

Sugar Beet Seed Institute (SBSI) Activities During the Past 50 Years

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ABSTRACT

SBSI activities in sugar beet breeding and production date back to 1941. It is the only institute in Iran that deals with breeding and sugar beet seed production. Since its inception, it has met the needs for sugar beet seed in Iran. The headquarters of the SBSI is located in Karaj and consists of the following research departments and laboratories:

Plant Breeding
Agronomy
Sugar Beet Technology
Cytology and Beta Gene Bank
Tissue Culture
Seed Technology
Plant Nutrition
Computer and Statistics

In addition, the SBSI supervises several regional research stations.

Additional Key Words: *Beta vulgaris* L., plant breeding

The Islamic Republic of Iran is a large country with an area of 164 million hectares (ha). Its elevation ranges from zero to 5600 m, and its temperature from -30 to 50°C. Annual precipitation varies from zero to 2000 mm.

Both sugar cane (*Saccharum officinarum* L.) and sugar beet (*Beta vulgaris* L.) are grown in Iran. Sugar cane has been grown in the tropical southeastern province of Khozestan for centuries. At present, there are 40,000 ha of sugar cane. The total sugar production in Iran is about 850,000 tons, of which 200,000 tons are from sugar cane and the rest from sugar beet. Sugar beet is grown in all the regions of Iran except in Sistan-Balouchstan, due to lack of water, and in Gilan and Mazandran, because of the priority of other crops. In 1992, 6 million tons of sugar beet were produced on 210,000 ha, an increase of 20% over 1991. The 1992 crop was also higher in sugar content than the 1991 crop.

The main area of beet production is at Shirvan (Khorasn Province) with 15,000 ha, and the minor area is at Mamassani with 800 ha. Each of the sugar beet production regions has peculiar cultural and climatic conditions and therefore suitable varieties have been developed for each region.

HISTORY OF SUGAR BEET RESEARCH IN IRAN

The first factory for extraction of sugar from sugar beet was established in 1894 in Kahrizak near Tehran. Unfortunately, this factory discontinued processing beets after three years in operation. The second sugar factory was built in 1933 in Karaj and at present is the oldest operating factory in Iran. At present, there are 35 factories with a total capacity of 62,000 tons per day. The largest has 5000 tons and the smallest has 450 tons per day capacity.

Sugar beet seed was brought to Iran by Dr. Pollak in 1857. For several years Persian sugar beet growers used seed brought or reproduced from foreign countries such as Poland, Germany, Russia, and Czech. In 1936, preliminary studies relating to sugar beet seed production were undertaken and in five years suitable multigerm seed were produced. In 1941, the Sugar Beet Seed Institute was established by Eng. Gharabaghi in Karaj. Dr. Niknejad produced polyploid varieties in 1950. In 1961, monogerm seed was imported from the USA and introduced into the breeding program. The utilization of cytoplasmic male sterility (CMS) for hybrid development was begun in 1969. In 1985, M. Mesbah and M.N. Arjmand simultaneously obtained plant regeneration *in vitro* utilizing pieces of sugar beet and *B. lomatogona* mature embryos. Research on the development of

non-bolting lines was started in 1970 after the construction of the Ahwaz sugar factory.

SBSI ORGANIZATION

The headquarters of SBSI is in Karaj (35 km west of Tehran) on the campus of the Seed and Plant Improvement Institute (SPII). The institute consists of eight research departments and supervises 13 regional research stations located in the principal sugar beet production areas.

Plant Breeding. The objective of the Plant Breeding Department is to improve yield and other characters of sugar beet. Research activities are based on the following: 1) high root yield and sugar content; 2) increase sugar yield and juice purity; 3) bolting resistant varieties; 4) resistance to curly top virus, *Cercospora* leaf spot, and powdery mildew; 5) improve and produce multigerm and monogerm hybrid varieties (triploid and tetraploid) based on CMS; 6) breed for abiotic stress such as salinity, drought, etc.; 7) utilize haploid plants regenerated from ovule culture; and 8) transfer useful genes from wild beets into sugar beet germplasm.

