Fodder Beet and Sugarbeet Breeding, Germplasm Collection, and Utilization in Lithuania

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ABSTRACT

Fodder beet and sugarbeet (*Beta vulgaris* L.) breeding programs were initiated in Lithuania in 1933. Two multigerm and one monogerm sugarbeet varieties were released between 1947 and 1971. Fodder beet breeding was continued until 1996, with the development of eight varieties. Research on fodder beet and sugarbeet genetic resources in Lithuania was started in 1994, under control of the Industrial Crop Group. All genebank activities relating to sugarbeet and fodder beet genetic resources are based at the Lithuanian Institute of Agriculture. Currently seven accessions (mostly old Lithuanian varieties) are kept in long-term storage facilities. Other accessions are in working collections and seed is available for exchange with other genebanks.

Additional Key Words: *Beta vulgaris*, breeding programs, genebank collections.

Sugarbeet breeding programs were active in Lithuania from 1933 until 1947, were suspended between 1947 and 1957, and discontinued in 1971. The most productive work was completed between 1957 and 1971 (Banelis, 1976). Initial breeding material was obtained from Belocerkovskaya and Jaltushkovskaya, breeding stations in the Ukraine, in 1957. This germplasm was not suitable for commercial production in Lithuania because of low root and sugar yield and excessive bolting.

The fodder beet breeding program was active from 1933 to 1970 (Ramanauskiene, 1970) and then reactivated in 1974. Initial fodder beet germplasm was from Sweden, Denmark and Germany. The most productive work was completed between 1974 and 1996 (Banelis and Mockaitis,

1992). A working collection of 90 accessions was maintained, and germplasm for future breeding work was selected.

Sugarbeet and fodder beet research was again emphasized in the National Plant Genetic Resources Program for cultivated plants initiated in 1994 (Budvytyte 1998). The *Beta* germplasm collection in Lithuania consists of the Lithuanian varieties, breeding material, and cultivated or wild *Beta* species from abroad.

MATERIALS AND METHODS

Lithuanian sugarbeet and fodder beet varieties were developed using intervarietal hybridization, individual plant selection, and chromosome doubling. Important agronomic traits were improved by mass (recurrent) selection. The breeding program includes 1) a nursery for initial germplasm screening, 2) a seed production nursery, 3) a progeny testing nursery that utilizes $12m^2$ plots, two to three replicates, and a standard variety every tenth plot, 4) yield trials with 24 m^2 plots, six replicates, and corresponding seed increase blocks, 5) variety testing at multiple sites, and 6) variety testing in official trials.

Agronomic traits that were considered in the *Beta* breeding programs were: root shape, root size, crown characteristics, bolting tendency, monogerm seed, disease resistance, root storage qualities, beet processing qualities, and sugar and dry matter yield. The sugarbeet breeding effort focused on root and sugar yield, improvement of germination, monogerm seed, disease resistance, and reduced bolting.

The goals of the fodder beet breeding program have not been consistent over years; originally the goal was to increase root yield, later the development of varieties with a higher dry matter content (semi-sugar) was emphasized. This was achieved by crossing fodder beet and sugarbeet. Breeding monogerm fodder beet hybrids suitable for machine harvesting was the goal from 1972 to 1996.

Accessions in the genebank collection are evaluated using IPGRI descriptors, and the seed is stored according to accepted seed storage protocols.

RESULTS AND DISCUSSION

Two multigerm sugarbeet varieties were developed between 1933 and 1947 at the Dotnuva Experiment Station. A new sugarbeet variety, DSS I (04), intended for commercial production was introduced in 1938 and another, DSS 05, in 1940. Performance of DSS 05 was similar to that of the best foreign varieties in Lithuanian yield trials.

Monogerm high sugar sugarbeet lines resistant to bolting were selected at the Rumokai Experimental Station. Five monogerm sugarbeet hybrids, Rumokai 1, 6, 14, 16 and 21, were developed between 1967 and 1970. Currently, only Rumokai 21 is available; the other hybrids have been lost.

