stages under the same soil and climatic conditions were caused by the germination of seed.

Evaluating the weather-climatic conditions that were formed at the moment of conducting researches, the deviation of a number of basic meteorological indices (air temperature, rainfall, and air relative humidity) from middle-perennial is observed,

that generally promoted the high yields of sugar beet. But the weather conditions during the years of research were formed differently. The division of rainfall by the phases of plants growth and development was uneven. The sowing period and germination were characterized by the negligible moisture deficit that didn't affect the level of field germination, which by variants was high and averaged for the years from 86.0% to 87.2% (pic. 1).



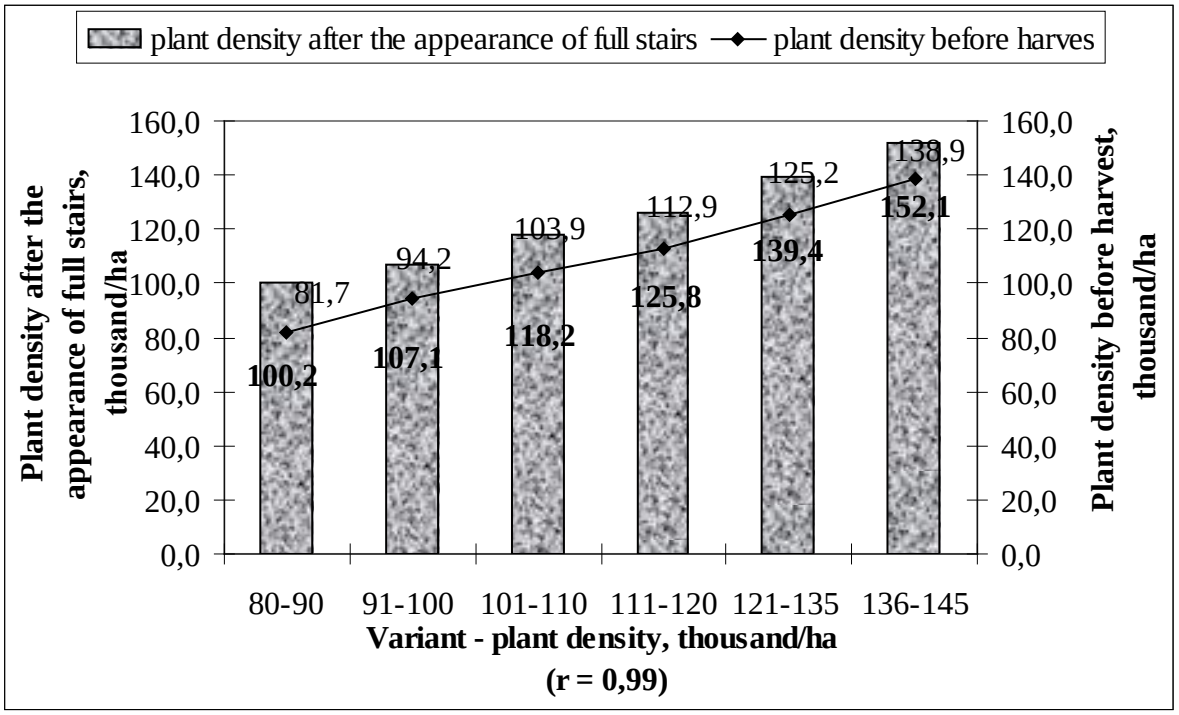
Pic. 1. Field germination (average for 2010-2012)

On average during the experiment the lowest field germination – 86.0% was observed in the variant where sowing was carried out on the final density of 80-90 thousand/ha, and higher – 87.2% during seeding on final density of 121-135 thousand/ha. The received research results indicate that the field germination depends on the intensity of seed germination on the initial stages and climatic conditions during the germination. As there was no significant difference with the intensity of germination, so there was no significant difference with the field germination of seed.

The dynamics of germination and field germination affected the density of sugar beet plants, which was determined after receiving complete sprouts (Pic. 2).

Thus, on average, for three years during determination of plants density after the appearance of complete sprouts, the tendency of increasing plant density in all variants compared to the planned is observed, as before sowing was increased seeding norm to 10-20%, taking into account the possible partial loss of plants during the vegetation period. In this case, it was within the variants 100,2 – 152,1 thousand/ha.

It is established that during the vegetation the plants density from germination to harvest decreased. Thus, on the control variant of 91-100 thousand/ha the plant density decreased by 12.9 thousand/ha or 12.0%, and the variant with the highest density of 136-145 thousand/ha – 13.2 thousand/ha, or 8.7%. In other variants there was also a decrease of plants density from 12.9 to 18.5 thousand/ha or 10,2-18,5%. In other words, regardless of the actual plants density on the period of complete sprouts ranged from 12.9 to 18.5 thousand/ha.



