The influence of harvest date and crop treatment on the production of two different sugar beet variety types

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ABSTRACT

In a four-year trial, the effect was evaluated of the harvest time on the production of two different sugar beet variety types (the Z-type variety Elan and the NE-type variety Epos) grown in three patterns – 1. check pattern, 2. fertilisation with 50 kg N/ha, 3. fertilisation with 50 kg N/ha + fungicide treatment. Sugar beet was harvested in two terms: at the beginning of the beet processing season, and four weeks later. The differences between the varieties became apparent mainly at the later harvest time. The root yields of the NE-type variety Epos were higher at the later harvest by the average 4.35 t/ha (statistically significant, $\alpha = 0.01$) while its sugar content was lower by 0.3% ($\alpha = 0.05$) than in the Z-type variety Elan. The postponement of the harvest time increased the root yields of both varieties by the average 10.47 t/ha (i.e. by 17.9%, $\alpha = 0.01$). The effect of the harvest time on the sugar content was dependent on the year. Due to retrovegetation following the rainfalls after a prolonged dry period in the year 2000, the sugar content decreased at the later harvest time by 1.68% in absolute figures (or by 8.35% rel., $\alpha = 0.01$). The content of molassigenic substances in sugar beet roots varied according to the year rather than to the factors followed. The white sugar yields increased at the later harvest by the average 1.57 t/ha (or by 16.9%, $\alpha = 0.01$). The average increment of sugar for each day of the postponed harvest was 58.2 kg/ha (or 0.63%). The effect of nitrogen fertilisation and fungicide treatment on the sugar beet production became apparent at the later harvest time. Fertilisation with 50 kg N/ha + fungicide treatment increased the root yields by 1.07 t/ha (or by 10.32%, $\alpha = 0.01$) in comparison with the pattern without nitrogen fertilisation and fungicide treatment. Spraying with fungicide itself increased the sugar yields by 0.81 t/ha (or by 7.81%, $\alpha = 0.01$) in comparison with the pattern equally fertilised but not treated with fungicide.

Keywords: sugar beet; harvest time; variety; nitrogen fertilisation; fungicide; production

Sugar beet is a crop with a very sensitive reaction to soil and climatic conditions of growing (Märländer 1991, Chochola 1998, Pulkrábek et al. 1999, Švachula 1999). Sugar beet growers endeavour to obtain high sugar yields even in extreme situations in the course of vegetation caused by negative environmental effects such as, e.g., weather changes, etc. A suitable combination of controllable growing factors enables to create optimum conditions for high and stable sugar yields per hectare (Pačuta and Bajči 1998). Among others, it also pays to seek and apply such growing measures which will make a significant contribution to the stabilisation of yields. These may include a suitable variety, optimum nitrogen dose (Bürcky 1991, Kühn 1996, Kováčová 1997, Chochola 1998), a suitable fungicide treatment of leaf system as well as the harvest time.

According to Minx (1999), the key precondition for increasing yields and technological quality of sugar beets in the coming years is an extension of its production process. When having moisture and sufficient temperature conditions, sugar beet grows during the whole vegetation term.

The root formation and sugar accumulation in the root occur with different intensity during the whole vegetation term, from sowing until harvest (dry mass increments as well as reductions). The root growth mostly follows the formation of sufficiently large photosynthetic system, i.e. from late July until mid-September (Bajči et al. 1997). The root growth then slows down and is followed by intensive accumulation of dry mass (increasing sugar content). An early beginning of the harvest season and a lack of respect for the proceeding with the harvest lead to considerable production losses (Minx 1999).

Bajči and Tomanová (1991) argue that, in order to obtain high and good-quality yields, it is important to achieve optimum degree of coverage of the leaf rosette and to limit the leaf formation after the creation of the necessary leaf system so that further formation does not lead to losses of energy and assimilates which could otherwise deposit in the form of saccharose. The grower has therefore to seek an early termination of the leaf formation stage in order to obtain sufficient time for the root formation and sugar accumulation. This may be achieved by an early sowing of sugar beet, creating of conditions for an early coming of the stand, its adequate nitrogen fertilising, and the considerate beginning of the harvest season (Minx 1999).

The aim of our work is to evaluate the production of two different sugar beet variety types harvested at the beginning of the beet processing season and four weeks later.

