

# Green Genetics



Innovative plants for sustainable flowers and food

BUSINESS PLAN for the Technological Top Institute GREEN GENETICS



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for the  
Technological Top Institute **GREEN GENETICS**

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## PREFACE

The Innovation Platform has selected Flowers & Food as one of the key areas of the Dutch economy. "Green Genetics" is the basis of all Flowers & Food and needs to be strengthened if the Netherlands wants to secure a leading role in the European knowledge economy of 2010. This business plan is an initiative of Plantum NL, as representative of the Green Genetics industry, and the Plant Sciences Group of Wageningen UR, representing the Dutch plant research community.

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## 1. EXECUTIVE SUMMARY

*The Technological Top Institute Green Genetics will develop and apply genetic information for the creation of crops with improved performance and improved quality: 'TTI Green Genetics will put genetics to work'.*

The Netherlands has a unique position in plant breeding, plant propagation and plant production (the 'Green Genetics industry'). Internationally the Dutch Green Genetics industry is recognised as leader in the breeding of vegetables, ornamentals, potatoes and grasses. The ambition of the industry is to strengthen and to extend its competitive position through the establishment of a Technological Top Institute Green Genetics.

TTI Green Genetics is a public-private partnership between the majority of the Dutch Green Genetics industry and the major players in the Dutch plant sciences. The industry will determine the research agenda at the national level and will contribute a strong financial commitment for the realisation of the programme. With an anticipated budget of in total € 50 million for 5 years, the contribution of all industrial parties is estimated to amount to approximately € 14 million, whereas the contribution of the research groups will amount to € 11 million.

The central theme of TTI Green Genetics is 'Innovative plants for sustainable flowers & food'. This expresses the main aim of the TTI: to utilise the knowledge and expertise of research organisations and industries for the development of innovative crop varieties. Plants will be optimised for sustainable growth under various environmental conditions to produce safe, beautiful and healthy products for consumers. To strengthen the central theme we will work on three disciplines: genetics, phytopathology and physiology.

We distinguish a "core programme" and "cluster projects". The primary objective of the core research programme is to strengthen our basic understanding of the growth and development of plants and its interaction with the environment. Cluster projects have the primary objective of creating know-how and expertise to strengthen the competitiveness of the Dutch industrial and technological position in Flowers & Food. All cluster research projects contribute to the central theme '*Innovative plants for sustainable flowers & food*' that is divided into three sub-themes: growth & development; plant health; and quality for the consumer.

The TTI core education programme is focused on capacity building in the three basic disciplines. The main goal is to strengthen the educational programmes as a way to improve the attractiveness of the plant sciences to scholars and students, leading to an increase in the Green Genetics labour force.

In this business plan the Green Genetics industry and the Dutch plant research community present the Technological Top Institute Green Genetics.





## 2. VISION AND STRATEGY

The Netherlands is one of the most important countries world-wide in the breeding and production of horticultural, floricultural and agricultural propagation material. This unique position is based on a combination of industrial entrepreneurship and a renowned research environment. In order to maintain and strengthen this global position, it is necessary to invest further in the exploitation of the scientific and technological capabilities of this economic sector. *This challenge has stimulated the Dutch plant propagation industry and research community to strengthen their collaboration in a new initiative: the Technological Top Institute Green Genetics.*

### 2.1 Rationale

The initiative for TTI Green Genetics is the result of an open discussion between industry and academia, hosted by Plantum NL, on how the “knowledge gap” between academic research and practical application can be bridged, and how results from academic research can be translated into innovations. In 2002 we had already analysed



“Plants have always been the most important resource for humankind, not only for food and feed, but also for other important biomaterials, such as oils, fibers, energy and wood for building houses and ships. Plant cells produce biomass from simple chemical building blocks in the air and the soil, including carbon dioxide, nitrogen and water, using the sun as a ‘for-free’ energy source. Today, in the face of important challenges at the European and global levels, we must pay renewed attention to plants. A growing population has to be fed, and increasing demands for high-quality, safe and affordable food has to be met. Scientific and technological progress, especially in plant biotechnology and genomics will have to play a role in achieving the transition to a sustainable economy.

The former European Commissioner for Research, Philippe Busquin in “Plants for the future” in:

*Plants for the Future: 2025, a European vision for plant genomics and biotechnology, EPSO, 2004.*

the problems that the industry faces and, together with the Plant Sciences Group of Wageningen UR, we have identified the opportunities for the sector in several reports (i.e. 'Groene Genetica', "Putting Genomics to Work").

These reports describe the strong international position of the sector and indicate how this position could be strengthened by a focused public-private partnership. This thorough analysis has contributed to the fact that in September 2004 the Innovation Platform recognised Flowers & Food as one of the key areas of the Dutch knowledge economy. In line with the current policy "backing the winners" the Ministry of Economic Affairs and the Ministry of Agriculture, Nature and Food Quality have shown their interest and support for the development of a TTI Green Genetics.

## 2.2 Putting genetics to work

Plants are the basis of life on earth. For centuries, humans have selected plants that best fit their needs in feeding their cattle and themselves, and they have developed crops that have many advantages in quality, yield and farming practices. Such plant breeding has been very successful, although multifactor traits involved in quality and resistance to pests and diseases have proven to be extremely difficult to improve.

The revolution in life sciences through molecular biotechnology and genomics has changed the scale and scope of our possibilities in plant breeding dramatically. This has enabled a detailed genetic understanding of plant performance at multiple levels of aggregation. The complex biological processes that underlie the quality-related processes of our crops and mechanisms of pest and pathogen resistance are now open to systematic functional analysis.

*Mission: TTI Green Genetics will develop and apply genetic information for the creation of crops with improved performance and improved quality: 'TTI Green Genetics will put genetics to work'.*





### 2.3 Strategic focus

TTI Green Genetics combines the effects of mega-trends in society with the scientific and technological capabilities of the Dutch genomics knowledge infrastructure and Dutch companies in the field of plants and food. These mega-trends are:

- **Globalisation:** new technologies spread very quickly around the globe. Dutch companies face increasing technological and price competition from all over the world.
- **Sustainable economy:** a growing awareness of the scarcity of resources and energy and the need for renewable resources and a bio-based economy.
- **The ageing population in western countries and the growing population in developing countries:** the need for sufficient, healthy and functional food for an increasing world population. This leads to an increasing need for a sustainable food production.

