50 years of flowerbulb research in North America

1965 - 2015

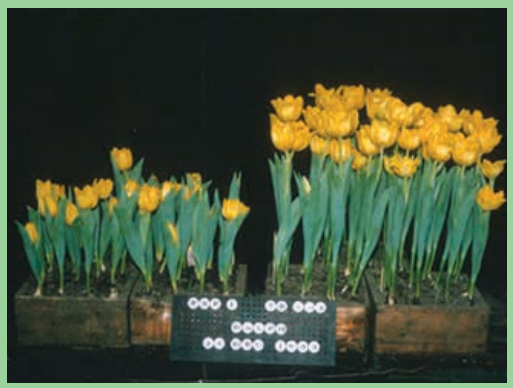
Anthos

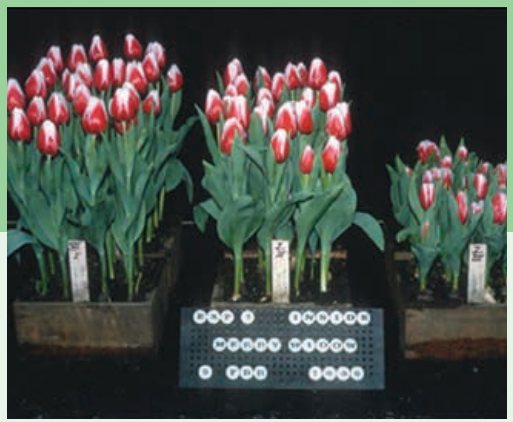
50 years of flowerbulb research in North America

1965 - 2015

Anthos
Royal Dutch Trade Association for Flowerbulbs and Nursery Stock

Table of Contents





Introduction

The flower bulb industry has a rich and colorful history and many issues have been studied and discussed in the last century. Sometimes it has been about an obvious or very popular issue, such as “tulip mania”, but often the issue is much more specific. This book is a category-two book.

Fifty years ago, Dutch exporters (Anthos group I) of flower bulbs to the USA and Canada made a crucial decision: they decided to fund research on flower bulbs in North America, which was a unique initiative. These efforts will be reviewed. Fifty years is a good milestone for a book, as the time period is not too long, and there are still individuals around who have been involved with the program since the very beginning. Three individuals from the Research Committee have contributed to the book: Mr. Henk Stuifbergen, Mr. Leo Berbee and Mr. Hendrik Jan Kloosterboer.

The book is divided into three chapters. The first chapter begins with a brief history of exporting flower bulbs to the USA and the start of the research program. This chapter describes the research that Dr. August (Gus) De Hertogh and his associates carried out at Michigan State University. The second chapter describes the period from 1978 to 1996, when Dr. De Hertogh was a member of the faculty at the North Carolina State University in Raleigh. This was a period of high productivity and output. The third chapter starts with the quest to find a new scientist and a new location. The main part of this chapter is about Dr. Bill Miller and his research.

Some North American growers give their views on the importance of the research program, and the book ends with the program’s future prospects.

There are two appendices. The first lists the names of all the members of the Florists’ Committee, later called the Research Committee. The second lists all the students who have worked on the program.

The need to publish this book was a decision taken by the Research Committee. For me it was a very special assignment and it opened up a whole new world to me.

Arie Dwarswaard


BULB FORCERS HANDBOOK

Starting from scratch

1965 to 1978

The years 1965 to 1978

Starting from scratch

For many individuals, the United States of America is the land of hope and promise, where a newspaper boy can become a millionaire and opportunities are open to everyone. This is also true for people in the flower bulb industry, but export to North America has not always been smooth and easy. Especially the years from 1849 to 1936 were sometimes troublesome. Over this period, there were good and bad years. There were problems with narcissus flies, with heating in transit, and climates that are too warm for spring flowering bulbs. Despite all these troubles, Dutch bulb traders and exporters continued to travel by boat to the USA, selling their bulbs.

According to Mr. Ernst Krelage in his classic book - *Drie Eeuwen Bloembollenexport* (Three Centuries of Flower Bulb Export) - the first was Mr. J.B. van der Schoot. He travelled to the States in 1849. The trip lasted six months and the boat trip home took him another five weeks. While in the USA, he visited many professional growers and consumer gardeners.

The market for flower bulbs in the USA grew from 1 million kilos in 1900 to 11 million kilos in 1916. After that, export to the USA decreased to 4 million kilos in 1919. By 1925, import had grown again. During that period, there were problems with daffodils due to the USDA's American import requirements. The main problem was the narcissus bulb fly. As a consequence, from 1925 to 1938 it was prohibited to send daffodils to the USA. Then, after 1938, the Second World War (WWII) started, and it was no longer possible to export flower bulbs to the USA at all.

Forcing bulbs was a small market

After WWII, the USA became a strong and rapidly growing market. By 1952, it had grown to 13 million kilos. However, after that year, the market declined. The USA became a difficult market, one without growth and again showing a decline. One of the problems was the short length of spring flowering bulbs in gardens in the southern states. Tulips, for example, were not growing as tall as they did in the Netherlands and in the northern states. The Dutch researcher, Mr. J.J. Beijer, solved this problem with two American colleagues. They discovered that bulbs for the south needed a low temperature treatment before planting. This turned out to be a pre-cooling treatment at 5°C (41F) that lasted several weeks. The lack of this cold period in the south was the main reason for the shortness of the tulips. This discovery was also important for the bulb forcing industry in Europe. What was known as the *vijfgradenbehandeling* (five-degree treatment) became a crucial instrument in the industry.

1965

Signing of the first contract at Michigan State University.

USA and Canada pre-clearance program

When exporting flower bulbs, the phytosanitary requirements of the importing country have to be met, like with the narcissus bulb fly. Due to the increasing export volume of flower bulbs to the USA, exporters were confronted with undesirable logistical delays because shipments were only released after the import inspection of USDA-APHIS. The delays seriously affected the quality of the flower bulbs and therefore several Dutch exporters took the initiative to contact the United States Department of Agriculture (USDA) in order to develop a new system of inspecting Dutch flower bulbs destined for the USA. This led to the development of what is known as the pre-clearance program. Within this system, the import inspection is no longer carried out at American ports, but is transferred to the Netherlands instead. The costs associated with the pre-clearance program were paid by the Dutch flower bulb industry based on a levy of the *Produktschap voor Siergewassen* (PVS). In 1950, Mr. Nunzio Santacroce, a USDA Inspector came to the Netherlands. One year later, the Pre-Shipment Inspection Program actually started with five inspectors. One of them was Mr. Santacroce and he has lived in the Netherlands for almost 25 years. His main role was to coordinate the inspection of the flower bulbs for export to the USA. Several years later, a pre-clearance program with Canada was also established. The Pre-Clearance Program turned out to be very beneficial for the export of flower bulbs to the USA, but more was needed for commercial market expansion.