Pic. 2. Plant density, thousand/ha (average for 2010-2012)

According to data of Zenin L.S. [7], the plant density and uniformity of their placement along the length of the row is one of the main reasons for the high productivity of sugar beet. By the uniform placement, plants during further growth and development are provided with the same area of nutrition and therefore before harvesting have the most aligned roots by the size.

According to the conducted researches by the uniformity of plants placement in a row was found that the number of given intervals of plants placement increases with the increase of seeding norm and consequently – of plants density (Table 3).

Thus, on the control variant with density of plants 91-100 thousand/ha the number of intervals of plants placement within the given interval (22,2-24,4 cm) was 66.7%, less than the given interval – 26.7%, and more – 6.6%, and in the variant with the plants density 80-90 thousand/ha in the given interval (24,7-27,8 cm), respectively – 42.8, 28.6 and 28.6%.

2. The intervals of plants placement in a row, depending on the density of plants (average for 2010-2012)

Variant – plant density, thousand /ha	Given interval of seed placement during sowing, cm	The number of intervals of plant placement		
		less	within	more
80-90	24,7 – 27,8	28,6	42,8	28,6
91-100 (control)	22,2 – 24,4	26,7	66,7	6,6
101-110	20,2 – 22,0	25,0	62,5	12,5
111-120	18,5 – 20,0	23,5	70,6	5,9
121-135	16,5 – 18,4	15,0	70,0	15,0
136-145	15,3 – 16,3	8,7	78,3	13,0

With the increase of planting density the number of intervals within the given interval increases. In the variant with the given finite density of 136-145 thousand/ha the number of intervals (15,3-16,3 cm) was 78.3%, and the number of intervals less than specified was only 8.7%.

This tendency is observed on the variants with the given finite density of plants from 101-110 to 121-135 thousand/ha. Thus, with increasing of plant density, is observed their more uniform placement in the row, and in turn it obtaines roots aligned by sizes and therefore – their better harvesting with less loss, which was proved previously by numerous conducted researches.

The uniformity of plants placement is evaluated by the coefficient of variation, which shows the standard deviation to the arithmetic mean of the totality. According to the data of Dospehov B.M. [8] the variability considered to be negligible if the coefficient of variation less than 10%, an average, if more than 10% but less than 20% and significant, if the coefficient of variation more than 20%. The results of the research revealed that an average for three years, the coefficient of variation in all studied variants, exceeded the level of 20%, namely the uniformity of placement of sugar beet plants was characterized by considerable variability. The highest coefficient of variation – 84.2 was in the variant where the sowing was carried out on the final density of 80-90 thousand/ha. In the control variant with the density of 91-100 thousand /ha the coefficient of variation was 81.0%. On all other variants with the density from 101-110 to 136-145 thousand/ha the coefficient of variation was lower and amounted within 70,0-77,8%. (Table 4), indicating a strong influence of this index on the development of sugar beet agrophytocenoses compared to the field germination (r = 0,18-0,26) and plant density after the germination (r = 0,12-0,30).

3. The coefficient of variation of uniformity of placement of sugar beet plants in a row

Variant – plant density, thousand /ha	Coefficient of variation, %			An average for three years
	2010	2011	2012	
80-90	55,9	99,6	97,2	84,2
91-100 (control)	61,5	92,4	89,1	81,0
101-110	77,5	71,1	84,7	77,8
111-120	66,0	81,8	85,1	77,6
121-135	48,0	89,2	72,9	70,0
136-145	65,6	76,5	76,1	72,7

Under the conditions of uniform placement of sugar beet plants in the row and better use of system of agro-technical activity, which provides the establishment of agrophytocenoses, the optimal area of plants nutrition forms, which contributes the proper formation of roots and strong leaf mass, and ultimately affects their productivity.

Conclusions. With the increase of plants density, the regularity of more uniform placement of plants in a row is observed, and this in turn provides receiving of roots aligned in size and therefore – their better harvest with less loss.

In all variants, the coefficient of variation of plants placement was on 20% higher, which indicates its high variability. The highest coefficient of variation – 84.2% was obtained in the variant where sowing was carried out on the final density before harvest 80-90 thousand/ha. With the increase of plant density, the coefficient of variation decreased, indicating their more uniform placement.