The Dutch plant sector anticipates these trends by focusing on its technological and scientific strengths to find ways to create advantages and market niches over its competitors. The plant propagation industry has a history of success, and the challenge is to maintain this leading position in the future. Therefore, the sector and the knowledge infrastructure formed a strategic alliance in TTI Green Genetics. The research projects in this virtual institute will lead to plants with improved traits, better resistance and better growth.

This TTI is characterised by:

- **Innovation:** starting from the market, companies and research institutes together translate market needs into research questions.
- **Research projects:** research institutes and companies work together in well-defined projects to carry out research in the initial phase of innovation.

*Product with high added value: tomato seed*

Price per seed	€ 0.20
Tomato fruit value per seed	€ 16.00
Grower pays per kg seed	€ 50 000.00
(in comparison: gold price)	€ 12 000.00)
Value per kg seed for grower	€ 3 500 000.00
Value per kg seed for retailer	€ 7 000 000.00



- **Valorisation:** companies and research institutes will implement the results of research in applications, tangible innovations and products of a high economic value.
- **Science:** results of the research projects will lead to new concepts to link the phenotype to the genotype, and vice versa.
- **Education:** all partners aim to increase the attraction of students to plant sciences by offering a stimulating educational and scientific environment. Research and education are directly coupled to industrial career possibilities.

## 2.4 Goal and deliverables

Our goal is to advance the Dutch industrial and technological position in the breeding of crops by a continuous flow of innovations. Operational effects are based upon the quality of the programme, achievement of innovation, quality of research, and effects of education. The quality of the programme will be reviewed by internal and external panels according to a fixed set of parameters (see 7.3 Quality Indicators). We will ask an external organisation to measure the level of satisfaction from the three stakeholders, the industrial, research and governmental partners. Our ambition is to score at least a 'high' at all levels:

- **Innovation deliverables** will be based upon return on investment. We expect that TTI Green Genetics will lead to more effective breeding programmes in the participating companies. Among others, this will be measured by the number of cultivars for which Breeder's Rights are requested. We expect major contributions in cultivars with improved resistance, growth characteristics and consumer traits, leading to a greater and broader worldwide market penetration by the participating companies. The direct financial effect is difficult to predict, but we will monitor the economic position of the participating companies annually. The external satisfaction interview will be targeted to this parameter. Our target is a 3% increase in total annual revenues of the participating companies as a direct effect of TTI. For this we will follow the effects of the innovations through independent market share analysis, we will analyse the innovative diffusion rate by the participating companies and we will determine the projected financial effects of innovations in the complete market chain.  
Another innovation deliverable is the number of patents. We expect to generate four patent applications annually. The development of the participating plant biotechnology companies such as Keygene and Genetwister will be measured by their increase in turnover and employment. Also the number of spin-offs will be measured and considered as an innovation deliverable.
- **Research deliverables** in the coming five years will be the number of scientific papers (target: about 100 publications in journals with an impact factor higher than 3.00), the number of presentations at international conferences (target: 150), the number of PhD theses (target: 15) and the number of granted projects (i.e. STW, EU, EZ Omnibus, IOP) that are additional to the programme.
- **Education deliverables** will be based upon the number of new study programmes within the scientific groups collaborating in EPS, the Graduate School for Experimental Plant Sciences (target: three new study programmes), the number of students active in TTI projects (target: 50), the number and quality of master classes (target: four) and increased interaction with Polytechnic Institutes (HBO/MBO).



### 3. POSITION OF TTI GREEN GENETICS

#### 3.1 Green Genetics

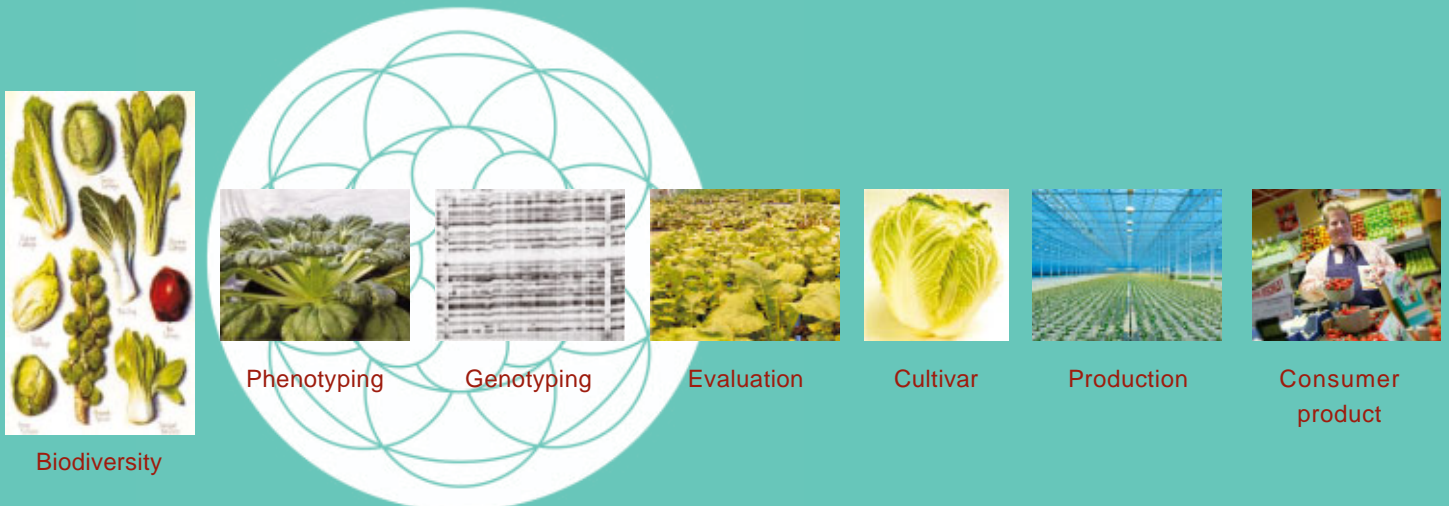
Green Genetics comprises of all activities in the breeding and propagation of horticultural, floricultural and agricultural crops. Breeding mobilises the genetic potential of plants by using biotechnology, genomics and tissue culture, and builds upon many scientific areas of expertise such as genetics, physiology, pathology, biochemistry, and statistics.