Ph. van Bourgondiën, N. Zonneveld, D. Westerbeek at the Centennial anniversary of Anthos.

Mr. Dolph Westerbeek

For the forcers and the exporters in the USA, many things were new, explains Dolph Westerbeek. He was one of the original members of the Florist Research Committee.

He started working for company C. Westerbeek & Sons in Sassenheim in 1951. Nowadays, he still lives in Sassenheim. The company had already been exporting flower bulbs to the USA for a long time. They had a special interest in the forcing market.
"We paid a percentage of our turnover for promotion in the USA. This levy was mostly used for the dry bulb market, so it was good that a new program began in the USA especially for flower production. I was one of the members of the Florist Research Committee, with other people such as Bill Van den Berg (Chairman), Kees Freriks, Gerrit de Jong, Jack van Reisen, Gus Springer and Jan van den Hoek. Over the years, other exporters such as Nic Zonneveld and John Heemskerk served on the committee.

I have also learned plenty about the forcing of flower bulbs. One of the most important things Gus De Hertogh promoted was bringing the forcing to a science-based level. The preparation of the bulbs and the use of a rooting room instead of planting the bulbs outdoors were very important when it came to ensuring success. Another benefit of having Gus conduct the program was that he was an American. The forcers trusted him more than they trusted the Dutch exporters. They listened to him. His work was very important and helpful for the Dutch flower bulb industry."
Dolph Westerbeek was a member of the Research Committee for thirty years. In 1992, his nephew, Mr. Ruud Westerbeek, took his place on the committee and became Chairman a few years later. Ruud is co-owner of Westerbeek Bulbs, which is currently based in Noordwijkerhout.

Bill Van den Berg – a concerned bulb exporter with a vision

In the 1950s and early 1960s, the situation regarding the export of flower bulbs to many countries was critical, so, in the Netherlands, the flower bulb industry took action. The members of Group I (USA/Canada) of the *Bond van Bloembollenhandelaren* (now Anthos) discussed options to change the situation. Everybody agreed to the main conclusion: something had to happen to alter the market situation, especially for the forcing market. At that time, about 80% of the bulbs were sold as dry-sale to the consumer and only 20% were sold to professional flower bulb growers (forcing market). In 1964, two researchers, Dr. Piet Schenk and Drs. Adri. F.G. Slootweg of the Dutch flower bulb research center *"Laboratorium voor Bloembollenonderzoek"* (LBO) in Lisse visited the USA. They met with forcers and determined why the market for forcing bulbs had decreased. It was a combination of the high prices of the bulbs, an outdated range of cultivars and poor storage conditions used by the forcing companies. Upon their return they reported their findings to the Board of Group I. They advised making investments in the forcing industry. The board of Group I decided to follow up on this advise and several meetings were held to discuss the possible options. The suggestion was made to establish a demo-greenhouse in the USA and to create a consultation agency for North American growers. But ultimately it was decided to start a research program at a university in the USA.

1972
Bill Van den Berg

In December 1964, Group I of the *Bond van Bloembollenhandelaren* met in Hilversum, where they talked about promoting flower bulbs in the USA. One of the attendees was Mr. Bill van den Berg, and he was greatly concerned. He was very much in favor to start a research program to stimulate the development of the forcing market. And his plea was heard and supported by individuals such as Nan Frijlink, who only sold dry bulbs for gardens.
The trip of Dr. Schenk and Mr. Slootweg, and the impassioned plea of Bill van den Berg provided the foundation for a new era: the start of conducting research on flower bulbs in the USA by American researchers and funded by the Dutch flower bulb industry.
The basis for 50 years of research was established during the meeting in Hilversum. A proposal was submitted by the *Bond van Bloembollenhandelaren* to the *Produktschap voor Siergewassen* (PVS). PVS decided positive and granted 100,000 dollars for five years.

Mr. Gus Springer, Director of the Netherlands Flower-Bulb Institute (NFI) in New York City and working for the Dutch flower bulb industry on the promotion of flower bulbs, was requested to find a university and researchers who were interested in flower bulbs. He approached Cornell University and The Ohio State University, but both declined for various reasons. He then approached Michigan State University (MSU), who accepted the program. Initially, it was to be led by Dr. Sylvan Wittwer and assisted by Dr. Richard Stinson, but in July 1965, Dr. Wittwer accepted a position as Director of

Research of the Agricultural Experiment Station at MSU.
In July 1965, Dr. John Carew, the Chairman of the Department of Horticulture at MSU, therefore asked Dr. August (Gus) De Hertogh, a vegetable plant physiologist who had never seen a tulip, to assume leadership of the Dutch Bulb Research Project. He accepted and the rest is history.

The first bulbs and two goals

Gus: The first tulips arrived in Michigan on August 28, 1965, but there were no trial plans for them yet. The trial plans were sent by sea mail. Jan van den Hoek was also due to bring a set, but he would arrive in mid-September. So, in August, the question was – what to do now? Dr. Stinson, a floriculturist, said that the bulbs should contain an immature flower. Several bulbs were therefore cut and they all contained around 0.5 cm of floral bulbs. It turned out to be an easy forcing year, a good way to start. The next decision was what to do with the tulip bulbs. Dr. Stinson said they needed to be in a cold environment, and a cooler was found and the bulbs were refrigerated at 9°C (48F).

On September 28, 1965 in East Lansing, Michigan the official contract was signed. As mentioned above, Jan van den Hoek, a young and knowledgeable bulb forcer started to educate Gus. In addition to forcing, he covered many details about the flower bulb industry. Jan was the son of Frans van den Hoek, who had a highly successful forcing company in 't Veld. Jan worked in Michigan from September 1965 until March 1966, and had, as he related later, a fantastic time with Gus and in the USA. Initially, he lived on the university campus, but soon he moved to the home of the De Hertogh family, where he almost became a family member. The friendship lasted for the rest of their lives. Jan became a technical assistant to the team surrounding Dr. Gus De Hertogh, which also consisted of Dr. Richard Stinson, who soon departed for Pennsylvania State University and Dr. Louis Aung, a Burmese Post-Doctoral student who received his PhD in Vegetable Crops from Cornell University.

She looks back fondly on a very nice period of her life.

Initially, there were no plant cases for forcing tulips. Jan started building special small wooden boxes like the ones they used at their company in 't Veld. Later, Mark De Hertogh, Gus' son, assembled them. Jan was responsible not only for part of the research, but he and Gus also visited growers in Michigan and Illinois. He even made his debut on the television, talking about the use of flower bulbs in the home. Some newspapers were also interested in the story of the young Jan from Holland. *The Detroit News* of April 28, 1966 published an article about the research program with a picture of Jan with a box of flowering tulips in his hands. And *The State Journal*

Ms. Connie Vandenberg-Berbee

For his research program in 1967, Gus De Hertogh had two young Dutch students to assist him. The* Bond van Bloembollenhandelaren *coordinated this project. The first two students were: Mr. Kees van Zanten and Ms. Connie Berbee.