MATERIAL AND METHODS

In order to evaluate the effect of the harvest time on the sugar beet yields, small-plot trials were established in the years of 1998 to 2001 at the Experimental Station of

Table 1. Percentages of the precipitation normal in the trial years, Červený Újezd (evaluated according to WMO method, Kožnarová and Klabzuba 2002)

Month	Precipitation normal (mm)	Percentage of precipitation normal							
		1998		1999		2000		2001	
April	43	27	vbn	33	vbn	31	vbn	124	n
May	60	41	vbn	67	n	99	n	88	n
June	68	149	an	62	bn	67	bn	86	n
July	76	84	n	111	n	74	n	123	n
August	68	33	vbn	31	vbn	63	bn	158	an
September	46	150	an	119	n	49	bn	152	an
October	39	222	van	63	n	146	an	61	n

Evaluation: ebn – extraordinary below normal, vbn – very below normal, bn – below normal, n – normal, an – above normal, van – very above normal, ean – extraordinary above normal

Table 2. Deviations from the temperature normal in the trial years, Červený Újezd (evaluated according to WMO method, Kožnarová and Klabzuba 2002)

Month	Temperature normal (°C)	Deviation of temperature normal (°C)							
		1998		1999		2000		2001	
April	7.4	2.5	an	1.5	n	3.2	van	–0.3	n
May	12.4	1.3	n	1.5	n	3.1	van	2.1	an
June	15.9	0.7	n	–0.3	n	1.7	an	–1.5	bn
July	17.4	0.0	n	1.4	an	–1.5	bn	0.9	n
August	16.8	0.8	n	0.7	n	2	van	2.2	van
September	13.7	–1.1	bn	3.3	van	0.1	n	–2.0	bn
October	8.2	0.4	n	0.5	n	2.5	van	3.5	ean

Evaluation: ebn – extraordinary below normal, vbn – very below normal, bn – below normal, n – normal, an – above normal, van – very above normal, ean – extraordinary above normal

the Faculty of Agronomy, Czech University of Agriculture, in Červený Újezd (Prague-West District). This location is situated 398 m above sea level, in a moderately warm, dry climatic region. The average annual air temperature is 7.7°C, the average annual precipitation rate is 549 mm (1961–1990 standard climatological normal). Tables 1 and 2 show the weather pattern in the trial years. The plow layer in the trial land is 40 cm deep. The soil type is haplic Luvisols. Agrochemical analyses showed a sufficient content of phosphorus in the soil (72.3 ppm – Mehlich II) and a high content of potassium (203.3 ppm – Mehlich II).

In a four-year small-plot trial, the effect was evaluated of the harvest time on the production of two different types of sugar beet variety – the Z-type variety Elan and the NE-type variety Epos. Three patterns were established for each variety: 1. check pattern (without nitrogen fertilisation and fungicide treatment); 2. fertilisation with 50 kg N/ha; 3. fertilisation with 50 kg N/ha + treatment with fungicide active against leaf diseases. The fertiliser applied to sugar beet was Hydro LAV (27% N), the fungicide was Alert S (active substance carbendazime + flusilazole). The fungicide dose applied was 1 l/ha at the time of the first symptoms of *Cercospora beticola* which

Table 3. Agrotechnical terms it the trial years

Year	Sowing	Emergence	N fertilisation	Fungicide application	1st harvest	2nd harvest
1998	10.4.	30.4.	14.5.	14.7.	22.9.	21.10.
1999	25.3.	9.4	20.5.	29.7.	22.9.	18.10.
2000	11.4.	25.4.	22.5.	23.8.	25.9.	23.10.
2001	20.4.	30.4.	23.5.	9.8.	2.10.	26.10.

Table 4. Comparison of production indicators of the Elan and Epos varieties at two harvest times

