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INFLUENCE OF REQUIRED TIME FOR EMERGENCE ON GROWTH AND YIELD OF SUGAR BEET

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Abstract: *Sugar beet belongs to the most productive crop. It produces high yields, which is also very energy rich (sugar). Therefore this plant species is often calls "queen of the field" as it has high requirements for environment condition. In these studies, we research the influence of the time from planting to emergence from different planting dates on percentage of field emergence and roots yield per plant at harvest time. There were four next planting date: 1) March 20-25, 2) March 26-31, 3) April 10-15 and 4) April 20-25. Number of days from planting to emergence, on average was 14, 15, 14 and 8 respectively for first, second, third and fourth planting dates. The average root weight at harvest ranged from 795 g (fourth planting date) to 1106 g (first planting date). In the same planting date root yield also varied. In the first planting date this variation were from 800 g to 1232 g per plant (the last and the first day of the emergence) and in the least planting date from 510 g to 778 g per plant.*

Key words *: sugar beet, planting date, emergence, root yield*

INTRODUCTION

Sugar beet belongs to a group of most intensive crop species. This plant species is often called "queen of the field" as it has high requirements for environment condition. It is probably one of the most intensive cultivated plant species and it is considered as one of the youngest cultivated species. The increase in sugar beet production is associated with the building of first sugar refineries and the launch of the first campaign for processing the sweet root in year 1801.

The significance of this plant species is the fact that it converts the highest amount of sun kinetic energy into organic matter energy. With eleven tons of sugar, 188.825 KJ of sun energy was converted into organic matter energy (sugar). By-products (head and leaves, beet pulp and molasses) contain 55.997 KJ, also converted into organic matter.

The impact of sugar beet production on the economy of a country is immense. A whole chain of other industrial (sugar plants) and food processing branches of economy is affected.

MATERIAL AND METHOD

A field experiment conducted in the Institute of Field and Vegetable Crops in Novi Sad at location Rimski Šančevi. The experiments were conducted on soil type chernozem, subtype on loess, variety carbonate, form medium deep, good physical and chemical characteristics.

In the experiment, four different sowing dates were studied: two optimal sowing dates (24. III and 31.III), one medium late (14.IV) and one late (28.IV). Elementary plot for sowing was 3x8 m, and for analysis 1.5x8 m. After sowing, emergence was monitored every other day, until end of emergence. Emergence was monitored on 3 lines 8 meters long. During emergence every plant was marked and monitored separately until the end of vegetation. During

vegetation standard care measures were taken. Fertilizing was based on agro-chemical soil analysis, and nitrogen fertilizing was based on N-min method (Marinković et al., 2003).

At the end of vegetation, roots were manually extracted and their mass measured. Out of analysed data, the following were calculated:

- number of days from sowing to emergence (DFSE) and weighted average number of days
- average mean day temperature
- sum of mean day temperature from sowing to emergence and weighted average sum
- sum of effective temperature (higher than 5°C) from sowing to emergence and weighted average sum
- number of seedlings
- emergence index
- percentage of emergence per days
- average root mass per plant and weighted average mass
- coefficient of variation (CV) of root mass
- root yield t ha^{-1} per sowing dates
- percentage of yield deviation from first day of emergence

Weighted average of number of days between sowing and emergence, sum of mean day temperature as well as sum of effective temperature, weight by number of emergence plants per day. Emergence index obtained dividing corresponding number of emergence plants by number of days between sowing and emergence

RESULTS AND DISCUSSION

The effects of sowing dates and emergence dates are shown in Tables 1 and 2. Table 1 shows the effect of March sowing date.