They studied at Michigan State University from August 1967 to May 1968. Later Ms. Connie Berbee married John van den Berg, son of Bill Van den Berg, the father of the research program. They currently live in Florida, USA, but for many years they lived west of New York City. Connie also visited the USA for a greenhouse project during the first few months of 1966, where she met Gus De Hertogh, so they had already made contact before she started working on the Research Project. She remembers very well what kind of work they had to do. "We were there for the practical work: sorting out the flower bulbs for the right temperature treatment and checking for Stage "G", planting the bulbs and watering them. And when the tulips started flowering, we measured the flowering period from every cultivar. For me, it was a very useful period. What we did was really a better version of the "gebruikswaardeonderzoek". *The information in the Dutch version was not useful to the American grower, which was the main reason why the research in the USA began." According to Connie, the role of Jan van den Hoek was very impressive. "He is in fact the founding father of forcing knowledge in the USA. His father Frans played a major role. Jan advised Gus to test many more cultivars, because the range the growers were working with was obsolete and too limited."*
For Connie Berbee, the seven months gave her much satisfaction. She looks back fondly on a very nice period of her life. And after Connie and Mr. Kees van Zanten, many students from Holland followed.

of April 14, 1966 was quite clear about the research program:
Tulips in December

Jan forced tulips into flower in December. The first flower was 'Ralph', a yellow tulip, on December 22, 1965. After the first season, Gus De Hertogh declared that he had learned that the temperature treatment is the most essential part of a successful tulip forcing program, and that it is best to execute this treatment in the USA or Canada and not in the Netherlands. To gain additional knowledge about the possibilities of the many tulip cultivars, specific research was necessary. That was the reason why, since the beginning of the research program, assortment tests had been carried out. Even now, Dr. Bill Miller annually tests the newer tulips, hyacinths, and daffodils on their specific forcing qualities. This information was and still is very helpful for the North American forcer to produce fresh cut flowers and flowering potted plants from December to May. During the first year, Dutch exporters sent 13,000 tulips, 2000 daffodils, and 4000 hyacinths to Michigan. One year later, this amount had more than doubled.

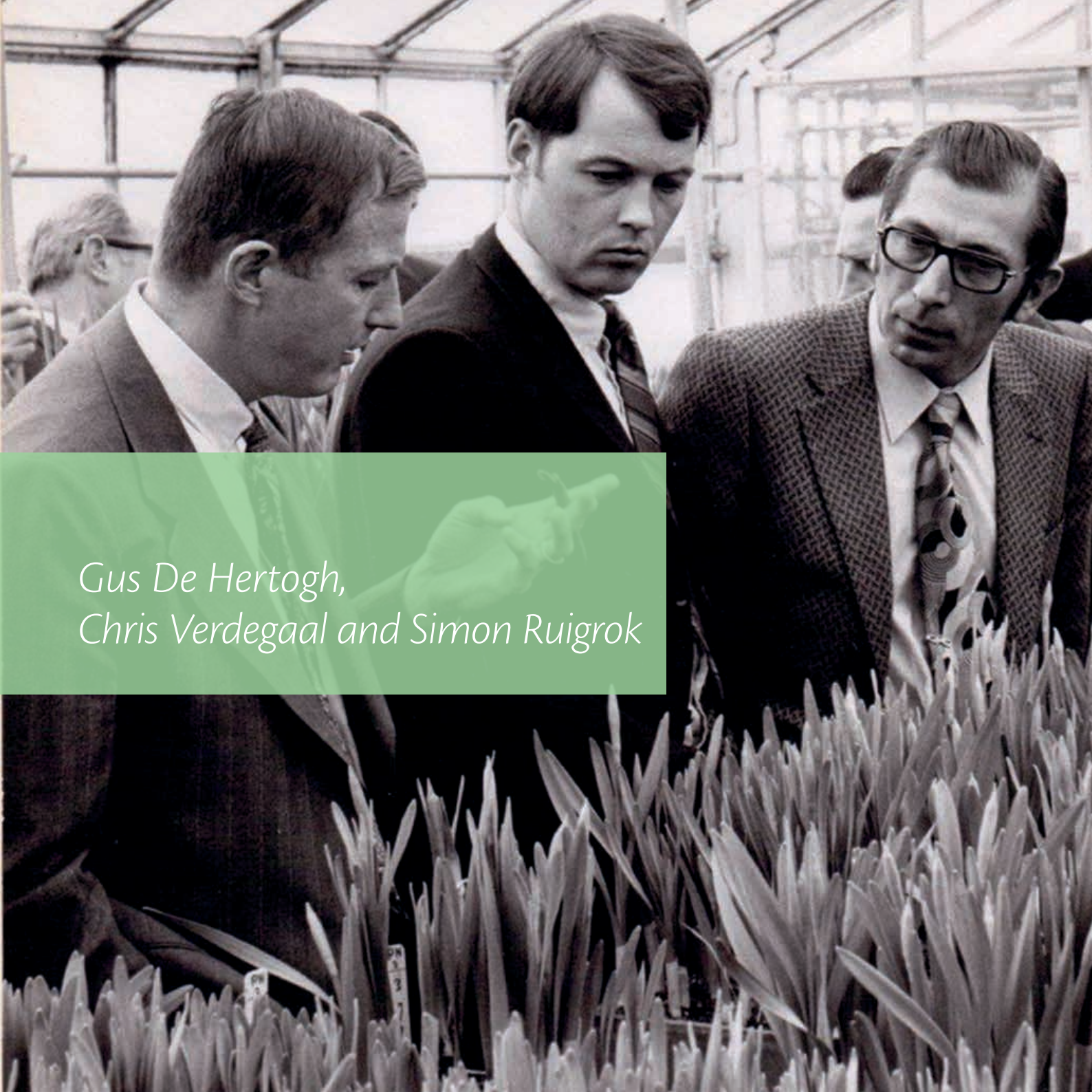
Jan did not go back to the USA as a technical assistant, but became part of The Florists Committee that was, founded in 1965, it was later renamed the Research Committee.

In 1976, Gus De Hertogh wrote an article for the *Westfriese Flora supplement* of the *Noord-Hollands Dagblad*. In this article, he looked back on the first years of what he called the "Dutch Marshall Plan". He told one impressive story about the knowledge of Jan van den Hoek. "No one in our team had ever looked at a tulip or a hyacinth. In our eyes, Jan had a fabulous knowledge of tulips. One time he took a few bulbs and looked at the label with their name on, which said 'Paul Richter'. According to Jan, this information was incorrect. 'These are 'Topscore' bulbs', said Jan. When they started flowering, we saw that he was right."