1998–2001	ELAN variety				EPOS variety				Average of varieties			
	1. term	2. term	difference	D_{min}	1. term	2. term	difference	D_{min}	1. term	2. term	difference	D_{min}
Roots yield (t/ha)	58.10	66.76	8.659**	4.089	58.83	71.11	12.281**	4.902	58.47	68.94	10.470**	3.048
Tops yield (t/ha)	36.89	35.82	–1.072	3.507	33.72	32.95	–0.773	5.324	35.31	34.38	–0.922	3.056
Sugar content (%)	17.84	17.80	–0.035	0.649	17.92	17.50	–0.426	0.432	17.88	17.65	–0.230	0.352
Alpha-amino nitrogen (mmol/100 g)	2.07	2.47	0.402*	0.399	2.24	2.43	0.187	0.409	2.15	2.45	0.294*	0.267
Potassium (mmol/100 g)	3.42	3.48	0.054	0.230	3.62	3.51	–0.107	0.207	3.52	3.49	–0.027	0.145
Sodium (mmol/100 g)	0.76	0.64	–0.118	0.132	0.66	0.60	–0.059*	0.052	0.71	0.62	–0.088*	0.072
White sugar yield (t/ha)	9.19	10.58	1.390**	0.683	9.30	11.05	1.745**	0.817	9.25	10.81	1.567**	0.491

*significant difference at $\alpha = 0.05$, **significant difference at $\alpha = 0.01$

usually occurred under the conditions of Červený Újezd in early August (Table 3).

Each plot consisted of three sugar beet rows and one marginal forage beet row. The harvest size of one plot (3 sugar beet rows) was 12 m^2. Each pattern was repeated 6 times. Three repeats were harvested at the beginning of the annual beet processing season; the remaining three repeats four weeks later (Table 3). Beet tops from each plot were manually cut, picked and weighed. Beet roots were harvested by means of three-row lifter, manually picked and weighed. The values obtained were used for the determination of the yields of roots and tops. Two samples, each of 25 pcs of roots, of each pattern were taken at the harvest time and analysed by the VÚC Prague for the sugar content, alpha-amino nitrogen content and potassium content. The values obtained were used to calculate the white sugar yields by means of Reinefeld formula.

The trial results were evaluated using the statistical programme Statgraphics Plus for Windows 4.0. We used the multifactor analysis of variance, Tukey method at the 99% or 95% significance level.

RESULTS AND DISCUSSION

The postponement of the harvest time had in both varieties a positive effect on the root yields and therefore also on the sugar yields (Table 4). In all years of the experiment