The Green Genetics sector provides the starting material for the entire agribusiness. The strategic position of TTI Green Genetics within the knowledge and production chain of the agro-food business is illustrated in the figure ('position of TTI Green Genetics in the green production chain').

To further strengthen the position of the strategic research of TTI Green Genetics, a strong interaction with fundamental and utilisation-oriented academic research is very important. TTI Green Genetics will benefit from "upstream" research as supported by STW and IOP programmes. But also "downstream" of TTI research, companies should be encouraged to use the results in their own R&D programmes. The TTI Green Genetics consortium recommends the government to support fundamental and utilisation-oriented research in plant sciences and also to develop additional instruments for valorisation and product development in innovative programmes within Flowers & Food.

Position of TTI Green Genetics in the Green Production Chain



### 3.2 Economics of the sector

The Netherlands has a unique position in plant breeding, plant propagation and plant production. Internationally the Dutch plant industry is recognised as leader in the breeding of vegetables, ornamentals, potatoes and grasses. The ambition of the Dutch Green Genetics industry is to strengthen and to extend its position by continuous innovation and investments in potential growth markets, such as products associated with human health and well-being, quality and taste, bio-based industrial products and new markets in Eastern Europe and Asia. Innovative applications are based on expertise and technology and thus require an excellent knowledge base. A continuous stream of innovations requires the combination of the most highly educated researchers and the most advanced technological tools. Hence, the innovation needs of the Dutch Green Genetics industry are great, and for this reason 14% of the annual turnover is invested in R&D. In this respect the Dutch Green Genetics industry is comparable to the pharmaceutical industry.

For the Dutch economy it is important that the Dutch Green Genetics industry improves its position:

- The direct turnover of the Dutch plant propagation industry is € 2.5 billion annually.
- The total export value is more than € 1 billion annually.
- Its labour force is 10,000.
- 8 of the 10 largest vegetable seed companies have their main office or a major R&D location in the Netherlands.
- Green Genetics is the basis of all Flowers & Food, representing a value of more than € 8 billion annually.

### 3.3 Interaction with (inter)national innovative research clusters

TTI Green Genetics is a new and unique innovative research collaboration. The collaboration in itself is innovative since this is the first time that the Dutch plant propagation industry will take the lead in determining the research agenda at national level and will establish a strong financial commitment for the realisation of the programme. This interaction will secure that the results of TTI research will be directly integrated into the R&D programmes of the participating companies.

TTI Green Genetics is distinct from other important Innovative research clusters, such as the Centre for Biosystems Genomics (CBSG), the EU programme on Solanaceous Crops (EU-SOL) and projects within IOP genomics. The major aim of the CBSG is to carry out genomics research, the programme is led by the participating research organisations and the research is targeted to obtain fundamental insights into biosystems regulations in three plant species (*Arabidopsis*, potato and tomato). The EU-SOL initiative is targeted at gaining fundamental insights into the genomics of tomato and potato.

In contrast, TTI Green Genetics, directed towards genetics research, is led by the industrial partners, the research is strategically oriented and will cover a wide range of different plant species, as reflected by their importance for the Dutch economy.

TTI Green Genetics is also additional to another project, which has been submitted to the current FES-programme. The project submitted concerns *Phytophthora* resistance in the potato and has a very well defined target that is a specific problem in the production of potato tubers.

TTI Green Genetics will establish collaboration and interaction with all the programmes and projects mentioned and with all other (national and international) projects that are carried out in the field of Green Genetics.



#### 4. THE PARTNERS OF TTI GREEN GENETICS, A PUBLIC-PRIVATE PARTNERSHIP

TTI Green Genetics is a strategic collaborative consortium led by the industrial partners. All partners agree to perform and integrate the research and educational programmes as described in this business plan. The participants are committed to share, co-develop and validate knowledge and research capacity and resources to achieve the institute's goals. All partners have agreed that most of the research will be carried out by the research partners. The involvement of the industrial parties will be dependent on the specific needs within a project.

The parties that have so far committed themselves to TTI Green Genetics with the intention of participating in research and educational projects are listed. These partners were either involved in writing this business plan, and/or have proposed research projects, and/or have otherwise indicated that they wish to be involved in TTI Green Genetics.

Plantum NL is the representative of some 400 companies involved in the breeding, tissue culture, production and trade of seeds and young plants. The Dutch Green Genetics industry is very diverse. Companies range from multinationals to one-man firms; the majority of the members of Plantum NL belong to small and medium-sized enterprises (SMEs). Their activities range from plant breeding and production of seeds to the production of tubers, bulbs, cuttings, tissue cultures and young plants. TTI Green Genetics will offer opportunities in research and education for both small and large-sized companies, active in all segments of the industry. To achieve this goal we have invited or will invite members of Plantum NL as well as other organisations such as the KAVB (Royal General Bulb Growers' Association), NFO (Dutch Fruit Growers' Organisation) and NAO (Dutch Organisation for Potato Merchants) to initiate projects within TTI Green Genetics. In such projects, the Product Board for Horticulture ("Productschap Tuinbouw") will also be involved. The partnership with central organisations facilitates the participation of SMEs into TTI Green Genetics as it provides the opportunity to cluster projects and helps to provide the financial inputs. The participation of SMEs is expected to grow further once TTI Green Genetics has started.