Dutch students

Back in Holland, Gus hoped that Jan could come back for another period of working at Michigan State University. In a letter to Walter Roozen dated July 19, 1966, Gus writes that 'he (Jan) has contributed so much to the program that I doubt if his value can be truly estimated.' But Gus had also understood that Jan's father Frans needed Jan for their own company in 't Veld. 'It is for this reason that I said we needed to find a replacement for him (…) I have too much respect and feeling for him to "use" him.' Jan did not go back to the USA as a technical assistant, but became part of The Florists Committee that was founded in 1965. It was later renamed the Research Committee. "In fact, this was a stroke of luck", says Gus De Hertogh now. "We had to do it ourselves and during the 1966-1967 season, we really learned about the forcer problems. It was therefore one great year, followed by a tough and challenging second year of forcing."

One year later, in 1967/1968, the first trainees came to Michigan. The idea came from "big" Kees van Zanten of Gebr. Van Zanten in Hillegom. Gus De Hertogh had dinner with the Van Zanten's in Hillegom and "'Big' Kees" van Zanten asked if he could send young Kees to work with the program for the upcoming season (1967-1968), as he needed the experience. Gus said we had never thought of this and would discuss the concept with the Florist Committee. He did and it was decided that two sets of hands would be best,



Gus De Hertogh,
Chris Verdegaal and Simon Ruigrok

so young Kees van Zanten and Connie Berbee were selected. From 1967 to 1995, a total of 42 Dutch students assisted at MSU and NCSU. In addition to the goal of accumulating a body of knowledge related to the forcing of Dutch-grown flower bulbs under North American conditions, there was another one, which was: to establish a source of practical and independent information that was readily accessible to U.S. and Canadian bulb forcers. At the very beginning, it was understood that printed material would be a primary tool for conveying information to all interested parties. That printed material became a major part of the project and will be described in this book.

A solid base

The first result of the cooperation between Gus De Hertogh and Jan van den Hoek was published in 1966. It was entitled "*Handbook for commercial growers of spring bulb flowers*". This small book forms the basis of all the subsequent forcers' guides that De Hertogh produced between 1970 and 1996. This basis was and is a firm one. In fact, this small publication of only 28 pages contained all the essential information about forcing. As Gus De Hertogh later explained, the growers needed this information very soon.

One year later, in 1967, a new publication was written by Gus De Hertogh. The title was much shorter: "*Bulb Forcers Handbook*". The total amount of the pages was doubled: 56 instead of the 28 the previous year. De Hertogh is, just as in 1966, not the only author. In Michigan, Dr. Louis Aung and Dr. William Carlson are co-authors, and from the Netherlands, A.F.G. Slootweg of the LBO is co-author. The subjects are the same as in the first small booklet, but the 1967 edition contains more background information about bulbs, the forcing and the development of the bulb, planting and rooting facilities. Information is provided about the forcing of tulips, hyacinths, and daffodils. In the appendix, you can find the optimum temperatures for the different selling periods.

In the same year, Gus De Hertogh wrote an article for The Florists' Review, an American magazine for professional flower producers.

One of the interesting characteristics of Gus De Hertogh is that he is a good writer and an enthusiastic communicator. In the Florists' Review article, he describes what the two major problems are in the USA with forcing flower bulbs. "It has generally been assumed that the methods recommended and the temperatures employed for bulb forcing in the Netherlands are directly applicable in the U.S. We know, however, that the growing conditions in this country are quite different compared to the Netherlands. (…) Another problem that growers face is that a lot of cultivars are available for either Valentine's Day, Easter forcing, or Mothers' Day forcing, and as a result, the different varieties must be handled differently for each flowering period. Just as with some other crops, mishandling and incorrect temperature treatments of the bulb can result in failures."

After 1967, De Hertogh started research on the assortment of tulips, hyacinths and daffodils, resulting in the first edition of the Holland Bulb Forcers' Guide in 1970.

Gibberelins, Plant Growth Regulators (PGRs) and Dahlias

After 1967, De Hertogh started research on the assortment of tulips, hyacinths and daffodils, resulting in the first edition of the Holland Bulb Forcers' Guide in 1970. There were two versions: a basic version, without cultivar information, and a version with the information about the most important tulip, hyacinth, and daffodil cultivars used in the forcing industry.

During the first year of his research, he and Dr. Aung also began investigations on the regulation of scape growth. Initially, the focus was on gibberellins. PGRs were added later. The main reason for this research was specific consumer demands in the United States and Canada. They not only bought fresh cut tulips, but also a range of flowering potted products. Hyacinths were very useful for this market, but it was equally interesting to look at the possibilities with tulips and daffodils.

Another early subject in the research program was a project for investigating which factors affected floral stalk elongation of flowering tulips. De Hertogh worked together with Maarten Benschop and Piet op den Kelder on this project. They were both students from the Landbouwhogeschool in Wageningen and two of the early students who helped De Hertogh with his research. The remarkable result of this project was that a tulip had the most firm growth in the internode directly beneath the flower during the period when the flower buds started coloring and the senescence of the flower. They also found out that if the

complete flower was removed and auxins (growth regulators) were applied as lanolin paste to replace the flower, the last internode was elongated in a manner similar to the intact flower. And so it became clear which hormones are responsible for the growth of the scapes when the tulips start flowering.
De Hertogh and his team not only examined tulips, hyacinths and daffodils, but also lilies. In 1969, he and Dr. Will Carlson wrote their first article about controlled temperature forcing (CTF) of planted Easter lily bulbs. Two years later they did a test on L. longiflorum 'Ace' and its reaction to gibberellin. This Easter lily and other high quality lily types were, and still are important for the American flower market

In 1972, Gus visited the Floriade in Amsterdam as one of its international judges. At this Floriade, he was impressed with the dahlias. It inspired him to start a new project: growing potted dahlias for home use. Much of this research was carried out by Dr. Jim Barrett, who became very successful as a Professor at the University of Florida.

The success of the Holland Bulb Forcers Guide of 1970 was so overwhelming, because it contained very practical information, that in 1973, a revised edition was published. Four years later, the second edition followed. In the same year, the research project at Michigan State University was terminated. The first twelve years were very successful, but it was time for a change. At the North Carolina State University (NCSU) in Raleigh, a new era of the Dutch-American Research Project began.

Kees Zonneveld

One of the last Dutch students at MSU was Kees Zonneveld, now co-owner of C.J. Zonneveld & Sons in Voorhout. Kees went to East Lansing with Kees Lommerse in the fall of 1976. To distinguish between the two Kees's, they were given nicknames "What a Kees" and "Such a Kees".