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Одержано 19.04.13

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Равномерность размещения и особенности роста и развития растений сахарной свеклы в зависимости от густоты насаждения

В статье освещены результаты исследований по определению равномерности размещения растений в рядке. Изучено особенности роста и развития растений сахарной свеклы в зависимости от их густоты. Доказано, что равномерность размещения растений и густота насаждения зависят от полевой всхожести. Результатами исследований установлена прямая зависимость между полевой всхожестью и густотой растений.

На начальных этапах прорастания наблюдаем, что фактическое количество всходов, которые взошли на 7-й день на 1 м рядка, в процентном соотношении к норме высева семян была разной, но существенно не отличалась за увеличение густоты растений от 80-90 до 136-145 тыс/га.

Погодные условия в годы проведения исследований складывались по-разному. Распределение осадков по фазам роста и развития растений было неравномерным. Период сева и получения всходов во все годы характеризовался незначительным дефицитом влаги, что практически не повлияло на уровень полевой всхожести, которая по вариантам была высокой и составляла в среднем по годам от 86,0 до 87,2%.

При определении густоты растений после появления полных всходов, наблюдаем тенденцию повышения густоты растений во всех вариантах по

сравнению с плановой, поскольку перед посевом были увеличены нормы высева семян на 10-20% с учетом возможного частичного выпадения растений в процессе вегетации. В данном случае она составляла в пределах вариантов 100,2-152,1 тыс/га.

Согласно проведенных наблюдений за равномерностью размещения растений в рядке установлено, что количество заданных интервалов размещения растений возрастает с увеличением нормы высева и, соответственно – густоты растений.

С повышением густоты насаждения растений количество интервалов в пределах заданного интервала растет. На варианте с заданной конечной плотности 136-145 тыс/га количество интервалов в пределах заданного (15,3-16,3 см) составляла 78,3%, причем количество интервалов меньше заданного составляла всего 8,7%.

Установлена зависимость между полевой всхожестью семян и плотности растений после появления полных всходов. Между полевой всхожестью и густотой растений установлена положительная корреляционная зависимость.

С повышением густоты насаждения растений наблюдается закономерность более равномерного размещения растений в рядке, а это в свою очередь обеспечивает получение корнеплодов выровненных по размерам и, соответственно – более качественное их сбора с меньшими потерями. Во всех вариантах коэффициент вариации размещения растений был выше 20%, что свидетельствует о высокой его изменчивости. Высокий коэффициент вариации – 84,2% получено в варианте, где сев проводили на конечную густоту перед уборкой урожая 80-90 тыс/га. С увеличением густоты растений коэффициент вариации уменьшался, что свидетельствует о более равномерном их размещении.

***Ключевые слова**: сахарная свекла, густота растений, полевая всхожесть, равномерность размещения.*

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The placement uniformity, the characteristics of sugar beet growth and development depending on the density of plantings

In the article the results of research on the definition of the uniformity of placement plants in the row are represented. The features of sugar beet plant growth and development depending on their density are investigated. It is proved that uniformity of plants placement and density of plants depends on the field germination. Was found a direct correlation between the field germination and plant density.

On the initial stages of germination, we observe that the actual number of sprouts ascended on the 7th day, at 1 m of row in the percentage ratio to the seeding norm was different, but wasn't differ significantly by increasing of plant density from 80-90 to 136-145 thousand/ha.

The weather conditions during years of research developed differently. The division of precipitation on the phases of plants growth and development was uneven. The sowing and germination period was characterized by the negligible moisture deficit that had no effect on the level of field germination, which by variants was high and averaged from 86.0% to 87.2%.

During the determination of plants density after the appearance of complete sprouts, the tendency of increasing of plant density in all variants is observed compared to the planned, as before sowing the seeding rate was increased to 10-20%, taking into account the possible partial loss of plants during the vegetation period. In this case, it amounted within the variants 100,2-152,1 thousand/ha.

With the increase of plant density the number of intervals, within a preset interval, increases. In the variant with the preset eventual density 136-145 thousand/ha the number of preset interval (15,3-16,3 cm) was 78.3%, and the number of intervals less than preset was only 8.7%.

It is established the dependence between the field germination of seeds and plant density after the appearance of complete sprouts. Between the field germination and plant density was established the positive correlation.

With the increase of plants density was observed the regularity of more equable placement of plants in the row, and this in turn provides receiving roots aligned by its size and therefore – their better harvesting with less loss.

In all variants, the coefficient of variation of plants placement was on 20% higher, indicating its high variability. The highest coefficient of variation – 84.2% was obtained in the variant where sowing was carried out on the final density before harvest of 80-90 thousand/ha. With the increasing of plant density decreased the coefficient of variation, indicating their more equable placement.

***Keywords**: sugar beet, plant density, field germination, uniformity of placement.*