

EUREKA PROJECT E!1868 - EUROAGRI GENIMPROVEDAPPLE

1. General description

Project	E! 1868 - EUROAGRI GENIMPROVEDAPPLE	Status	Announced - 30-JUN-1998
Title	Genetic Improvement Of Apples For Quality And Tolerance Or Disease-Resistance.		
Class	Sub-Umbrella	Technological area	Medical and Biotechnology
Start date	01-AVR-1998	End date	01-JAN-2003
Duration	57 months	Total cost	1.95 Meuro
Partner sought	Yes		
Summary	As The Quality Of Apples Suitable For Environmentally- Friendly Growing Methods Is Not Fully Competitive With Top Standard Cultivars, This Project'S Solution Is To Use A Traditional Cultivation Approach With New Genotypes.		

Budget and duration

Phase	Budget(Meuro)	Duration (Months)
Definition phase	0.2	9
Implementation phase	1.75	48
Total	1.95	57

Member contribution

Member	Contribution	Position	Since
Czech Republic	33.00%	Contact Member	11-DEC-1997
Belgium	67.00%	Participating Member	30-JUN-1998

Participants

Company	Country	Type	Role
RESEARCH AND BREEDING INSTITUTE OF POMOLOGY	CZECH REPUBLIC	Research Institute	Main
KUL - FRUITTEELTCENTRUM	BELGIUM	University	Partner
KATHOLIEKE UNIVERSITEIT LEUVEN	BELGIUM	SME	Partner
JOHAN NICOLAI & CO. N.V.	BELGIUM	SME	Partner
N.V. BETTERFRUIT	BELGIUM	SME	Partner

2. Project outline

Project description

The apple (*Malus x domestica* Borkh.) is the most important fruit species in the CZECH REPUBLIC and BELGIUM but also in the majority of other European countries. Apples now account for approximately 50% of the output of deciduous tree fruit in Europe. In EU countries alone the present total annual production of apples fluctuates around 10 million tonnes. However, the prices in the European market for fresh apples were low in last few years because of stagnation in fresh apple consumption.

This is connected with higher competition of subtropical and tropical fruit and subsequent other expectations of the consumers as regards fruit quality. Also in this context, apples grown under environmentally friendly conditions with limited use of chemicals are now preferred.

Over the last 10 years several new apple cultivars with resistance or tolerance to scab (the most important disease caused by the fungus *Venturia inaequalis*) have been developed. These new genotypes are not fully accepted by the consumers because the inferior fruit quality compared with common varieties such as 'Golden Delicious', 'Jonagold' and some others. This means that more breeding is needed to develop resistant cultivars with good fruit quality. One of the problems encountered is the apple's very long breeding cycle, up to 8 years at least, and nearly the same period is necessary for testing all promising genotypes at both grower and consumer level.

Therefore it is important that the main partner has advanced promising new selections with disease tolerance or resistance from different donors such as 'Antonovka' cv. and some other varieties with the given traits controlled by polygenes. These quite diverse genotypes are now being mutually combined by intercrosses with the aim to make this disease resistance more stable. Seedlings originating from these crosses are artificially inoculated and all susceptible genotypes are removed.

All partners can use this germplasm for further testing under their specific climate conditions and further breeding, with respect to their specific market.

The project also aims to combine polygenic and monogenic resistance. In addition to disease resistance, the partners are interested in other specific characteristics such as growth patterns, fruit bearing pattern, early flowering, late bloom, late ripening and parthenocarpy.

Fruit quality, however, will be a major objective of the project. While all above-mentioned characteristics are important for the successful acceptance of new cultivars by the growers, fruit quality will be considered the most important factor for consumer acceptance. Some orchard characteristics, such as disease resistance, will play a primary role in selecting tree types. However, without acceptable top quality, a new cultivar will fail, regardless the superiority of orchard characteristics.

The term 'fruit quality' contributes to those attributes that make fruit attractive as a food source. The unique role of fruit in the diet is related to their desirable combined sensory properties such as colour, size, shape, flavour, crispness, juiciness and texture. Sometimes it is

very difficult to define what the best quality is because it may differ for different groups of people. Therefore this subject has been chosen as a topic for international collaboration to better understand different target marketing areas. Moreover, breeding for quality differs from breeding for other tree and fruit characteristics in an important way. For most tree characteristics, the fruit breeder alone is competent to select superior genotypes among the segregating progenies. Few breeders, however, possess the expertise and analytical equipment to identify the many intangible characteristics that collectively constitute superior fruit quality. Genetic improvement of apple quality therefore requires a team effort involving breeders and experienced practical pomologists, each contributing the special expertise toward developing the final superior cultivar.