During a 12-year period, the research program had become just like a hard-working, well-oiled machine. "We saw Gus once, sometimes twice a week, when we didn't skip class. We were comfortable and Gus had his own responsibilities: research, publishing, teaching the class, maintaining industry contacts and consultancies. He remembers that when he and Kees Lommerse arrived, everything was ready for their seven-month period. "The apartment had been rented and the binder containing instructions and experiments was waiting in the lab. Planting of the first potted bulbs began the next day on the farm".

In the lab we were joined by Tim Prince and Jim Barrett. Jim was finishing his PhD research on Tuberous Dahlias, which were grown as a flowering pot plant. This work truly encouraged the export of Dutch-grown dahlia tubers during the years to come. With regard to vision, an additional market was also developed for this traditional garden plant.

Together with Gus's technical assistant, Mr. Norman Blakley, we spent most of our time across the street: in the greenhouse complex, on the farm and of course, during lunch break, at the Dairy Lab where we became the taste panel for the yoghurt and cheese products developed and produced on campus.

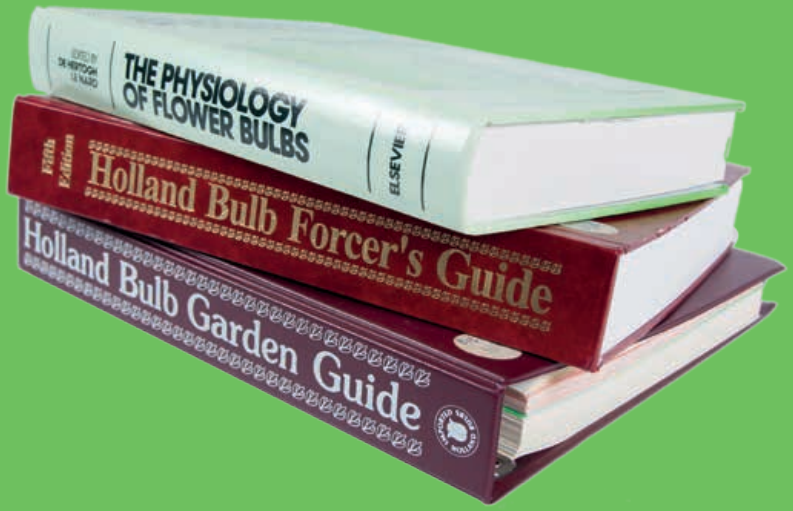
1978

Kees Zonneveld
and Kees Lommerse

In addition to all the tulips, hyacinth and specialty bulb experiments, I got intrigued by Gus' work on Lilium longiflorum 'Nelly White', counting primordial leaves to predict and control blooming date. This was relevant information for the grower. With that information, a grower could time his crop properly, which was quite a job because the physiological age of lily bulbs, as well as Easter itself, are not scheduled on fixed calendar dates. Crop timing in the US is crucial, as most floral business is geared around specific holidays. If you are two days late, good market opportunities will have evaporated. This makes all the schedules in the Forcers Guide, originating from many repeated experiments through the years, so important.

Kees Zonneveld also worked on the remnants of the perennializing trials at MSU. This project, resulting in the Holland Bulb Garden Guide*, was published in 1982 (see next chapter).*

The period at MSU meant much more to Kees Zonneveld than just bulbs. Back in Holland, he began his studies at the former Landbouwhogeschool in Wageningen, now the Wageningen University and Research Centre (WUR). "For me, working with Gus on the Research Project was a real eye opener. To learn and inspire, that is what I still want to do, in today's business environment.


THE PHYSIOLOGY OF FLOWER BULBS
ELSEVIER
Fifth Edition
Holland Bulb Forcer's Guide
Holland Bulb Garden Guide

Changing universities
and directions

1978 to 1998

1978 to 1998

Changing universities and directions

Changing universities is not really necessary in the United States. Every state has at least one land-grant university, but sometimes it is possible for a scientist to go to another university. And so Gus De Hertogh did this in 1978 and, in the late nineties, Bill Miller did the same thing, in order to head up the Flower Bulb Research Program at Cornell University.

For Gus De Hertogh, North Carolina State University (NCSU) in Raleigh was nothing new. He had graduated from his Bachelor degree in 1957 and his Master's degree in 1961. The Department of Horticultural Science at NCSU is one of the largest in the world, with over forty faculty members. In 1977, they began the search for a Head of Department, explains Gus De Hertogh. "I was approached by the Floricultural Faculty to apply for this position, which I did, and I accepted the position in the fall of 1977."

This step was not just important for him as a person, but also for the Research Program, he explains. "This step allowed me not only to bring the bulb research program to NCSU, but also to involve many faculty members, staff, and students in my research program. These people gave the program a wide range of expertise. For example, Dr. Paul Nelson, a world-renowned scientist, conducted research that developed "bulb booster". Gus De Hertogh also evaluated the perennialization of tulips, hyacinths, and narcissus in three climate zones and with three soil types. As Head of Department, Gus De Hertogh was also challenged to develop the department into a "world-class" unit. These changes have had long-lasting effects. For example, Gus De Hertogh hired Dr. Sylvia Blankenship who was a co-developer of 1-MCP, which can be used to protect tulip bulbs from ethylene." This 1-MCP is now sold in the Netherlands as FreshStart for use in tulips and SmartFresh in apples to eliminate the risks of too much ethylene.

In North Carolina, the level of the research that Gus has carried out has remained high, he says. "We used the NCSU Phytotron to study *Hippeastrum* (Amaryllis), Oxalis, and other bulbs. We also increased the evaluation of *'Bulbs for the Garden and Landscape'*, started by

the late Maarten Benschop at MSU in 1968. Looking back, Gus De Hertogh concludes that the transfer of the research program from MSU to NCSU was beneficial to science and industry."

Field-grown flower bulbs

During the period in which the research program was shifted from MSU to NCSU, the second edition of the Holland Bulb Forcers Guide was published. In this second edition, which came out in 1977, the results of twelve years of intensive research on the forcing of tulips, hyacinths and daffodils were presented. Looking at the amount of cultivars, there was an increase in fresh-cut tulips, potted tulips and potted daffodils. It is clear that the market for potted bulbs was becoming the most important part of the flower market in the USA. Also new in the second edition was the advice to use the plant growth regulator ancymidol. For every cultivar, the guide mentions in which period ancymidol is needed. This period is cultivar specific. The basis for this information was research started by De Hertogh at the beginning of the 1970s at MSU. The reason for using ancymidol was clear: The group of cultivars used for forcing on pots became much bigger, and the grower had a way of controlling the ideal market height with ancymidol.

