



Information for the public.

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Title of the project:

Five year programme (2000-2004) for the field evaluation and for the seed increase of sugar beet (*Beta vulgaris*) lines and hybrids genetically modified to be tolerant to the herbicide glyphosate.

Experimental programme 2001

European identification number

B/BE/00/VWSP1

Upon advice of the Biosafety Council and the Service of Biosafety and Biotechnology of the Scientific Institute of Public Health – Louis Pasteur, the Belgian Ministry of Agriculture has granted consent to SES Europe N.V./S.A. to perform experiments from the year 2000 till 2004 in accordance with their application B/BE/00/VWSP1.

For the year 2001 this program will be executed on 3 different locations on the territory of the municipalities of Jodoigne and will follow the normal growing period of sugar beet (*Beta vulgaris*) that goes from the month April till September 2001.

Contact the Biotechnology Department of SES-Europe for additional information on experimental programme B/BE/00/WSP1:

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1. Description of the genetically modified plants:

Sugar beet lines and hybrids (*Beta vulgaris*) derived from transformation event T227-1 and resistant to the herbicide glyphosate.

The intended modification introduced in the transformation event T227-1 is that the sugar beet is tolerant to glyphosate, the active ingredient of the herbicide Roundup®, while non-transgenic sugar beets are naturally susceptible to the herbicide.

2. Purpose of the release:

The objectives of the experimental release of 2001 are:

- (1) The evaluation of the agronomic performance of sugar beet hybrids based on Advanta germplasm and tolerant to glyphosate.
- (2) The validation of the performance of transformation event T227-1 for the level of tolerance to glyphosate in a variety of environmental and agricultural conditions (multilocal trials will be conducted in parallel in several European countries and in the USA.)
- (3) The generation of data for the registration package required to apply for the deregulated status of transformation event T227-1 in Europe.

The field releases planned in Belgium in 2001 will be root crop trials (vegetative beets)

There will not be any seed increase in Belgium in 2001.

3. Advantages for the environment, the farmer and the consumer:

The purpose of the modification is that lines and hybrids derived from transformation event T227-1 are tolerant to glyphosate, the active ingredient of the herbicide Roundup.

The use of Roundup in the sugar beet crop is a new alternative to weeding in this crop.

The main advantages for the farmer are:

Glyphosate has a broad efficacy spectrum and efficiently controls most of the weed species found in the sugar beet crop.

As part of the Roundup Ready® system, Roundup will not require mixing with any other herbicide; this is to be compared with the current effective weed treatments of the beets crop that require the mixing of several herbicides.

Roundup Ready® sugar beet also gives new flexibility in the timing of herbicide applications.

The use of Roundup will allow a reduction in the amount of herbicide needed for sugar beet; Two sprays of Roundup give an improved weed control, compared to the three or more mixed sprays needed currently in the sugar beet crop.

It has been observed that with Roundup Ready® sugar beet, a consistent high yield of extractable sugar can be obtained, superior to that obtained from conventionally treated sugar beet crops.

4. Biology and development cycle of the plant

Beta vulgaris is a member of the Chenopodiaceae which contains four cultivated forms in the subspecies *vulgaris*: sugar beet, fodder beet, leaf beet (e.g. Swiss Chard) and garden beet (Red beet).

Cultivated sugar beet is biennial and requires vernalisation (a period of cold) followed by long days to flower. During the first year of growth, sugar beet plants form a large root rich in sucrose and, during the winter, in appropriate climatic conditions, the plants undergo a period of vernalization. Flowering and seed set are promoted during the next spring with the increase in day length and temperatures.

In the sugar beet crop, the vegetative plants are harvested at the end of the first growing season and the roots are processed for sugar extraction.

4.1. The plant as a weed

Beta originates from the Mediterranean area. Taxa of section *Beta* are widely distributed occupying the littoral zone of Europe, Middle East and the Indian subcontinent.

Sea beet (*Beta maritima*) is rare on the coasts of Belgium, Netherlands and Germany but fairly common on the coasts of Great Britain and Western France. The plants usually grow in a narrow band along the coast, 10-20m above the high water mark. On the Belgian coast for example, *Beta maritima* grows only sporadically in specific locations in limited numbers of individuals, close to the shore. In competition with other species, for example grasses, North Atlantic wild beets do not establish on a long-term basis.

The natural habitat for sugar beet is in cultivation; it is widely grown in arable systems throughout Western, Central and Eastern Europe.

Volunteer sugar beets or 'weed beets' are significant weeds of sugar beet crops. The weed beet originates from early-bolting or annual contaminants in a crop, releasing seeds which germinate in the following years.

In the usual rotation, weed beets are destroyed easily by the selective herbicides used in the crops following sugar beet (for example the herbicides used in the cereal crops). Beet is not listed as a weed in any crop, except in sugar beet.