## Partners of TTI Green Genetics

### Industrial Partners

At this moment the Industrial Partners include, but are not limited to:

#### *Vegetable seed companies*

Bejo Zaden

BioSeeds Partners:

- Enza Zaden
- Nickerson-Zwaan
- Rijk Zwaan
- De Ruiter Seeds
- Takii Europe

Nunhems Netherlands

SVS Holland

Syngenta Seeds

#### *Producers of young plants*

Companies united in the product group "greenhouse vegetables" of Plantum NL

Companies united in the product group "strawberry plants" of Plantum NL

#### *Breeding and propagation companies of ornamental crops*

Beekenkamp Plants

Companies united in the product group "flower seeds" of Plantum NL

Dekker Breeding

Deliflor Breeding

Fides

Kapiteyn Breeding

Könst Kwekerijen

Mak Breeding

Royal Van Zanten

De Ruiter Innovations

Gebr. Vletter & Den Haan

Wulfinghoff Alstroemeria

#### *Tissue culture companies*

Könst Kwekerijen

SBW International

Vitrocom Holland

Vitro Plus

#### *Breeding and propagation companies of arable and forage crops*

Agrico Research

Averis Seeds

Barenbrug Holland

HZPC Holland

Handelmaatschappij Van Rijn

C. Meijer

Vandijk Semo

#### *Breeders of fruits and mushrooms*

ABZ Seeds

Bromyc

Fresh Forward

Inova Fruit

#### *Plant biotechnology companies*

Genetwister Technologies BV

KeyGene N.V.

Add2X Biosciences

#### *Other companies and organisations*

Noldus Information Technology BV

Naktuinbouw

Plant Dynamics BV

### Research Partners

#### *University/ Research institute*

Wageningen University and Research Centre

Leiden University

Radboud University Nijmegen

TNO Quality of Life

Utrecht University

University of Groningen

University of Amsterdam

Vrije Universiteit Amsterdam



## 5. THE RESEARCH AND EDUCATION PROGRAMME

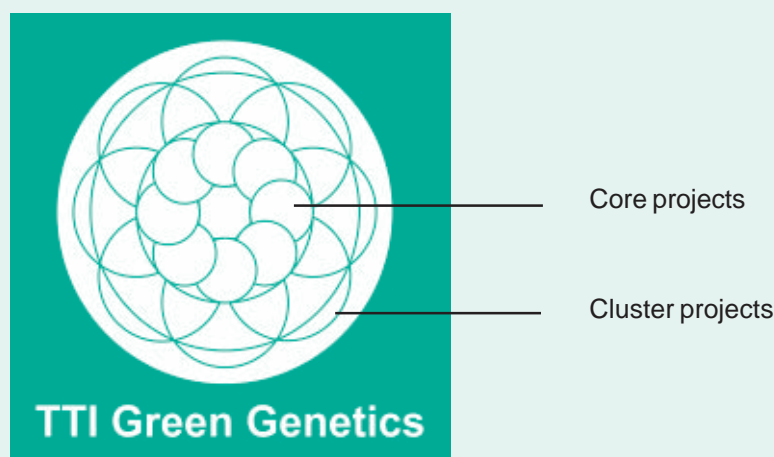
### 5.1 Central theme

The central theme of TTI Green Genetics is: *'Innovative plants for sustainable flowers & food'*. This theme expresses the main aim of TTI Green Genetics: to utilise knowledge and expertise of research organisations and industry for the development of innovative crop varieties – plants that are optimised for a sustainable growth under various environmental conditions to produce safe, beautiful and healthy products for consumers. The results will enable breeders and growers to use fully the genetic potential of plants for optimal and sustainable growth under existing and new production systems.

The central theme has been chosen by the research committee of Plantum NL, in close interaction with leading Dutch scientists in the plant sciences. Plantum NL has set the research agenda for the entire Dutch plant propagation industry: in this agenda, the needs of the whole production chain and the needs for specific research disciplines have been appraised. The choices made by the industry determine the TTI research agenda. They focus on the central theme *'Innovative plants for sustainable flowers & food'* around the following core disciplines:

- Genetics;
- Phytopathology;
- Physiology.

Genetics encompasses the quantitative genetics of traits; phytopathology includes entomology, virology, nematology and bacteriology; and physiology comprises plant physiology, seed physiology, cell biology and biochemistry.



## 5.2 Research programme

All research projects will be linked to the central theme of the programme, and will be connected to the three basic research disciplines, genetics, phytopathology and physiology. The heart of TTI Green Genetics is a core programme for research and education that will generate expertise that is used in the cluster research projects. In these clusters, industrial partners, together with research institutes, will translate the research in proof of concepts.

## 5.3 Core agenda

The core will focus on expertise development and capacity building in the three basic disciplines: genetics, phytopathology and physiology. The core programme will disburse approximately 20% of the TTI budget (15% for research and 5% for education) and will comprehend a limited number of integrated research and education projects.

### 5.3.1 Core research

The primary objective of the core research programme is to strengthen our basic understanding of the growth and development of plants and its interaction with the environment. Preferred projects are strategic in nature and build upon the fundamental insights from the research groups involved.

Projects are targeted to result in an improved ability to screen, analyse and understand the plant phenotype. Results are expected to lead to new concepts and/or quantitative genetic technologies that help to link the phenotype to the genotype, and vice versa. Results of the core research programme will be used in the cluster research projects and will facilitate the development of the educational and training programme.





### 5.3.2 Core education and training

The core education programme is focused on capacity building in the three basis disciplines: genetics, phytopathology and physiology. The main goal is to strengthen the educational programmes as a way to improve the attractiveness of the plant sciences to scholars and students, leading to an increase in the Green Genetics labour force. We will develop an education and training programme in close contact with higher education establishments and universities in the Netherlands and in a direct collaboration with current national educational programmes.

The participation of the industry in the educational programmes, as instituted through the TTI framework will generate extra opportunities for the setting up of an attractive education and training agenda.

TTI Green Genetics will:

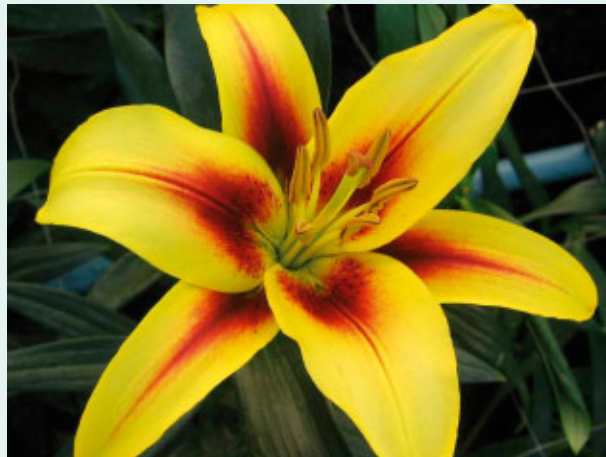
- Finance extraordinary professorships in the basic disciplines (i.e. genetics, phytopathology and physiology);
- Arrange a 'scientific hotel function' at universities for industrial researchers to stimulate a flow of ideas from science (students) to industry and vice versa (compare the Casimir programme);
- Invite students and young scientists to work in a company environment as part of their professional training;
- Commit scientists from the industry to participate actively in educational programmes;
- Offer support (financial, organisational, communication) for universities in their attempts to attract students;
- Offer students financial support for their educational programme in the plant sciences;
- Organise master classes in genetics, plant propagation, and emerging new related technologies.