Furthermore, this edition contained information about using flower bulbs in patio gardens and flower bulbs for commercial cut flower production in the field. In 1977, the range was rather small. Some useful bulbs were Allium aflatunense, Ixia, and Brodiaea. In addition, there was specific information about hydroponic usage. The source of this idea came from glass houses were tomatoes were grown on hydroponic systems. De Hertogh sought possibilities for using this system for flower bulbs as well.

He learned so many things about this typical Dutch flower bulb that at the request of Prof. Dr. San Wellensiek in Wageningen, he started to write a scientific monograph about the tulip.

Tulip physiology

For Gus De Hertogh, the tulip was his main study object. He learned so many things about this typical Dutch flower bulb that at the request of Prof. Dr. San Wellensiek in Wageningen, he started to write a scientific monograph about the tulip. It was published in 1983 and written by De Hertogh, Aung and Benschop. In 80 pages, they wrote everything there was to know about the scientific aspects of the tulip.

One of the interesting subjects in this publication was the information about '*ijstulpen*' - tulips which are stored for over a year to use for forcing in fall a year after the bulbs were harvested. This approach was jointly developed by Dutch and American researchers and growers.

Informing the consumer

In 1982, another extensive publication was published: *The Holland Bulb Garden Guide*. Although the Research Committee's focus was to increase the commercial forcing of flower bulbs, there was also some money set aside for the dry bulb market. In the 1970s, De Hertogh started with a keen research subject: he was looking for possibilities for flower bulbs in the different climatic zones in Canada and the USA. Here you can apprehend the benefit of having a good network of fellow researchers. De Hertogh asked researchers in fifteen locations to collaborate in this project. The idea was not a new one. In the 1960s, the Dutch flower bulb industry initiated a project at 18 locations with 155 tulip cultivars. This study had a much wider spectrum of bulbs and included crocuses, daffodils, Muscari and Fritillaria. An interesting aspect of the study was the perennialization of many of the tested flower bulbs. One year after planting, the researchers recorded the perennialization habit of the bulbs. In fact, the information in this publication was the first step towards the bigger project of the 1990s, coordinated by Mr. Frans Roozen of the International Flower Bulb Center (IBC). The subject was the same, but the scope much wider: not only the USA and Canada, but also different climates in Europe. Many more spring flowering bulbs were tested.

Another result of this long-term project were the many publications by the IBC about landscaping and the use of flower bulbs for this purpose, which found their way to many cities, landscapers, and public gardens.

Informing the flower bulb forcers

Research was needed, but the crucial element was to inform the growers of forced flower bulbs about the results in order to increase the market for bulbous flowers produced from Dutch-grown flower bulbs. Looking back at this period, Leo Berbee is clearly convinced that "It worked". The Dutch traders in the USA used the information of the Flowerbulb Research Program when they visited their customers. Every year, there was a meeting with Gus De Hertogh.

1989

Research Committee

Henk Stuifbergen, Philip van Bourgondiën,
Frans Roozen, Gus De Hertogh,
Kees Zonneveld, Nic Zonneveld,
Lena Gallitano and others.

Frans Roozen

Frans Roozen began working for the IBC in 1975. The IBC's main task was to promote the use of flower bulbs for professional flower production and for use in home and garden, the so-called dry sale. In 1983, Frans Roozen also became a member of the Research Committee as an advisor, just like Jan van den Hoek.

Later Rob Bogers, the director of the LBO also became an advisor. Every year they travelled to the USA for the Research Committee meeting and to see the trials in the greenhouse. They also visited growers to see the North American forcing practices. After the annual Research Committee meetings in Raleigh (NC), it was a good custom to have dinner in "The Black Angus". Gus always made sure that the Dutch interns brought enough bunches of cut tulips, which we gave to the waitresses. Later, in Ithaca, we always went for dinner at "The Boatyard".

In the Research Committee, most research focused on professional flower production, but the dry sale exporters also paid for the research program and wanted more research that focused on their market. According to Frans Roozen, that was the main reason for the follow-up to the Holland Bulb Garden Guide. *"I talked with Gus De Hertogh about promoting the dry sale of flower bulbs. The result of that conversation was the great perennialization project. The project had a wider scope than Gus's first project. Bulbs were planted in the United States, in many countries of Europe (from Sweden to Spain), and in New Zealand. The range was also bigger than the first time. Also new was the idea of using bulbs for landscaping. Of course, it was interesting for gardeners to know which bulbs could be used for perennialization, but there was another interesting market: cities that had parks and public gardens. Normally, they used flower bulbs like they did in Keukenhof. Planting took place in the fall, followed by flowering in spring. After flowering the bulbs were lifted and thrown away. The new idea was to create plant combinations that would be successful in subsequent years, which also gave rise to a new perspective: combining spring flowering bulbs with perennials. In the Netherlands the exporters together with the growers built up a new market for perennials, and the exporters to the USA anticipated on this development and created a large market for bare root plants of Hosta, day Lily, peony and many more varieties of perennial plants. One of the most impressive results was planting the gardens at the White House. Our representative for promotional activities in the USA, Ms Sally Ferguson, played a very important role in this accomplishment. Three first ladies baptized their own tulip during that period: Mrs. Barbara Bush, Mrs. Hillary Clinton and Mrs. Laura Bush. The whole world was looking for Dutch tulips."*

He presented the results of his research. In fact, one day later we were able to report them to our customers." As a young man, Leo Berbee and his brother Jan attended the undersigning meeting in 1965. Along with three of his brothers, he became a member of the board of Leo Berbee & Zn, an amaryllis bulb and flower production company by the name of Ludwig & Co., and an extensive bulb trading company in Lisse. His brothers Henk and Jan emigrated to the USA and Canada, and Leo and Ruud stayed in Lisse. For many years, Henk and Jan were busy with the sales of flower bulbs in the USA and Canada. Jan's death made it necessary for Leo to travel to the USA again. "In 1980, I started travelling to the USA again, fifteen years after the start of the research project. I was impressed by the quality the forcers produced. They worked with a forcers' scheme and had invested in pre-cooling and cooling (rooting room) facilities. Both were the result of Gus' research.

He brought structure to forcing. He gave useful information about the temperature treatment the flower bulbs needed for specific days such as Valentine's Day, Easter and Mother's Day. The firm base for this information was laid by Jan van den Hoek, and Gus developed it further. He advised the growers to build precise bulb storage facilities. With a cooler, they were not dependent on the weather. Frost or snow were no longer barriers for the forcers. They stored their bulbs in a pre-cooler and not outside. The research on the use of flower bulbs for forcing caused the market to grow and made it much more stable. And Gus De Hertogh's position was clear: forcers working with flower bulbs knew the way to Michigan and after 1977, to Raleigh. He was their source of information and organized meetings where he informed them about the latest results. So the same information came from two sides: from the Dutch traders and from Gus. And this information reached the owner of the company and their growers. In many companies these were two different positions. The owner was mainly the person who sold the pots and cut flowers, and the grower was the person who had to grow them. It was very important that the latter was well-informed about the new results of Gus' research."