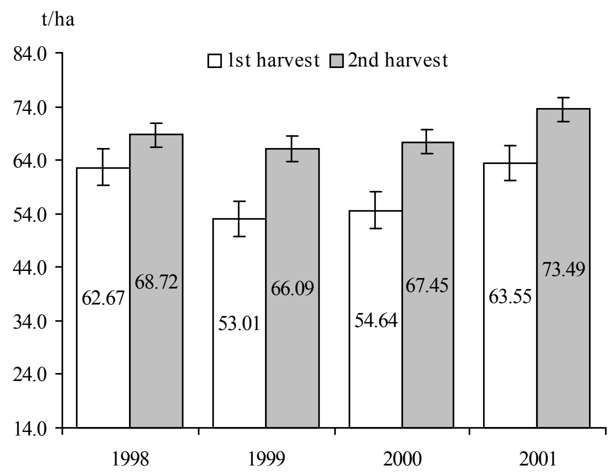

Figure 1. Root yields at earlier and later harvest times in individual years

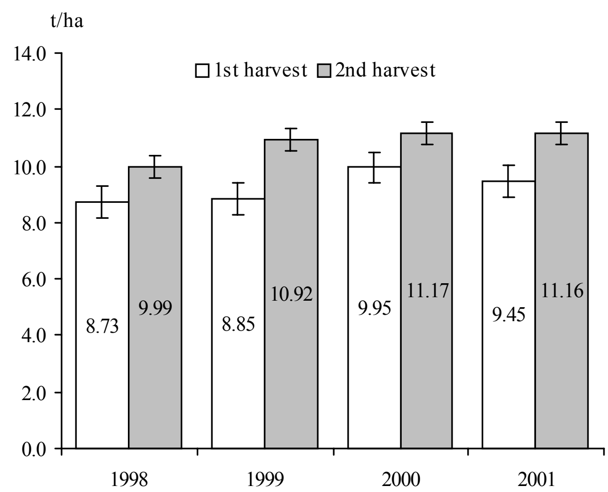

Figure 2. Sugar yields at earlier and later harvest times in individual years

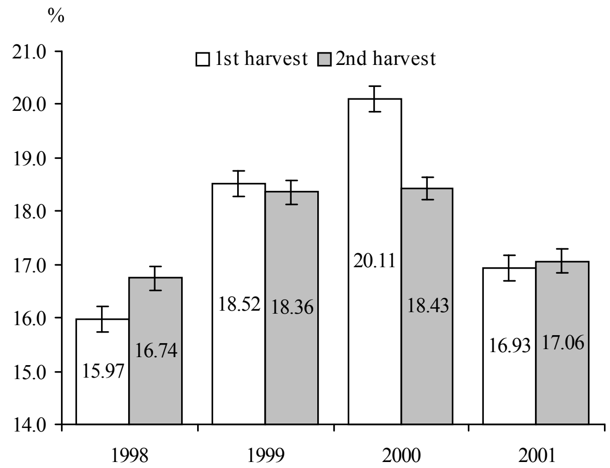

Figure 3. Sugar content at earlier and later harvest times in individual years

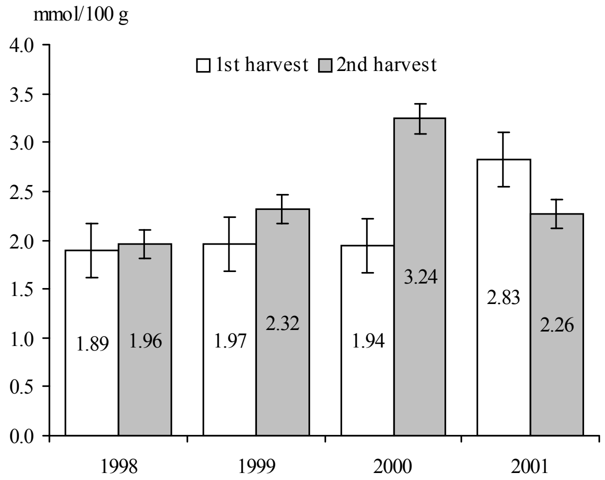

Figure 4. Alpha-amino nitrogen content at earlier and later harvest times in individual years

the root yields were significantly higher at the later harvest time (by 9.7 to 24.7% rel., $\alpha = 0.01$) rather than at the earlier harvest time (Figure 1). The postponement of the harvest time increased the root yields by the average 10.47 t/ha (rel. 17.9% of the earlier harvest yields). This means that each day after the earlier harvest, beet roots grew by the average 387.8 kg/ha (or by 0.66%). In the trials published by Märländer (1991) the postponement of the harvest time from 15.9. to 1.11. increased the root yields by 15.5%.

The white sugar yields were also significantly higher at the later harvest (by 12.3 to 23.4%, $\alpha = 0.01$) rather than at the earlier harvest in all years of the trial (Figure 2). The white sugar yields grew in the period between the harvest times by the average 1.57 t/ha (or by 16.9% of earlier harvest yields) which means a daily increase of 58.2 kg/ha (or 0.63%). According to Minx (1999) the postponement of the harvest time brings an increase of the sugar yields by 0.3 to 0.4% for each day of extension of the vegetation term in autumn. The increments are, however, rather different, from 0% (retrovegetation may even lead to negative values) up to 0.9% per day, according to the moisture relations and health condition of the stand. In our trials, the sugar yields in individual years grew by the daily average of 0.45 to 0.87%.

The changes of the sugar content depended on the year (Figure 3), in particular on the weather character at the end of the vegetation period. There was a very sig-

Table 5. Comparison of production indicators of two sugar beet variety types at two harvest times

1998–2001	1. harvest term				2. harvest term				Average of harvest terms			
	ELAN	EPOS	difference	D_{min}	ELAN	EPOS	difference	D_{min}	ELAN	EPOS	difference	D_{min}
Roots yield (t/ha)	58.10	58.83	0.730	3.482	66.76	71.11	4.352**	3.323	62.43	64.97	2.541*	2.278
Tops yield (t/ha)	36.89	33.72	3.164	4.458	35.82	32.95	2.866	4.19	36.35	33.34	3.015	3.056
Sugar content (%)	17.84	17.92	0.085	0.341	17.80	17.50	0.306*	0.228	17.82	17.71	0.110	0.352
Alpha-amino nitrogen (mmol/100 g)	2.07	2.24	0.170	0.292	2.47	2.43	0.045	0.156	2.27	2.33	0.063	0.267
Potassium (mmol/100 g)	3.42	3.62	0.198*	0.191	3.48	3.51	0.036	0.15	3.45	3.57	0.117	0.145
Sodium (mmol/100 g)	0.76	0.66	0.097	0.132	0.64	0.60	0.038	0.069	0.70	0.63	0.067	0.072
White sugar yield (t/ha)	9.19	9.30	0.113	0.579	10.58	11.05	0.467*	0.417	9.88	10.17	0.290	0.367

