EFFECTS OF HARVESTING DATES AND PLANT POPULATION ON SUGAR BEET SEED FRACTIONS

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ABSTRACT: The effects of harvest date and plant population on sugar beet seed size by fraction were studied in a three-year field trial after primary seed cleaning. The seed size was highly significantly affected by the different harvesting dates. The highest percentage of the seeds fell into either the 3.5-4.5 mm fraction or the 4.5-6.0 mm one. This indicates that in the three different climatic years the highest amount of large seeds was obtained with hybrids tolerant of sugar beet rhizomania. In most cases, no significant differences were found when comparing the different plant populations per hectare. Highly significant differences were found among the study years resulting from the influence of uncontrolled climatic factors of the agroecological region. This leads to the conclusion that seed sugar beet harvesting is the most important cultural practice affecting seed size in this crop during the production process.

Key words: seed size, seed fraction, harvesting dates

INTRODUCTION

The influence of parental lines' hereditary traits may be one of the factors affecting seed size in sugar beet (Kawakatsu et al. 1997). Today's cultivars of sugar beet are triploid and have a somewhat smaller seed size than the old, diploid cultivars. Larger-sized seeds are formed in the first third of the main stem and in the axils of lateral branches. Small-sized seeds form on the branches of the first, second and third rows of the flower-bearing stem. (Dokić, 1992). Sugar beet is a species with small seeds, so it is vitally important that the percentage contribution of large seeds be as large as possible.

Increased seed size gives larger endosperm and germ masses. (Richard et al. 1989). The larger seed fractions have higher germinability and 10% less empty seeds after primary seed cleaning (Kawakatsu, 1998). Larger seeds provide larger germ mass, resulting in faster root growth and larger root mass. Plants with a greater percentage of large seeds have a better ratio of root organic matter to organic matter of the above-ground plant parts in favor of the former. (Dokić and Stojaković, 1978). Te Krony and Hardin (1968) report a positive correlation between seed size and seedling mass resulting in earlier seedling growth and greater sugar percentage. In a laboratory study by Krauss (1984), larger seeds brought about faster germination by five days relative to smaller seeds (Krauss, 1984).

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The effects of harvesting date and stand density in Stefanović (1987) were not great, except for the two most common fractions, 3.5-4.5 and 4.5-6.0, with the latter fraction comprising more than half of the seed yield. Longden (1974) stresses the importance of year for seed size. In the first year of his study, the 3.2-5.5 mm fraction accounted for 632 g/1 kg seed, while in the second tha ratio was 675 g/1 kg seed. Kristek and Matić (1984) report obtaining a yield with 75% of the seed in the 3.2-3.7 and 3.7-4.2 mm fractions, which is a large amount of small-sized seeds.

MATERIALS AND METHODS

A field trial was carried out at Selenča during 2000, 2001 and 2002 using a randomized block design with three replicates. The size of the basic plot within a commercial plot was 10 m^2.

The trial factors were: Factor A – harvesting dates, Factor B – plant population and Factor C – seed size. Factor A included four treatments corresponding to different stages of beet growth and development, namely start of wax maturity, end of wax maturity, start of full maturity and end of full maturity. Factor B also involved four treatments: 100,000, 125,000, 150,000 and 175,000 plants per hectare at harvesting. The following seed fractions were anlyzed after primary cleaning: <3,5 mm C^1, 3,5-4,5 mm C^2, 4,5-6,0 mm C^3 and >6,0mm C^4.

The results of the three-factorial trial with four treatments per factor were processed by analysis of variance according to H a d ž i v u k o v i ć (1977). The rhizomania-tolerant hybrid Lara was used.

The objective of the paper was to determine how the time of harvesting and plant population at harvestimg affect sugar beet seed size, so that a greater percentage of seeds belonging to the larger fractions can be obtained.