After the sowing was done in the second decade of March (24.III) sugar beet required from eleventh to nineteenth day to emergence. The majority of plants (41) emerged on the fifteenth day after sowing (34%), lesser on eleventh day (37 plants, 31%) and on thirteenth day (32 plants, 27%). Total emergence index in this sowing date was 9.12, and the highest was on the first day of emergence 3.36 (11 days from sowing to emergence DFSE). Weighted average required days for emergence was 13, while the weighted average daily mean temperature was 10.7°C. With delayed emergence (from 11th to 19th day) the average daily mean temperature increased from 10.0°C to 11.0°C. At the same time, total temperature sum increased from 120.5°C (11th DFSE) to 219.9°C (19th DFSE), while the effective temperature sum varied between 56.1°C and 114.7°C. Root mass, as the most important element of this experiment, was highest with the plants which emerged on the 11th DFSE (1232g). With the emergence delay, root mass dropped. Plants that emerged on the 13th DFSE had lower mass (1136g) by 8% compared to the plants that emerged first. In next delays, for 2 and 4 days, (15th and 17th DFSE) root mass significantly dropped. Compared to the first date of emergence, root mass was lower by 287 and 276g per plant (23%). Last emerged plants (19th DFSE) had the lowest root mass, 800g per plant and compared to the first date of emergence, lower by 35%. C.V of root mass increased from 11th to 17th DFSE, (from 15% to 36%) and highest was on 17th DFSE 36%. This variation was expected because the plants were endangered by competition of earlier emerged plants. Average root yield per hectare in this sowing date was 109.1 tha^{-1}.

In the sowing at the end of March (31. III) emergence required from 13 to 19 days. Weighted average required days for emergence was 14 (one day more than in previous sowing date). The sum of effective temperatures ranged from 72.5 to 123.6 ^{0}C, depending on the time

required for emergence (from 13 to 19 DFSE). Total temperature sum varied between 148.9 and 229.6 ^{0}C. Weighted average daily mean temperature was 10.9°C and was higher for 0.2^{0}C than in previous sowing date (range was 10.6 to 11.5 ^{0}C). Total emergence index in this sowing date was 8.35, and lower for 0.77 than in previous sowing date. In the first two days of emergence, 13th and 15th DFSE, emerged 109 plants (90.8%), and in the coming days another 11 plants (9.2%). Average mass of roots per plants, emerged 13th day after sowing was 1038g, with CV 22%. Average mass of roots per plants emerged 15th day after sowing was for 8% lower (957g). The highest reduction of root mass per plant for 114g or 11% were on plants emerged 17th day after sowing. Same plants had the lowest CV of 19%. Average root yield per hectare in this sowing date was 98.7 1 tha^{-1}.

Table 1.

Influence of required time for emergence, in March sowing dates, on sugar beet emergence and root yield

Date		Number of days from sowing to emergence	Period from sowing to emergence			Number of seedlings	Emergence index	Emergence (%)	Average root mass per plant (g)	CV of root mass (%)	Root yield (t ha$^{-1)}$	Root mass deviation from first day of emergence (%)
Sowing	Emergence		Average mean day temperature (^{0}C)	Σ T (^{0}C)	Σ effective T (^{0}C)							
24.III	4.IV	11	10.0	120.5	56.1	37	3.36	31	1232	15		100
	6.IV	13	10.3	144.8	67.6	32	2.46	27	1136	18		92
	8.IV	15	11.0	176.1	85.2	41	2.73	34	945	21		77
	10.IV	17	11.1	200.5	105.3	7	0.41	6	956	36		77
	12.IV	19	11.0	219.9	114.7	3	0.16	3	800	8		65
Sum / Average	6.IV	13	10.7	153.1	73.4	120	9.12	100	1091	22	109.1	
31.III	13.IV	13	10.6	148.9	72.5	43	3.31	36	1038	22		100
	15.IV	15	11.0	175.8	85.6	66	4.4	55	957	25		92
	17.IV	17	11.5	206.4	107.7	10	0.59	8	924	19		89
	19.IV	19	11.5	229.6	123.6	1	0.05	1	940			91
Sum / Average	14.IV	14	10.9	169.2	83.1	120	8.35	100	984	24	98.4	

In the April sowing date's plants emerged faster (Tab. 2). In the sowing at April 14, all seed emerged 13 and 15 days after sowing. Weighted average required days for emergence was 14 and the weighted average daily mean temperature was 12.4 ^{0}C. Weighted sum of temperature was 186.4 ^{0}C, and the sum of effective temperature varied from 96 ^{0}C (13 DFSE) to 111.9 ^{0}C (15 DFSE). Total emergence index was 8.78. The average mass of roots per plants was 830g and ranged from 847g to 812g. It means that delay emerged plant had for 3% lower root mass. CV of root mass per plant on average was 28% and ranged from 25% (13 DFSE) to 32% (15 DFSE). Root yield per hectare on average was 83.0 tha^{-1}.