*significant difference at $\alpha = 0.05$, **significant difference at $\alpha = 0.01$

Table 6. Effect of nitrogen fertilisation and fungicide treatment on two sugar beet variety types production at earlier harvest time

1998–2001	ELAN				EPOS				Average of varieties			
	0	50 N	50 N + F	D_{min}	0	50 N	50 N + F	D_{min}	0	50 N	50 N + F	D_{min}
Roots yield (t/ha)	58.17A	56.47A	59.68A	5.997^{ns}	56.50A	60.27A	59.73A	9.763^{ns}	57.33A	58.37A	59.70A	5.188^{ns}
Tops yield (t/ha)	34.55A	38.38A	37.73A	6.791^{ns}	33.73A	32.76A	34.69A	8.655^{ns}	34.14A	35.57A	36.21A	6.642^{ns}
Sugar content (%)	18.09A	17.88A	17.54A	0.801^{ns}	18.18A	17.92A	17.66A	0.879^{ns}	18.13A	17.90AB	17.60B	0.507*
Alpha-amino nitrogen (mmol/100 g)	1.97A	1.94A	2.30A	0.517^{ns}	2.00A	2.50A	2.22A	0.596^{ns}	1.98A	2.22A	2.26A	0.435^{ns}
Potassium (mmol/100 g)	3.42A	3.34A	3.51A	0.487^{ns}	3.62A	3.56A	3.67A	0.524^{ns}	3.52A	3.45A	3.59A	0.284^{ns}
Sodium (mmol/100 g)	0.83A	0.70A	0.75A	0.311^{ns}	0.61A	0.71A	0.66A	0.152^{ns}	0.72A	0.70A	0.71A	0.197^{ns}
White sugar yield (t/ha)	9.36A	8.98A	9.23A	1.340^{ns}	9.04A	9.57A	9.30A	1.644^{ns}	9.20A	9.28A	9.26A	0.863^{ns}

^{ns}non significant difference, *significant difference at $\alpha = 0.05$
Numbers marked with different letters show significant difference

nificant reduction of the sugar content in the year 2000, with a record high sugar content at the earlier, i.e. September, harvest time (trial average 20.11%). Due to the drier weather in August and September (precipitations below normal) sugar beet was already well mature. The retrovegetation caused by the warm and rainy October (temperatures very above normal and precipitations above normal) reduced the sugar content by 1.68% in absolute figures (or by 8.35% rel.) in comparison with the earlier harvest time (statistically significant difference, $\alpha = 0.01$). Pačuta et al. (2000) similarly argue that the technological quality of sugar beet roots significantly depends on the course of precipitations and temperatures in the months of September and October. According to Švachula (1999), there is a negative relationship between the sugar content and precipitations while the relationship between the sugar content and temperatures is positive. Minx (1999) argues that the restoration of tops after heavier rainfalls following a prolonged dry period leads even to the consumption of sugar deposited in the roots. On the other hand, if the photosynthetic system is sufficiently powerful, dark green and sound, the autumn increments of the sugar content may reach high values. In the trials published by Minx (1999), the sugar content increased during October by 0.59 to 1.42% (absol.). Our trials showed a statistically significant increase of the sugar content by 0.78% absol. (or by 4.9% rel. of earlier harvest, $\alpha = 0.01$) in the year 1998. There were no statistically significant differences in the sugar content between the harvest times in the years 1999 and 2001.

The year also affected the changes of the content of molassigenic substances in sugar beet roots (α-amino nitrogen, potassium and sodium). The summary evaluation of the four-year results proved a significantly higher content of alpha-amino nitrogen at the later harvest time (by 0.29 mmol/100 g, or by 13.49%, $\alpha = 0.05$) even though the postponement of the harvest time in the year 2001 reduced the content of alpha-amino nitrogen by 0.56 mmol/100 g (or by 19.79%, $\alpha = 0.01$) (Figure 4). In the trials published by Märländer (1991), the content of alpha-amino nitrogen grew by 24% between the harvest times of 15.9. and 1.10. The difference in the potassium content between the harvest times was not statistically evident. The sodium content decreased by the average 0.09 mmol/100 g, or 12.68% ($\alpha = 0.05$) with the postponement of the harvest time. The results published by Märländer (1991) show a reduction of the potassium content by 3% and that of the sodium content by 10%, due to the postponement of the harvest time (from 15.9. to 1.10.).