The *cp4syn* gene that was introduced in sugar beet confers tolerance to the herbicide glyphosate. The beets derived from transformation event T227-1 remain susceptible to all herbicides that are lethal to non-genetically modified sugar beets, except glyphosate.

The sites chosen for the releases will be in an agricultural ecosystem. No particular environmental effect, different from those due to non-modified sugar beets, is expected from the genetically modified plants derived from event T227-1.

4.2. Information on seed survivability and dissemination

Sugar beet seed are dormant and may survive several years in the ground in optimal climatic and edaphic conditions. Germination rates will be influenced by a variety of factors; for example, germination rate of seed buried at 2 cm deep is reduced to 25%, and to 3% at 10 cm.

5. Potential risks for the environment:

5.1. Dissemination and diffusion to natural ecosystems:

- Transgene dissemination through pollen:

The experimental releases of 2001 in Belgium will only be of vegetative sugar beets (i.e. root trials).

The probability of diffusion of the transgene through pollen or hybridisation with other non-genetically modified sugar beet plants or volunteer beet is very low. In normal weather conditions, the sugar beets remain at the vegetative stage in yield trials.

Regular visits of the trial by experienced staff, not less than once every two weeks, will allow any bolting plant to be detected. Procedures are then followed to destroy the bolting plant immediately, and thus long before flowering. The risk of transfer of genetic material to the environment, through pollen, is very low.

There will not be any production of seed in Belgium in 2001.

- Transgene dissemination through seeds:

In vegetative beet releases (i.e. root trials), the probability of diffusion of the transgene by seed is very low. Under normal culture conditions, the sugar beet will remain vegetative.

Weekly visits of the trial sites during the experimental releases will be organised to detect and destroy, before flowering, any beet showing signs of bolting. The risk of transfer of genetic material to the environment, through seeds, is very low.

There will not be any production of seed in Belgium in 2001.

- Selective advantage:

The *CP4syn* gene that was introduced in transformation event T227-1 confers tolerance to the herbicide glyphosate. It only confers a selective advantage if the beets are treated with the herbicide glyphosate.

Moreover, the glyphosate resistance gene will not give any selective advantage to sugar-, volunteer- or wild beets, that would develop in an environment where the herbicide is not applied.

The genetically modified beet derived from transformation event T227-1 will remain susceptible to all other herbicides lethal to sugar beets.

5.2. Interactions between the genetically modified plant and target organisms:

Not applicable.

5.3. Interactions between the genetically modified plant and non-target organisms:

The environmental impact of the interactions between the genetically modified sugar beet plants derived from transformation event T227-1 and non-target organisms is not expected to be different from that arising from a trial of non genetically-modified sugar beet.

The sites chosen for the releases will be in an agricultural ecosystem. No particular effect of the genetically modified plants to the environment is expected, which differs from that of non-genetically modified sugar beets.

The climatic conditions will affect the sugar beets but the genetically modified sugar beet are not expected to behave differently from non-genetically modified sugar beet grown under the same conditions.

The culture conditions will be similar to those applied in any sugar beet yield trial.

5.4. Potential impact of large-scale and long-term use

Experimental releases with transformation event T227-1 are in planned in Europe and in the USA. The data generated will be used for the registration package required to apply for the deregulated status of the transformation event T227-1 in Europe and in the USA.

The data produced so far on transformation event T227-1 and derived lines and hybrids indicate that the phenotypic characteristics of the genetically modified sugar beet are similar to those of near-isogenic genotypes grown in similar conditions.

The only selective advantage of the genetically modified sugar beets is the glyphosate tolerance. This is applicable only in ecosystems where the herbicide is applied.

The sugar beets derived from event T227-1 remain susceptible to all of the other herbicides used to control non-transgenic beets in an agricultural ecosystem.

6. Measures taken for release confinement, control and monitoring:

The field experiments of genetically modified sugar beets derived from transformation event T227-1 are covered by a detailed protocol, that also fulfil the instructions of the official protocol issued by the Minister of Agriculture on the deliberate release in the environment of genetically modified sugar beets.

The field experiment protocol gives the precise set up of the trials, the agricultural practices applying to any sugar beet yield trial within breeding programmes and the specific guidelines related to the genetically modified sugar beets.

All activities conducted at the trials sites will be done by qualified technicians of Advanta (SES-Europe) and will be recorded in a trial logbook.

The hybrids derived from transformation event T227-1 and the non-transgenic hybrids used as controls will be sown directly in the trial sites using a precision driller. The excess seeds will be sent back to SES-Europe to be destroyed.

The trial plots will be sowed in excess. After germination, the trials plots will be thinned to keep a population of 90-100 beets per 10m² plot, according to a standard procedure used by sugar beet breeders to ensure homogenous beet populations within the trial plots. The plants that are uprooted by thinning will be left in the trial site.