At the latest sowing date at April 28, the average number of days required for emergence was 9, the lowest compared to other sowing dates (lower for 4 or 5 days). Weighted average daily mean temperature during emergence was the highest (15.3 ^{0}C). In regard to other sowing dates it was higher by 4.6; 4.4 and 2.9 ^{0}C respectively. The total temperature sum was only 142.5 ^{0}C, and the sum of effective temperatures ranged from 79.1 (7 DFSE) to 106.7 ^{0}C (11 DFSE). Total emergence index also was the highest (15.16) compared to other sowing

dates. The average mass of roots per plant in this sowing date was the lowest (774g) and ranged from 778g (7 DFSE) to 510 g (11 DFSE). CV of the root yield varied from 33% (7th DFSE) to 28% (9 DFSE). The yield per hectare was 77.4 tha^{-1} and in regard to other sowing dates was lower by 31.7; 21.0, and 5.6 t ha^{-1} respectively

Table 2.

Influence of required time for emergence, in April sowing dates, on sugar beet emergence and root yield

Date		Number of days from sowing to emergence	Period from sowing to emergence			Number of seedlings	Emergence index	Emergence (%)	Average root mass per plant (g)	CV of root mass (%)	Root yeld (t ha^{-1})	Root mass deviation from first day of emergence (%)
Sowing	Emergence		Average mean day temperature (^{0}C)	Σ T (^{0}C)	Σ effective T (^{0}C)							
14. IV	27.IV	13	12.4	173.7	93.0	76	5.85	63	841	25		100
	29.IV	15	12.4	199.0	111.9	44	2.93	37	812	32		97
Sum / Average	27.IV	14	12.4	183.0	99.9	120	8.78	100	830	28	83	
28. IV	5.V	7	16.2	129.6	79.1	58	8.29	48	778	33		100
	7.V	9	15.4	154.3	98.0	61	6.78	51	773	28		99
	9.V	11	14.2	170.5	106.7	1	0.09	1	510			66
Sum / Average	6.V	8	15.3	142.5	88.9	120	15.16	100	774	31	77.4	

The sowing date has a great influence on plants yield, especially on plant species with small seeds that need to be sowed early in the year. Sugar beet is a plant on which sowing date has a significant influence (MARINKOVIĆ et al., 2002). With a too early sowing date, plants can be endangered by occurrence of spring frosts (NENADIĆ et al., 1996), while late sowing dates could affect provocative germination and thus a lower number of plants (MARINKOVIĆ et al., 2005a and 2005b). During these experiments, a highest yield was accomplished in the first sowing date (March 21) which agrees with results obtained by MARINKOVIĆ et al. (2005a), MARTIN (1983) and TAHSIN et al. (2004). Varieties has a significant role in creating yield, and different variety have a different reaction to sowing dates, which can be seen in experiments conducted by MARINKOVIĆ et al. (2005b), in which the author states that one variety (MARATON) out of four studied, gives the highest yield in the fifth sowing date (10.IV), similar results were obtained by REFAY (2010). Besides the variety, agro-ecological terms of production on global, as well as on micro level, have a significant influence on yield. Fortune et. al. (1999 and 2000) states in different years, highest yield occurred at different sowing dates, from first to third. Similar conclusions could be made by examining the experiments conducted by MARINKOVIĆ and ass. in their papers which deal with different years (2002; 2005a; 2005b)

Generally, the choice of a optimal sowing date depends on global climate conditions, micro region conditions, varietal specificity and specificity of every year. These are the principles of crop management practice for which MARINKOVIĆ with his associates stands for in his numerous papers.

CONCLUSION

The presented experimental results clearly indicate on the following conclusions:

- The delay in sowing date regularly decreased yield for 31.7; 21.0 and 5.6 tha^{-1}. The smallest was in sowing on April 28 (77.4 tha^{-1}).
- The mean coefficient of variation of yield also increased with later sowing dates. Variation was 22% (March 24) to 31% (April 28).
- The highest average root mass per plant (1232g) was in the first sowing date (11th day from sowing to emergence), and the lowest 510g in the last planting date April 28 (11th day from sowing to emergence).

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