## 5.4 Cluster project agenda

The cluster research projects are initiatives of the industrial partners and will be carried out by selected research groups from the research partners. The projects have the primary objective of creating know-how and expertise to strengthen the competitiveness of the Dutch industrial and technological position in Flowers & Food. All cluster research projects contribute to the central theme *'Innovative plants for sustainable flowers & food'* that is divided into three sub-themes:

- **Growth and development:** Crops need to perform optimally under a variety of culture conditions. To reach this goal we need a better understanding of the physiology of plants to develop crops that perform optimally in dry, wet, dark or light conditions. This will lead to better yields, higher labour efficiency and sustainable growth. The scientific challenge is to gain more insight into the physiology of the plant and the genetic regulation of processes involved in its growth and development, including seed germination, plant architecture, fruit ripening and senescence. *The results will be used for the genetic improvement and the development of culture conditions and culture regimes that guarantee a high, uniform and controlled growth and development of seeds and plantlets.*
- **Plant health:** Crops are continually threatened by pathogenic organisms such as viruses, bacteria, fungi and insects. Changing culture conditions, new crops and new culture regions require continuing research into the development of novel means of resistance. Special attention needs to be given to insects as they can cause direct damage and are vectors for many viral diseases. In general, resistance against insects appears to be much more complicated than resistance against viruses, bacteria and fungi. Nevertheless, consumers pose an ever-increasing demand for pesticide-free produced food. TTI Green Genetics aims to improve the genetic potential for the natural protection of crop plants to insects (e.g. whitefly and thrips), mites, nematodes, micro-organisms (fungi and bacteria) and viruses. The scientific challenge is to gain a better insight into the regulation of the interaction between plant and pathogens and to develop expertise and methods to intervene in this relationship. *The results will be used for the pathogen-free production of seeds, cuttings, bulbs and plantlets and for the genetic improvement of cultivars that are more resistant to pathogenic organisms.*
- **Quality for the consumer:** Products derived from the cultivation of crop plants need to fulfil all the various needs of the different partners in the product chain (from grower to consumer). Consumers prefer flowers with beautiful colours, subtle fragrances and good vase life and prefer vegetables with a good appearance, fine taste and more health-promoting contents. Growers need to produce flowers and food in a sustainable way, and have to comply with all regulations on quality and safety. TTI Green Genetics will develop knowledge on the genetics of traits, in order to enable the translation of consumer preferences into the phenotype of the plant. *The results will allow breeders and producers to exploit the existing genetic variation and to create plants that fulfil the needs of the various partners in the chain.* The scientific challenge is to better understand the complexity of components that determine aspects such as colour, fragrance, taste and health-promoting effects of plant products, to unravel the genetic basis of the biochemical pathways involved and to show that this will lead to plant products with improved contents.



## 5.5 Three research examples

### Growth and development

Increasing efficiencies in plant production systems require novel solutions with regard to seed quality. Fast and uniform germination is determined by genetics, growing conditions during seed production and by a whole array of seed sorting, seed health treatment and seed enhancement technologies. TTI Green Genetics research will yield knowledge on the interaction between physiology and genetics and will generate technologies to improve seed quality in some major crops. The photograph depicts germinating lettuce seeds that were encapsulated to facilitate automated sowing and that were treated to overcome their natural inability to germinate under hot and dark conditions.

### Plant health

Lilies are important for Dutch floriculture; they represent a value of € 500 million annually. New innovations in colour, shape and various resistances against pests and diseases drive the market. TTI research will focus on the molecular processes that regulate genetic recombination frequencies. This knowledge will be used to direct inter-specific hybridisation of, for example, lily breeding materials and will lead to the targeted introduction of new resistances. Resistances to insects are especially important.

### Quality for the consumer

The fragrance and taste of Flowers & Food is an important quality attribute for consumers. Plant volatile emission is genetically regulated and is affected by physiological and environmental conditions. TTI Green Genetics will use innovative non-destructive technologies to analyse the volatile composition and will correlate the fragrance profiles with human perception studies. Goal is to gain a better insight in the regulation of volatile emission. Results allow breeders and growers to exploit the existing genetic variation and to create plants that fulfill the expectation of the consumer.



## 6. KNOWLEDGE TRANSFER AND IPR PROTECTION

The main objective of TTI Green Genetics is to convert knowledge developed in the programme into value for the Dutch economy in the key area Flowers and Food. Therefore, the participating companies and research organisations will implement the results of research into product innovations and into new plant cultivars. The transfer of knowledge between partners and awareness of the value of such knowledge is important therefore. The valorisation and transfer of knowledge, technology and material will be the responsibility of all TTI partners.

The transfer of knowledge between the partners will be achieved via the regular meetings of the programme or project committees, but also through informal interactions between researchers from industry and research organisations. To facilitate the knowledge transfer, the direct involvement of industrial partners in the execution of each project is of great importance. This interaction between industry and research will stimulate the flow of information.

After having protected the intellectual property rights (IPR) and after having transferred the knowledge to the participating companies, the research groups will publish all the results of the research in high-rating scientific journals, in theses or in the popular press.

TTI Green Genetics will take action for the timely and adequate protection of research results, *inter alia* via IPR protection. The protection and valorisation of IPR will be in line with the European Community Framework for State Aid for Research and Development, the new EU regulations on State Aid for Innovation and the Regulations concerning IPR laid down by the Dutch Ministry of Economic Affairs.