An important aspect in apple breeding is breeding efficiency. Breeding efficiency in this project will be improved by the development of early selection methods, based on the relationships between seed dormancy, bud dormancy and time of harvest, between juvenility and precocity, growth patterns and other characteristics during the juvenile period.

Moreover, the choice of parents, based on combining ability studies (both general and specific combining ability) and the use of molecular markers for specific characteristics to support early selection, will increase breeding efficiency.

The project also aims to implement the new genotypes in the fruit industry. The research and development of new selections involve:

A) Creation and preliminary identification of new advanced genotypes. It will comprise selection of parents, hybridisation (making crosses), pre-selection of young seedlings, evaluation and selection of seedlings in the orchard stage.

B) Testing and evaluation of promising genotypes. Establishing small plot testing trials for comparison with standards in cultural conditions with respect to the most advanced growing technology and for the proper evaluation of the most important economic characteristics.

C) Establishing single pilot orchards with one or a few superior genotypes to evaluate their orchard performance. These orchards will also supply greater quantities of apples demanded to test their market acceptance and develop their marketing.

D) Pre-marketing activities: developing of suitable procedures of post-harvest handling, storage and marketing (including a logistics approach).

Keywords: apple, variety, breeding.

Technological development envisaged

Our purpose is to conduct joint work with the ultimate goal of developing technology and know-how to develop highly market-oriented, new and valuable apple cultivars. These new varieties, resulting from this joint project will offer a unique and logistic approach to increase consumption of this desirable fruit. They will offer the opportunity to the growers of both target areas and others

to make the apple industry more profitable.

To reach the final goal, the introduction of new apple varieties, we aim to develop a better breeding methodology, technology and testing procedures for:

- a) the choice of parent for the specific aims based on combining ability,
- b) in the case of disease resistance: combination of different genetic sources of resistance to create a more stable resistance. The starting material will be the most advanced selections of the breeding programme of all partners,
- c) an early first selection of genotypes based on juvenile characteristics and artificial infection in the case of resistance. Development of standard methodologies for selection,
- d) evaluation of fruit quality based on fruit appearance (colour, size, shape) and sensory assessment by a taste panel and the relationship of the latter with measurable characteristics such as sugar content, acidity and firmness,
- e) validation of putative homozygous plants
- f) development of selection technology based on molecular markers (AFLPs, micro-satellites, etc.)

The new varieties will permit the growers to reduce pesticide use in a more environmentally friendly way. These pesticides include fungicides (disease resistance) and plant growth regulators (parthenocarpy, growth patterns).

Markets application and exploitation

The first new variety with the above-described properties can reach the target market for the first time with high probability in the period 2000-2002. In the first step, the most advanced apple growers will plant it. After 2002 we expect a yearly increase of 100 to 200 hectares in both countries.

The new product will be more profitable for growers and therefore the annual market will also be settled progressively in other European countries and subsequently in other countries as well. The final target is estimated at 10% of the EU market.

The novelty should be important also for innovation of nursery production because expectations are that during the first years of exploitation alone about 2 million trees of the nursery stock will be demanded annually.

Conventional fruit growing seems to be on the decrease because of changes in demand from consumers in favour of environmentally friendly production. Therefore, fruit growers are also demanding new cultivars which are tolerant or resistant to disease. For growers and the food industry alike, new perspectives will be opened by development and marketing of these apple varieties.

This project will not only develop new varieties but also technologies and know-how. The participants will own their results. The implementation of the results on the market will depend on the effort invested, strategy and intrinsic value.

The partners commit themselves to an agreement that still has to be negotiated.

Project codes

BSI

ESK
ET/EW
HFH
ICB/ICI

plant genetics
plants
horticulture
fruits

NACE

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Agriculture, hunting and related service activities
Research and development

3. Main participant

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Organisation type Research Institute
Participant role Main

Contribution to project

New hybridizations are planned (10,000 cross-pollinations yearly). 15,000 apple seedlings pre-selected for resistance will be evaluated at the orchard stage.

Expertise

4. Partner

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Organisation type University

Participant role Partner

Contribution to project

Investigation of the physiological aspects concerning breeding: fruit quality, disease resistance, tree architecture, dormancy, flowering and parthenocarpy.

Expertise

4. Partner

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Organisation type SME
Participant role Partner

Contribution to project

Investigation of the physiological aspects concerning breeding: fruit quality (colour, weight, sugar content, sour, stiffness, shelf-life, bruise susceptibility, etc.), disease resistance, dormancy, flowering and parthenocarpy.

Expertise

4. Partner

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Organisation type

SME

Participant role

Partner

Contribution to project

It will support the FRUITTELTCENTRUM and N.V. JOHAN NICOLAI. It will have its own developing programme. Testing of superior genotypes in collaboration with research stations in Europe.

Expertise