The trial will be harvested mechanically using a mobile tare-house. The beets will be removed from the soil and they will be sliced in the trial area. Pulp samples will be kept from each plot and will be frozen to be sent to the laboratory of SES-Europe in Tienen. All other parts of the beets will remain on the release site to be incorporated mechanically into the ground.

The trials of 2001 will be conducted by qualified staff of Advanta (SES-Europe), under the supervision of the Sugar beet Biotechnology Department.

6.1. Control of pollen dissemination

As already mentioned in 5.1, the experimental field releases of 2001 in Belgium will only concern trials of vegetative sugar beets.

In vegetative beet trials, the probability of diffusion of the transgene through pollen or of hybridisation with other non-genetically modified sugar beets or weed beets is very low. In normal culture conditions, the sugar beets remain in the vegetative state.

The beets in the trial will not be allowed to flower. The monitoring plan of the trial sites during the experiment release provides regular visits of the trial by experienced staff, not less than once every week, that will allow any bolting plant to be detected. Procedures are then followed to destroy the bolting plant at an early stage, long before flowering.

There will not be any production of seed in Belgium in 2001.

6.2. Control of seed dissemination:

In vegetative beet trials, the probability of diffusion of the transgene through pollen is very low. Under normal culture conditions, the sugar beets remain vegetative in yield trials.

Weekly visits of the trial sites during the experimental releases will allow any bolting plant to be detected and destroyed.

There will not be any production of seed in Belgium in 2001.

6.3. Post-release treatment

The trial will be harvested mechanically using a mobile tare-house. The beets will be removed from the soil and will be sliced on the trial area.

Pulp samples will be kept from each plot. The samples will be frozen and will be sent to the laboratory of SES-Europe in Tienen to be analysed to determine the yield potential of the trial hybrids.

After harvest plant debris and waste water will be spread on the trial site and incorporated into the soil mechanically.

The site will not be used for sugar beet cultivation for the following two years, during which time all volunteer beets that may appear will be destroyed.

7. Monitoring:

During the trial and for the following 2 years any volunteer beet appearing on the plot will be destroyed before flowering.

The site will not be used for sugar beet cultivation for two years following the trial.

If necessary, regrowth of genetically modified material will be identified using two methods:

- Transgenic beets sprayed with glyphosate would survive while non-genetically modified plants would die.
- Genomic Southern blot analyses or PCR using *cp4syn* specific primers would indicate the presence of the inserted DNA in the genetically modified plants.

8. Destruction of the transgenic material

After sowing of the trials plots, the seeds in excess of requirements will be sent back to SES-Europe to be destroyed.

The trial plots will be sowed in excess. After germination, the trials plots will be thinned to keep a population of 90-100 beets per 10m₂ plot. At thinning, the excess plants will be left in the trial site.

At harvest plant debris and waste water will be spread on the trial site and incorporated into the soil mechanically.

9. Emergency plans

Regular visits to the release site during and after the trial will ensure that any unexpected event will be identified at an early stage.

If the need arises, the trial plants can be effectively destroyed by the application of one of the herbicides lethal to sugar beet.

Treatment of the site, other than already described, will be based on previous experience of sugar beet cultivation.

10. Inspection:

The Inspectorate General of Raw Materials and Processed Products of the Belgian Ministry of Agriculture is in charge of the supervision of field trials involving transgenic material. In order to plan their inspections, the notifier has to inform the competent body about the sowing and harvest dates. Inspectors will watch over the execution of sowing and harvesting activities in the field, being in accordance with the ministerial approval on the protocols. In addition the inspector will sample plant material for analysis in an official laboratory.

11. Social-economic aspects:

The experimental programme B/BE/00/WSP1 for the year 2001 concerns the evaluation in real agronomic conditions of genetically modified sugar beet hybrids tolerant to the herbicide glyphosate.

The use of the Roundup Ready® technology in sugar beet offers a new alternative of weeding in the sugar beet crop.

Glyphosate has a broad efficacy spectrum and controls most of the weed species of the sugar beet crop efficiently. As part of the Roundup Ready® system, Roundup will not require mixing with any other herbicide; the current effective weed treatments of the beet crop, which require the mixing of several herbicides. Roundup Ready sugar beet also gives new flexibility in timing herbicide applications.

The use of Roundup will allow a reduction in the amount of herbicide needed in the sugar beet crop: two sprays of Roundup give an improved weed control, compared to the three or more mixed sprays needed currently for sugar beet.

It has been observed that with Roundup Ready® sugar beet, a consistent high yield of extractable sugar can be obtained.

The Roundup Ready system is broadly used in different crops in several countries, in particular in America.