The arrangements for IPR protection and knowledge transfer will be fully defined and described before the start of TTI Green Genetics. A summary of the basic rules as agreed upon by the parties is presented as Appendix 1.



## 7. ORGANISATION

- TTI Green Genetics is an organisation aimed at scientific collaboration between research organisations and industry active in plant propagation material.
- TTI Green Genetics is a virtual institute that uses the existing infrastructure of the research partners. It consists of a public-private partnership in which industry together with the top-level research groups of Dutch universities and technology and service providers co-operate in a coherent programme.
- The (small) organisation itself is responsible for acquiring and managing research and educational projects.
- Most of the actual research activities (of both the core and the cluster projects) will take place at the research groups' locations.
- The industrial partners lead the consortium and have a 50%+ vote in all decision-making bodies.
- The total organisation and office costs are budgeted at a maximum of 5% of the total budget.
- The legal form of TTI Green Genetics will be a not-for-profit foundation according to Dutch law.

### 7.1 Management structure

#### Supervisory Board

The Supervisory Board is responsible for the vision and strategy of the TTI Green Genetics Foundation. It consists of representatives of Plantum NL, the various industrial sectors and the research organisations, with the industry having the majority of the votes. A representative from an adjoining scientific or industrial field (e.g. a representative of Wageningen Centre Food Science) will also be invited into the Supervisory Board.

The Chairman is chosen from one of the industrial representatives by the Supervisory Board. The Supervisory Board appoints the Managing Director and the Programme Leaders. It will consult the industrial stakeholders, represented by Plantum NL, in this process. The Supervisory Board itself is installed by the Ministry of Economic Affairs, in consultation with the Ministry of Agriculture, Nature and Food Quality and the stakeholders from industry and research organisations.

#### Managing Director and Programme Leaders

The Managing Director is responsible for the internal organisation and supervises the personnel, financial and administrative aspects of the organisation. The Managing Director (1.0 fte) forms a management team together with the four Programme Leaders (3 x 0.2 fte and 1 x 0.4 fte). This team also acts as statutory council for the foundation. The management team is supported by an office manager (1.0 fte). A legal advisor will be hired when necessary, on an *ad hoc* basis. The management team represents the TTI Green Genetics Foundation in all external relations.

#### Management Team

The Management Team is responsible for the scientific quality of the research programme and the dissemination of research results. It is also involved in guarding the processes of valorisation of research results and the protection of intellectual property rights. The Management Team plays an important role in the evaluation of the research proposals, together with the Project Evaluation Committees.



### Research Programmes and Core Programme

The Core Programme contains both the research and the educational agenda. The sub-themes of TTI Green Genetics are represented in three Research Programmes. The Core Programme and each Research Programme are managed by a Programme Leader. Each Leader will be appointed for 0.2 fte to the TTI, except the leader of the Core and Educational Programme, who is appointed for 0.4 fte.

### Research Projects

Various research projects are executed within the Research Programmes, each under the responsibility of a project leader. The project leaders report to the Programme Leader, who in turn reports to the Management Team. Each project will have a Project Committee, with representatives of the partners in the project. The Committee appoints a Chairman and Secretary and convenes at least twice a year.

### Project Review Committees

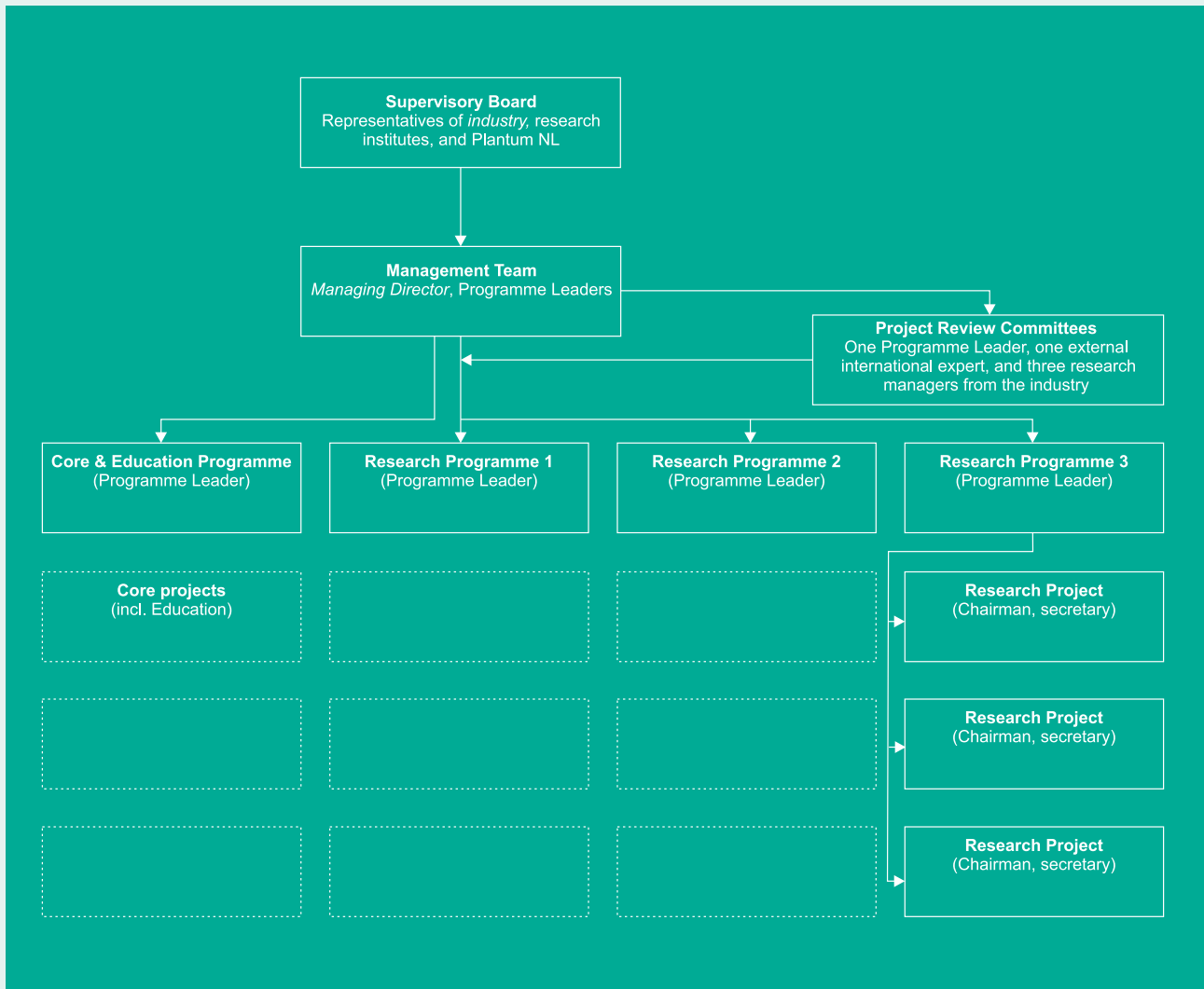
The evaluation of new project proposals will be carried out by Project Review Committees (one committee for each programme). These committees work under the responsibility of the Management Team, each consisting of one external international expert, one Programme Leader and three selected Research Managers from the industry. In reviewing the proposals, the committees take into account:

- confidentiality regarding the contents of the proposal and the participants;
- scientific quality of the proposal;
- valorisation opportunities;
- commitment of the companies and research institutes involved, both in financial terms and in terms of the implementation of results.

Based on these criteria, each project proposal is reviewed by the relevant Project Review Committee, who advises the Supervisory Board. This board decides whether or not a project is accepted and under what conditions.



## 7.2 Organisational Scheme TTI Green Genetics





### 7.3 Quality indicators

- The quality of the work will be reviewed annually by the Supervisory Board, supplemented with three internationally renowned scientists from industry and/or research centres. To analyse the quality, all project leaders will be invited to present their work both on paper and orally. Quality indicators are: milestones achieved, deliverables obtained, intensity of knowledge transfer, opportunities gained for valorisation, participation in education programmes and scientific level.
- These quality indicators will be assessed on the basis of the detailed project description, including carefully described deliverables and milestones that have been defined before the start of each project.
- Project progress will be discussed with a project committee representing all stakeholders.
- The main purpose of all reporting activities will be to facilitate and increase the transfer of the developed knowledge from knowledge institutes to industry.
- In the second year of the programme, all research and education projects will be evaluated for a go/no-go assessment, based on the list of deliverables and milestones per project. To analyse quality, the Management Team will write a self-assessment report each year, based upon the project reports and the development of the complete programme. For this programme evaluation, the Supervisory Board will be supplemented with four external independent international scientists.
- Apart from the annual quality project indicators, the go/no-go decision will be based upon: accomplishment of pre-defined deliverables and achievement of the pre-set milestones, completeness of research programme, and interaction between projects, effectiveness of organisation, economic relevance, and valorisation importance at the programme level.



## 8. FINANCES

### 8.1 Introduction

- The Foundation TTI Green Genetics is a public-private partnership between industrial parties, research groups and the Dutch government.
- All partners will contribute financially to the TTI programmes, but the contribution of the industrial partners and research groups will be different in the core programme and the cluster programmes.
- The contribution of the industrial partners can be in cash and/or in kind. The in-kind contribution will be dependent on the specific contents of a project, but is set at a maximum of 50%. The in-kind contribution made by industry may include materials or technologies that will be used in the research projects. The value of such in-kind contribution will be appraised before the start of the project. The in-kind contribution can also be delivered via 'in-house' research activities within the project.
- The contribution of the research partners can also be in cash and/or in kind. The research groups will be selected from leading universities and institutes on the basis of their specific know-how and expertise in the field of interest.
- In addition, specialised companies and organisations that can provide specific technologies or services to the research projects will participate. They will also contribute financially in cash and/or in kind to the project.
- The Dutch Government will support TTI Green Genetics via matching: the total investment of the industrial and research partners will be doubled.





## 8.2 Scenario for funding

The total budget of TTI is subdivided into a Core Research Programme (15% of total), a Core Education Programme (5% of total), a Cluster Research Programme (75% of total) and Organisation & Administration (5% of total).

Since the Core Research Programme is aimed at basic strategic research by the research groups, about 50% of the financing of these projects will be provided by the research groups participating in a project, with limited financial contribution by industrial partners. Collaboration and co-funding by industrial partners, especially the specialised research companies and technology providers will, however, be possible. In such cases, the financial contribution of research groups will be accordingly lower.

The cluster projects, which form the largest part (75 % of the budget) of TTI Green Genetics, are carried out by the research partners on behalf of and in collaboration with (a group of) industrial partners. These projects will be financed by industry (35%) and by research groups (15%).

The resources for organisation and administration (5% of the total budget) and the resources for the education programme (also 5% of the total budget) will be shared equally (25% each) by the industrial and research parties. All industrial parties participating in cluster projects will contribute financially to the Core Education Programme and the TTI organisation which totals to about 10% of the total budget. With an anticipated budget of total € 50 million for 5 years, the contribution of all industrial parties is estimated to amount to ca. € 14 million, whereas the contribution of the research groups will amount to ca. € 11 million. About 90% of all financial inputs will be used for research. Thus, averaged over all activities, the ratio of funding by industry, research organisations and government is expected to be 28%, 22% and 50%, respectively. Table 8.1 gives the budget breakdown of the funding of TTI Green Genetics.



**Table 8.1. TTI Green Genetics Budget breakdown.**

TTI Green Genetics	%	Total Budget	Industrial Parties	Research Parties	Government
Core programme	15	7.50	0.10*	3.65	3.75
Education programme	5	2.50	0.63	0.62	1.25
Cluster programme	75	37.50	13.13	5.63	18.75
Organisation	5	2.50	0.63	0.62	1.25
<b>Total</b>	<b>100</b>	<b>50.00</b>	<b>14.49</b>	<b>10.52</b>	<b>25.00</b>

Financial figures in million €

\* indicating collaboration with specialised research companies and technology developers

**Table 8.2. Planning of the financial inputs of stakeholders.**

Year	2006	2007	2008	2009	2010	Total
Partners						
Industrial Partners	1.40	2.00	2.80	3.90	3.90	<b>14.00</b>
Research Partners	1.10	1.50	2.20	3.10	3.10	<b>11.00</b>
Governmental Support	2.50	3.50	5.00	7.00	7.00	<b>25.00</b>
<b>Total</b>	<b>5.00</b>	<b>7.00</b>	<b>10.00</b>	<b>14.00</b>	<b>14.00</b>	<b>50.00</b>

Based on a budget of € 50 million. Figures are given in million €. Expenditures will be adjusted annually to the retail price index figure. Expenditures of Industrial Partners and Research Partners are in cash and/or kind.