Agronomy. The Agronomy Department is responsible for research on the proper cultural practices for sugar beet as follows: 1) optimum period of irrigation, 2) identification of sugar beet macro and micro element requirements, 3) identification of suitable machines for sugar beet cultivation, and 4) determination of suitable sowing methods and utilization of precision drilling.

Beet Technology. During the harvest campaign more than 30,000 sugar beet root samples from varietal evaluation experiments from the different sugar beet research station are washed, weighed, pulped, frozen and transferred to the Beet Technology Department at Karaj. Sugar percentages and impurities (potassium, sodium, amino nitrogen, alkalinity, and sugar in molasses) are determined.

Cytology Department and *Beta* Gene Bank. The cytology lab was established in 1960 primarily to produce tetraploid lines by means of colchicine treatment and determine "O" types in diploid pollinators. CMS is introduced into high yielding inbred lines by back crossing. "O" types are identified at the same time. The best single cross hybrids are identified in yield trials. All cytological procedures, from the beginning of the breeding program to the distribution of commercial sugar beet seed, are conducted in this lab. Since 1990, a flow cytometer system (CAII Partec, GmbH Munster Germany) has been used to determine ploidy level. In the past five years the *Beta* Gene Bank has collected wild *Beta* species and land races in their natural habitat. This germplasm is

being evaluated in the fields and greenhouses.

Tissue Culture. The Tissue Culture lab was established in 1988 when two members of the staff (M. Mesbah and M. N. Arjmand) regenerated plants through inflorescence explant of sugar beet and mature embryo culture of *B. lomatogona*. Its activities comprise: 1) micropropagation of selected beet genotypes of wild, table, and fodder beet; 2) salt tolerance studies in tissue culture and identification of salt tolerant shoots; 3) plant regeneration from callus; 4) production of monoploid plants through unfertilized ovule culture; 5) production of sexual hybrids through protoplast culture (future); and 6) genetic manipulations through genetic engineering (future).

Seed Technology. The Seed Technology lab, established in 1978, tests all sugar beet seed for germination percentage, moisture, presence of impurities, germicity, seed borne diseases, and other pertinent characters. Recently the lab succeeded in formulating and producing monogerm pelleted seed. Mass production of pelleted seed will be available in the near future.

Sugar Beet Nutrition.

Statistics and Computer.

SUGAR BEET SEED PRODUCTION

Assessment of new varieties is based upon three years of variety trials located at Karaj, Miandoab, Torogh, and Zargan. More than 100 ha of experimental plots are conducted each year. At the Karaj station, 25 ha are devoted to sugar beet trials each year. New varieties selected for commercial use are multiplied under isolation conditions. One of the most important sites for large scale production of CMS is located at Firzkuh (160 km N.E. of Tehran). Elite seed production is carried out by SBSI on more than 30 ha. At this time, we are self-sufficient in the production of sugar beet seed. Ploidy level in tetraploid seed production is monitored by the Cytology Department. Monogerm seed fields are checked before flowering. Commercial seed (produced from elite seed) are produced at Ardabil. The annual seed production of selected varieties at Ardabil is more than 5,000 metric tons. Strict purity controls are applied in the field and seed quality tests are carried out in the well equipped lab. The main sugar beet varieties released by SBSI are: Charabachi, IC6201, IC6202, IC6203, BR1, DEZ, PP22, PP8, 7233, SIMIN2 and H5505.

INTERNATIONAL COLLABORATION

SBSI has been a pioneer in the utilization of modern technology

for sugar beet improvement and has encouraged its scientists to acquire more knowledge and experience. In 1960, the institute initiated a long period of collaboration with SES (Belgium). A contract with van der Have (Holland), from 1969 to 1979, was beneficial to SBSI. At present, SBSI has close relations with KWS (Germany), ICI-SES (Belgium), Hilleshög (Sweden), and Maribo (Denmark). A recent contract with Maribo (Denmark) provides for short training courses for SBSI staff and for the evaluation of breeding material in field trials in different regions. In 1991, SBSI initiated a cooperative effort among the neighboring countries of Pakistan, Turkmanistan, and Azarbayejan for variety adaptation to those regions. Finally, a contract with CPRO-DLO (Wageningen, Holland) has brought about the possibility for continuation of studies in Biotechnology.

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