Gus De Hertogh was not only the source of information for growers and traders, but he was also consulted by USDA/APHIS if they had specific phytosanitary problems. It helped to solve problems quickly and easily.

NAFWA

In 1983, a new initiative gave a firm boost to the research project and the marketing of flower bulbs. In this year the North American Flowerbulb Wholesale Association (NAFWA) was founded in Chicago, Illinois. In fact, it was the successor to the Horticultural Dealers Association, which had been dissolved a few years earlier. NAFWA comprised of two types of members: Full and Associate. Full members were the North American-based flower bulb importers and wholesalers. Associate members were allied organizations, such as Karl Schroff and Associates, which produced and/or exported bulbs or which provided essential needs of the flower bulb industry, such as shipping.

One of NAFWA's goals was to coordinate and support marketing and research needs for North America. Because of their annual financial support to the Flowerbulb Research Program, NAFWA was allowed to appoint a representative in the Research Committee. Members throughout the years were Mr. Jack Zonneveld, Mr. Dick Smith, Mr. John Langeveld, Mr. Andrew Lee, Mr. Jan Doornbosch, Mr. John Vandenberg and Mr. Ron Beck.

NAFWA also started to organize annual membership meetings. Research was an important topic in the program of the two-day event. Gus De Hertogh and later Bill Miller had the opportunity to present the results of their research. A tour to the glass house was a standard part of the program. When the program moved to Cornell University, the meeting took place in Ithaca every second year. Various trade companies used the NAFWA meeting to organize meetings with their sales teams. The NAFWA meetings were a big success and the sales representatives were well- informed about the research results.

Joost Pennings

"Jan-Willem van Straten and I received a warm welcome when we travelled to Gus De Hertogh in September 1992. We both completed our studies at the Rijks Middelbare Tuinbouw School in Hoorn, and this school asked us to participate in the research program.

We had an apartment near the North Carolina State University campus. We worked on different projects, like the testing of the newer cultivars of tulips, hyacinths, and daffodils for the American market, but we also worked with some other crops such as Astilbe *and* Chasmanthe*. Lena Gallitano was the lady who gave the daily instructions, but there was also regular contact with Gus De Hertogh. It was a very interesting period for Jan-Willem and I. The most important thing I learned was the great importance of a high quality level of flower bulbs that we export to the USA. Working here showed me the last part of the product chain, and that opened my eyes. I also learned that not every flower bulb is suitable in the USA. And those nine months were enough for many friendships, including the one with Gus De Hertogh and his wife Mary Belle."*

1992

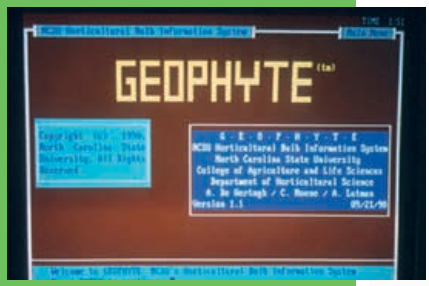
Lena Gallitano, Jan Willem van Straaten and Joost Pennings

Bigger and bigger

In 1985, the third edition of the Holland Bulb Forcers' Guide was published. Again, it was bigger than the earlier editions. It now had a totally new format and was divided into five sections. It resembled a bible and in fact, it almost was an actual bible for many growers and other professional users of flower bulbs. The third edition consisted of 284 pages. Some of the sections were already known, such as general forcing information and forcing of rooting room bulbs. Some of them were new such as forcing of non-rooting room bulbs and special forcings, and some of them had expanded, like the part on outdoor cut flowers.

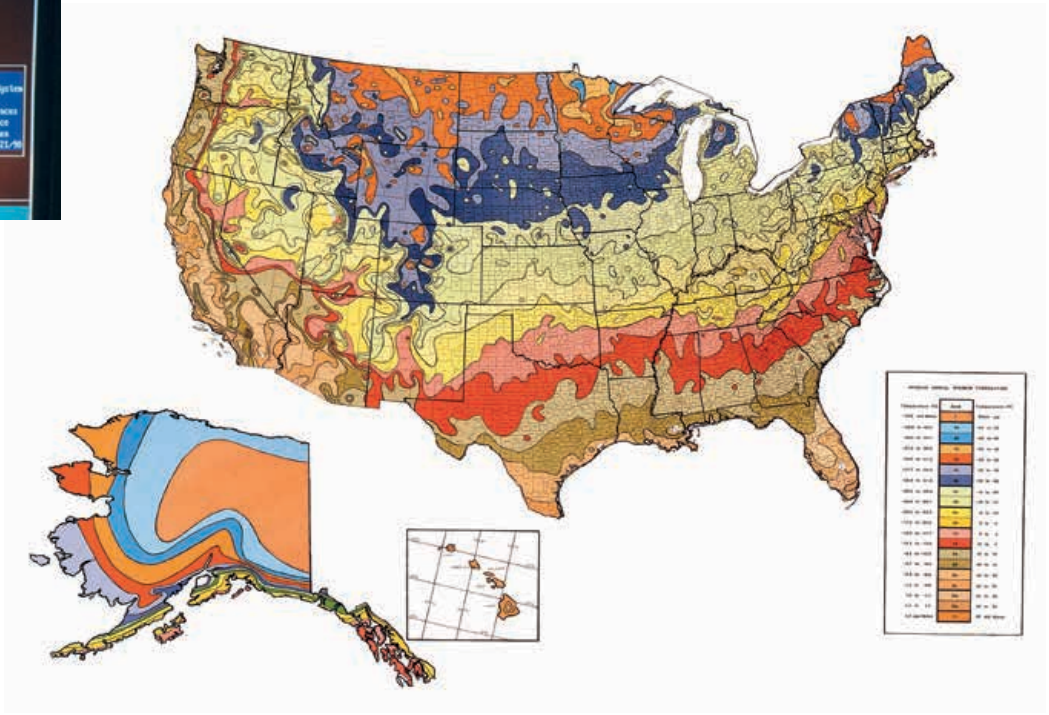
The content of this third volume was like a complete handbook for the bulb, and contained everything that related to the production, forcing and marketing of these bulbs. The first part of the book contained information about the inside of the bulbs, about the best time for harvesting flowers for the market and information about the most common diseases.

The section about non-rooted room greenhouse forced bulbs is about bulbs such as *Hippeastrum, Caladium,* dahlias and *Zantedeschia* or calla lily. These flower bulbs do not need to be treated in the rooting room. In section E, Gus writes about hydroponic forcing and the so-called Eskimo tulips or "*ijstulpen*".