There were no significant differences in the tops yields between the harvest times (Table 4). Minx (1999) argues that sugar beet consumes the assimilates for the formation of tops mainly in the first half of the vegetation period. The root growth and dry mass accumulation occur mainly after the formation of sufficiently large photosynthetic system; the grower has therefore to seek an early termination of the leaf formation stage in order to obtain sufficient time for the root formation and sugar accumulation.

Table 5 shows the differences between the trial variety types at the earlier and the later harvest times. The varieties showed no differences in the yield and quality indicators at the earlier harvest time. Only the potassium content in the Elan variety roots was significantly lower at the earlier harvest than that in the Epos variety ($\alpha = 0.05$). The later harvest time revealed more significant differences between the varieties. The root yields in the NE-type variety Epos were higher at the later harvest by the average 4.35 t/ha (statistically significant, $\alpha = 0.01$) while the sugar content was lower by 0.3% ($\alpha = 0.05$) in compari-

Table 7. Effect of nitrogen fertilisation and fungicide treatment on two sugar beet variety types production at later harvest time

1998–2001	ELAN				EPOS				Average of varieties			
	0	50 N	50 N + F	D_{min}	0	50 N	50 N + F	D_{min}	0	50 N	50 N + F	D_{min}
Roots yield (t/ha)	63.45A	66.39AB	70.45B	6.709*	66.65A	71.19B	75.51C	3.192*	65.05A	68.79B	72.98C	3.605*
Tops yield (t/ha)	33.18A	36.76AB	37.52B	3.590*	28.01A	30.73AB	40.11B	11.696*	30.60A	33.74AB	38.81B	8.123**
Sugar content (%)	18.05A	17.52A	17.84A	0.635^{ns}	17.80A	17.28B	17.40AB	0.496*	17.93A	17.40B	17.62AB	0.442**
Alpha-amino nitrogen (mmol/100 g)	2.57A	2.47A	2.37A	0.393^{ns}	2.38A	2.49A	2.41A	0.432^{ns}	2.48A	2.48A	2.39A	0.233^{ns}
Potassium (mmol/100 g)	3.50A	3.44A	3.48A	0.363^{ns}	3.54A	3.49A	3.51A	0.446^{ns}	3.52A	3.47A	3.50A	0.224^{ns}
Sodium (mmol/100 g)	0.66A	0.64A	0.62A	0.220^{ns}	0.55A	0.62A	0.64A	0.121^{ns}	0.60A	0.63A	0.63A	0.102^{ns}
White sugar yield (t/ha)	10.17A	10.35A	11.22A	1.230^{ns}	10.56A	10.91A	11.67B	0.752*	10.37A	10.63A	11.44B	0.809**

^{ns}non significant difference, *significant difference at $\alpha = 0.05$, **significant difference at $\alpha = 0.01$
Numbers marked with different letters show significant difference

son with the Z-type variety Elan. The white sugar yields with the Epos variety were higher at the later harvest by 0.47 t/ha in the four-year average than those with the Elan variety (statistically significant, $\alpha = 0.05$).

The evaluation of the effect of nitrogen fertilisation and fungicide treatment on the production of the two sugar beet varieties showed no significant differences between the patterns at the earlier harvest (Table 6).

Significant differences between the patterns occurred mainly at the later harvest time (Table 7). At the later harvest time, we proved an effect of the trial patterns on the root yields, tops yields, sugar content, and white sugar yields ($\alpha = 0.01$). The highest root yields (72.98 t/ha on average for the varieties) and at the same time the highest root increment in the period between the earlier and the later harvest times (13.28 t/ha) occurred in the pattern fertilised with 50 kg N/ha + treated with fungicide. Fertilisation with 50 kg N/ha increased the root yields by 3.74 t/ha (5.75%, statistically significant $\alpha = 0.05$) in comparison with the zero fertilisation check pattern. Even though the occurrence of leaf diseases was very small in all trial years, the treatment with fungicide increased the root yields by 4.19 t/ha (6.09%, $\alpha = 0.05$) in comparison with the pattern without fungicide treatment. Spitzer and Fišer (2000) similarly argue that the root yields are always higher in the pattern treated with fungicide, and that the increase of the root yields after the application of fungicides vary in the interval of 10–30%.