**Table 8.3. Multi-annual planning of budgets for the various programmes of TTI Green Genetics.**

Year	2006	2007	2008	2009	2010	Total
Programme						
Core Research	1.00	1.50	1.50	1.75	1.75	<b>7.50</b>
Core Education	0.50	0.50	0.50	0.50	0.50	<b>2.50</b>
Cluster Research	3.00	4.50	7.50	11.25	11.25	<b>37.50</b>
Organisation	0.50	0.50	0.50	0.50	0.50	<b>2.50</b>
<b>Total</b>	<b>5.00</b>	<b>7.00</b>	<b>10.00</b>	<b>14.00</b>	<b>14.00</b>	<b>50.00</b>

Figures are given in million €. Expenditures will be adjusted annually to the retail price index figure. Expenditures of Industrial Partners and Research Partners are in cash and/or kind.



**Table 8.4. Financial commitment of industrial sectors (m€).**

Dutch Plant Propagation Industry	Estimated financial commitment per year
Vegetable breeding companies	1.35
Producers of vegetable plantlets	0.20
Ornamental breeding/propagation companies	0.50
Field crop breeding/propagation companies	0.20
Tissue culture companies	0.05
Fruits & mushrooms	0.20
(Biotech) companies, other organisations	0.20
<b>Total</b>	<b>2.70</b>



## 9. NEXT STEPS

This Business Plan for the Technological Top Institute Green Genetics was developed in a joint effort of the Dutch Green Genetics industry and the Dutch plant research community. From both sides very enthusiastic support was given and this has resulted in a strong commitment and in a large number of ideas for innovative research proposals. Over 50 research proposals were received from the industrial partners during the preparation of this Business Plan. These ideas for research were put forward by all different sectors of the plant propagation industry, showing that the basis for the creation of a TTI Green Genetics is very broad indeed.

The Ministry of Economic Affairs as well as the Ministry of Agriculture, Nature and Food Quality have been very supportive during the development of the programme, and the plan has been evaluated by the CPB (Netherlands Bureau for Economic Policy Analysis) in the frame of the governmental grants for FES. On the 10<sup>th</sup> of November 2005 this Business Plan was presented to the Minister of Economic Affairs during his visit to the Flowers & Food business in "het Westland". At that occasion the first two booklets of the business plan were presented to him and his colleague the Minister of Agriculture, Nature and Food Quality. Currently the various stakeholders from industry and research organisations have started the further conversion of the research ideas into research projects. Depending on the decisions that have to be made in the coming weeks, the working group "Business Plan TTI Green Genetics" anticipates to start-up the programme as soon as possible in the year 2006.





## Appendix 1: Knowledge Transfer and IPR protection

Summary of the basic rules.

### *Background knowledge*

- All parties' background knowledge is and shall remain the exclusive (intellectual) property of the party that has made such knowledge available and grants to all other parties a royalty free, non-transferable right of use of its knowledge solely for purposes of research to the extent described in the project plan. If background knowledge is needed for product development and commercialisation, parties will have an option for a license. If needed, background knowledge can be used as an 'in-kind' contribution to the project.

### *Foreground knowledge*

- Research partners participating in a research project shall have a royalty-free, non-transferable right of use of the foreground knowledge derived from such project, solely for research purposes.
- Industrial partners participating in a research project shall have a royalty-free, co-exclusive and non-transferable right to use the foreground knowledge derived from such project, for research & development and commercialisation.
- Foreground knowledge will be kept confidential within the project group. At the start of each project a plan for knowledge transfer (including periods of secrecy) will be defined.

### *Intellectual property rights in core research*

- The research partners (and eventual industrial partners) that participate in a core research project shall have the right to file applications for intellectual property rights on foreground knowledge derived from the project. They will do so in their own name and at their own expense.
- On payment of compensation, the Industrial partners participating in TTI Green Genetics shall be granted a licence to use patent-protected research results for R&D and exploitation. The compensation to be paid will be based on the market value and revenues shall be allocated for research.

### *Intellectual property rights in cluster research*

- The industrial partners that participate in a cluster project shall have a mutual and exclusive right to file applications for intellectual property rights on foreground knowledge derived from the project. They will do so in their own name and at their own expense. In return for obtaining this mutual and exclusive right, industrial partners shall pay a fair and reasonable financial compensation to the research partners involved in the project.
- With regard to the compensation, the contribution from each partner – consisting of background information, the input in cash or in kind, and the intellectual input during the project – will be taken into account.
- The researcher(s) directly responsible for the results from the research leading to a patent application will be mentioned as (co)-inventors in the patent application.

### *Exploitation of research results towards third parties*

- If none of the involved partners wishes to protect the generated foreground knowledge, such rights can be transferred to third parties, for exploitation outside the field of interest of the industrial parties. This will be decided by the Supervisory Board, on the recommendation of the Project Committee.
- The purchase price to be paid by third parties as compensation for intellectual property rights and/or user's rights with respect to research results shall be based on the market value. Such compensation shall be paid by a third party to the TTI Green Genetics Foundation and shall be reallocated for research within TTI.
- TTI Green Genetics will stimulate the formation of new start-up companies. The possibilities for start-ups will be considered within the legal IPR framework, taking into consideration the interests of the parties.
- Companies that do not participate in TTI Green Genetics will profit from innovations achieved in the TTI via the so-called breeders' exemption in Plant Breeders' Rights legislation. This exemption allows breeders to use protected varieties to breed new commercial varieties.



## Appendix 2: Working group Business Plan TTI Green Genetics

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C.G.M. (Cees) Hageman	De Ruiter Innovations Area Manager
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