RESULTS AND DISCUSSION

Table 1. Effect of harvesting dates and plant population on sugar beet seed fractions expressed as percentage

		B^1				B^2				B^3				B^4			
	g	C^1	C^2	C^3	C^4	C^1	C^2	C^3	C^4	C^1	C^2	C^3	C^4	C^1	C^2	C^3	C^4
A^1	1g	6	32	52	10	6	38	51	6	6	32	51	11	5	35	54	6
	2g	9	30	57	4	6	31	58	5	7	42	46	5	7	41	46	6
	3g	4	54	40	12	2	53	41	4	2	54	41	3	2	52	42	4
A^2	1g	8	53	57	7	6	23	57	14	5	27	52	16	8	28	58	6
	2g	5	40	48	7	5	39	51	5	5	36	51	8	6	35	50	9
	3g	2	45	50	3	3	45	49	3	3	45	47	5	2	45	51	2
A^3	1g	5	22	61	12	3	22	61	14	4	21	61	14	5	20	61	14
	2g	4	32	60	14	4	36	55	5	3	34	56	7	6	34	55	5
	3g	2	41	55	2	2	41	55	2	2	35	60	3	2	35	61	2
A^4	1g	4	15	64	17	5	15	64	16	4	16	63	17	4	14	61	7
	2g	5	33	58	4	3	34	57	6	4	31	58	7	4	30	60	6
	3g	2	35	61	2	2	30	63	5	2	28	65	5	2	28	64	6

$A^{0,05}$	$A^{0,01}$	$B^{0,05}$	$B^{0,01}$	$C^{,0,05}$	$C^{0,01}$	$AB^{0,05}$	$AB^{0,01}$	$AC^{0,05}$	$AC^{0,01}$	$BC^{0,05}$	$BC^{0,01}$
2,46	3,25	2,46	3,25	2,46	3,25	4,98	6,51	4,92	6,51	4,92	6,51

Table 2. Analysis of variance

	Source of variation	Degrees of freedom	Sum of square	Mean square	F-ratio
1	Replicate	2	0,042	0,021	0,0006
2	Factor A	3	16,37	5,458	0,1467
4	Factor B	3	40,958	13,653	0,3670
6	AB	9	22,500	2,500	0,0672
8	Factor C	3	82767,750	27589,250	741,5265**
10	AC	9	3126,208	347,356	9,3360**
12	BC	9	70,958	7,884	0,2119
14	ABC	27	329,917	12,219	0,3284
15	Error	126	4687,958	37,206	
	Total	191	91062,667		

Of the three factors, it was only with Factor C, seed size, that had significant differences among treatments, while the other two did not. Only one significant interaction was recorded, and it was between Factor A (harvesting date) and C (seed size). The difference for both the factors was highly significant (Tab. 1, 2).

The largest significant influence of harvesting dates on seed size was found in the 3.5-4.5 and 4.5-6.0 mm seed fractions. Similar results were obtained by (Kristek and Matić, 1984) with the 3.7-4.2 mm fraction, while with earlier harvesting a larger percentage of smaller seeds in the 3.0-3.7 mm fraction was obtained. Harvesting dates are very important for seed size, because what is at stake is the process of seed growth and development, which must not be halted before the seed is fully formed. (Debenham et al. 1997). In our trial, the percentage contribution of the seed fractions after primary seed cleaning was the same with all harvesting dates and study years. This can be attributed to the larger percentage of smaller seeds in the >2.00 mm fraction that was obtained on the first harvest date and discarded by primary cleaning (Stefanović, 1987), making the percentage of the smallest fraction – <3.5 mm – unchanged relative to the rest of the fractions. The reason for the same seed fraction ratio in the three climatically different years should lie in the different effects of environmental conditions on seed formation (Longdem, 1974).

ACKNOWLEDGEMENT

The field trial was carried out on a private plot owned by Jovan Vađina from Selenča by the DTD canal. We are thankful for his labor and intermediate goods.

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