Fertilisation and fungicide treatment increased also the yields of tops. The highest tops yields occurred in the plants fertilised with 50 kg N/ha + treated with fungicide. The tops yields in this pattern were higher by the average 8.21 t/ha (or by 26.83%) than in the check pattern ($\alpha = 0.01$).

The highest sugar content occurred in the zero fertilisation pattern (17.93% on average for the varieties). A number of authors agree on a fast reduction of the sugar content with increasing doses of nitrogen (Bajči 1990, Märländer 1990, Bürcky 1991, Chochola 1998, and others). The sugar content in sugar beet fertilised with 50 kg N/ha + treated with fungicide was lower by 0.31% (absol.) (statistically non-significant difference), and the sugar content in sugar beet fertilised with 50 kg N/ha was lower by 0.53% (absol.) (statistically significant, $\alpha = 0.01$) in comparison with the check pattern not fertilised with mineral nitrogen fertiliser.

There were no statistically significant differences between the patterns in the contents of molassigenic substances.

The highest white sugar yields occurred in the pattern fertilised with 50 kg N/ha + treated with fungicide. The sugar yields were higher by the average 1.07 t/ha (or by 10.32%, $\alpha = 0.01$) than in the check pattern (without nitrogen fertilisation and without fungicide treatment) and higher by 0.81 t/ha (or by 7.81%, $\alpha = 0.01$) than in the pattern with the same fertilisation but without fungicide treatment.

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ABSTRAKT

Vliv termínu sklizně a ošetření porostu na produkci dvou rozdílných typů odrůd cukrovky

Ve čtyřletém pokusu byl hodnocen vliv doby sklizně na produkci dvou typově odlišných odrůd cukrovky (cukernaté odrůdy Elan a normální až výnosové odrůdy Epos), pěstovaných ve třech variantách: 1. kontrola, 2. hnojení 50 kg N/ha a 3. hnojení 50 kg N/ha + ošetření fungicidem. Cukrovku jsme sklízeli ve dvou termínech: na začátku řepné kampaně daného roku a o čtyři týdny později. Rozdíly mezi odrůdami se projevily především při pozdější sklizni. Normální až výnosová odrůda Epos dosahovala při pozdějším termínu sklizně v průměru o 4,35 t/ha vyšší výnos bulev (statisticky průkazně, $\alpha = 0{,}01$) a naopak měla o 0,3 % nižší cukernatost ($\alpha = 0{,}05$) než cukernatá odrůda Elan. Výnos bulev se u obou odrůd posunutím doby sklizně zvýšil v průměru o 10,47 t/ha (tj.o 17,9 %, $\alpha = 0{,}01$). Změny cukernatosti vlivem oddálení termínu sklizně byly závislé na ročníku. Vlivem retrovegetace po deštích následujících po delším suchém období v roce 2000 se cukernatost v absolutní hodnotě snížila o 1,68 % (tj. o 8,35 % rel., $\alpha = 0{,}01$). Změny obsahu melasotvorných látek v bulvách cukrovky byly více ovlivněny ročníkem než sledovanými faktory. Výnos bílého cukru se posunutím termínu sklizně zvýšil v průměru o 1,57 t/ha (tj. o 16,9 %, $\alpha = 0{,}01$). Za každý den oddálení sklizně stoupl v průměru o 58,2 kg/ha cukru (tj. o 0,63 %). Vliv hnojení dusíkem a ošetření fungicidem se na produkci cukrovky projevil až při pozdější sklizni. Hnojení 50 kg N/ha + ošetření fungicidem zvýšilo výnos bulev o 1,07 t/ha (tj. o 10,32 %, $\alpha = 0{,}01$) oproti variantě bez hnojení dusíkem a fungicidního ošetření. Samotný postřik fungicidem zvýšil výnos cukru o 0,81 t/ha (tj. o 7,81 %, $\alpha = 0{,}01$) oproti variantě stejně hnojené, ale fungicidně neošetřené.

Klíčová slova: cukrovka; termín sklizně; odrůda; hnojení dusíkem; fungicid; produkce

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