Fodder beet varieties Dotnuvos Bares I and Dotnuvos Bares were developed between 1939 and 1952. In 1946 a breeding program to develop semi-sugar (higher dry matter content; up to 17 %) beet was started. The first attempts were not fruitful. After a long period of mass selection and testing, three semi-sugar varieties were produced, Puscukriniai raudonieji, Puscukriniai oranziniai and Puscukriniai baltieji. All three varieties have been lost. Another cross was successful; the semi-sugar variety Puscukriniai baltieji was created and remains on the current National List of Varieties. Three hybrids were developed between 1981 and 1994; a monogerm semi-sugar diploid hybrid (Dotnuvos vienasekliai), a multigerm semi-sugar triploid hybrid (Dotnuvos geltonieji), and a monogerm fodder beet hybrid (Raudoniai). Dotnuvos geltonieji and Raudoniai currently are on the National List of Varieties.

Currently seven fodder beet accessions are in long-term storage; others are maintained in working collections. Nine varieties were described in the "Catalogue of Lithuanian Plant Genetic Resources" (Budvytyte and Labokas, 1997). All these are fodder and semi-sugar varieties. Sugarbeet varieties were first included in the genebank collection in 1998, when it was decided to recover the only remaining monogerm Lithuanian sugarbeet hybrid (Tamosiuniene, 1998) (Table 1). Recently, attempts to locate accessions of Lithuanian origin at Sankt-Peterburg Institute of Plant Industry have been initiated. We hope to find Lithuanian germplasm which is no longer available in our country. Documentation of passport data of available accessions has begun.

Today's genebank collection in Lithuania includes sugar, semi-sugar and fodder beet varieties and hybrids and their parental lines, which were developed from 1933 through 1996. The primary task of the genebank is to recover accessions of Lithuanian origin and to place them in long-term storage. A secondary task is to increase seed samples and select valuable accessions for the genebank collection. The preferred germplasm is that adapted to the region, and hence important for future breeding efforts and for exchange with other genebanks.

Table 1. Description of fodder beet (*Beta vulgaris* var. *crasa*) and sugarbeet (*Beta vulgaris* var. *sacharifera*) varieties of Lithuanian origin.

Variety or Hybrid	Sample status†	Ploidy level	Root Dry Matter content, %	Root Yield t/ha	Multigerm or monogerm	Seed Availa-bility‡
			Fodder beet			
Dotnuvos Bares	3	2x	12.1	97.6	Mult.	A
Puscukriniai baltieji	5	2x	16.5	65.6	Mult.	A
Dotnuvos vienasekliai	7	2x	15.2	68.0	Mono.	A
Dotnuvos geltonieji	7	3x	15.6	70.8	Mult.	A
Raudoniai	7	2x	13.8	- - -	Mono.	A
line from strain 6927	4	2x	13.5	71.4	Mono.	A
line from P.Korsroe	4	4x	15.8	63.4	Mult.	A
line from Lutea	4	2x	14.5	65.1	Mult.	A

†Sample status. 1 – wild, 2 – weedy, 3 – traditional cultivar/landrace, 4 – breeder's line, 5 – advanced cultivar, 6 – mutant, 7 – hybrid, 0 – unknown;

‡ Seed availability. A – available, NA – not available (will be available soon).

Table 1 (continued). Description of fodder beet (*Beta vulgaris* var. *crasa*) and sugarbeet (*Beta vulgaris* var. *sacharifera*) varieties of Lithuanian origin.

Variety or Hybrid	Sample status†	Ploidy level	Root Dry Matter content, %	Root Yield t/ha	Multigerm or monogerm	Seed Availa-bility‡
			Fodder Beet (continued)			
line from Solanka	4	2x	15.0	- - -	Mono.	A
Line from Monogerm yelow	4	2x	15.2	49.2	Mono.	A
hybrid AltaxR.V.C.R	4	2x	13.0	69.0	Mono.	NA
Solanka x Puscukriniai baltieji	4	2x	14.4	93.1	Mult.	NA
Ekendorf yelow	3	2x	11.4	68.8	Mult.	A
Rote Valze	5	2x	11.9	69.2	Mult.	A
			Sugarbeet			
Rumoku vienasekliai cukriniai runkeliai line 21	7	2x	17.0§	29.1	Mono	NA

†Sample status. 1 – wild, 2 – weedy, 3 – traditional cultivar/landrace, 4 – breeder's line, 5 – advanced cultivar, 6 – mutant, 7 – hybrid, 0 – unknown;

‡ Seed availability. A – available, NA – not available (will be available soon).

§ Sugar content

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