1990

Geophyte: a computer program developed by Gus De Hertogh and the USDA Climate Zone Map

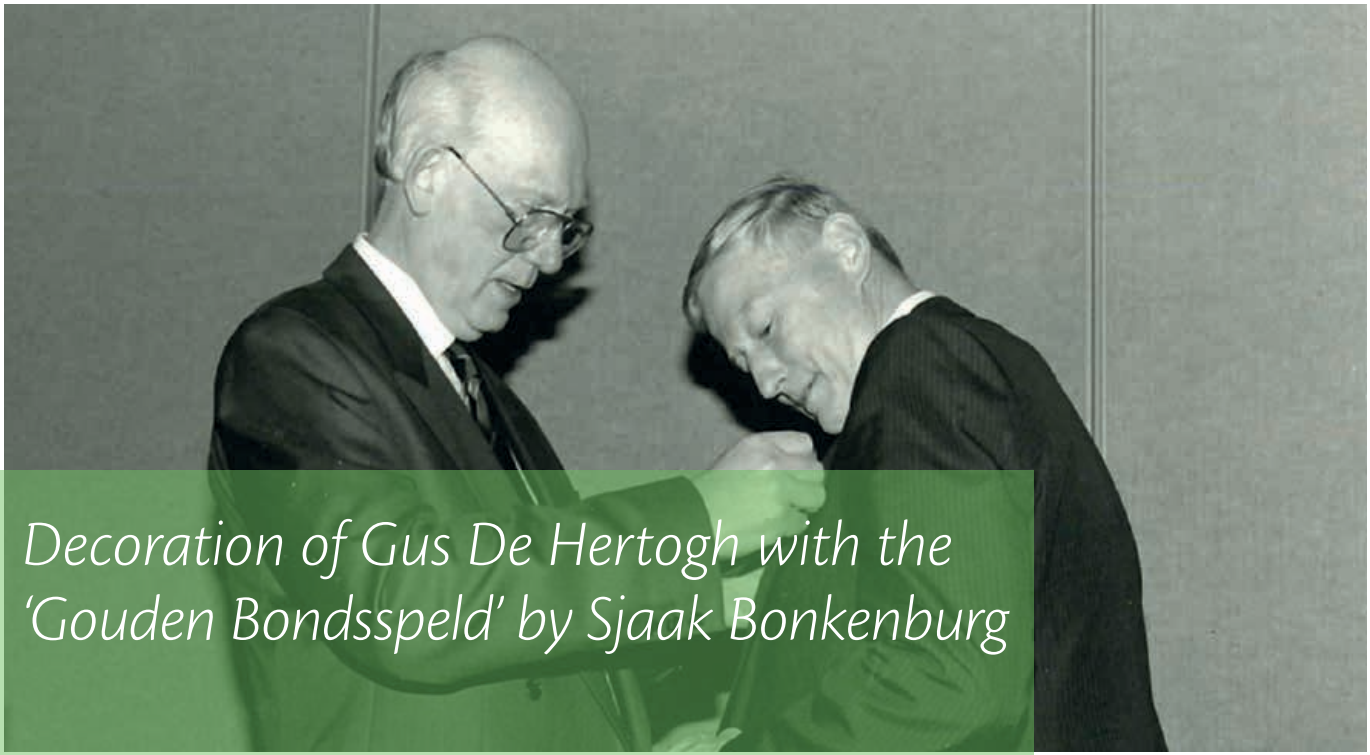


Hydroponic forcing is the production of flower bulbs on water in specially designed hydroponic containers. In fact, it resembles the practice with hyacinth vases, but now on a large commercial scale. Flower bulbs suitable for this specific goal are hyacinths, tulips, and 'Paper White' narcissi. Four years later, the fourth edition was published. This one has the same framework as the third edition, only the number of pages had increased to 369 pages.

Geophyte

De Hertogh not only worked on articles and books, but he also developed a computer program called Geophyte™. This program was developed for garden centers, flower bulb exporters, and landscape architects at the very beginning of the 1990s. The program contained information about the use of flower bulbs and perennials in many specific situations. If you need to know which plants you could combine in a half-shade garden in climate zone 7, when planted in spring, the program gives a list of about forty flower bulbs and perennials, such as Begonia, Scadoxus and Canna. Additional information is provided for every crop, such as the correct pH level, height, scent and water requirement.

Not every publication was a success. In 1994, De Hertogh told me about a report called 'Basic criteria for selecting flower bulbs for North American markets'. For each flower bulb, he reported the strong and weak points for the garden, potted plant and cut flower



Decoration of Gus De Hertogh with the 'Gouden Bondsspeld' by Sjaak Bonkenburg

usage. The Dutch bulb breeders never used this report. "It was my biggest flop", De Hertogh concluded. The results are described on pages 8 and 9 in 'Ornamental Geophytes - From basic science to sustainable production', edited by R. Kamenetsky and H. Okubo.

Gus' Awards and Honors

In 1985, the Dutch government granted Gus De Hertogh a medal of honor (Manhouts Medal) for his efforts on behalf of the Dutch flower bulb industry. In 1988, an intense blue hyacinth from C.J. Ruigrok was baptized by Gus and received the name 'Professor De Hertogh'. Also, in 1988, he was inducted into the SAF Floriculture Hall of Fame. Then in 1990, he and his wife Mary Belle baptized the tulip that was grown by M.C. Zonneveld 'Mary Belle'. It is a sport of 'Margot Fonteyn' and is very suitable for forcing as a pot tulip. In 1990, the *Bond van Bloembollenhandelaren* awarded Gus the "Gouden Bondsspeld". In that same year, he was awarded the "Nicolas Dames Medal", a highly prestigious award. In 1996, De Hertogh received the Silver Tulip from the IBC.

Through the years, Gus worked hard and his research also generated a global network with fellow researchers. Many researchers in the world who worked with flower bulbs became affiliated with the research program. The result of this network was the publication of *The physiology of flower bulbs* in 1993, a massive 812-page book, which was edited by Gus De Hertogh and his friend Marcel Le Nard.

1987

Research Committee
Gus De Hertogh,
Pieter Vermeulen,
Rob Bogers,
Dolph Westerbeek,
Nic Zonneveld,
Simon Ruigrok,
Philip van Bourgondiën,
Bruce Kapteyn and others.

It's still a reference for everyone who wants to know more about the physiology of a very wide range of flower bulbs. It doesn't just cover the well-known species of flower bulbs, but also specialty crops such as *Caladium, Nerine, Polianthes* and *Ranunculus*. Two chapters cover the smaller spring and summer flowering bulbs, such as *Chionodoxa, Galanthus, Eremurus, Eucharis* and *Ornithogalum*. This book also contains a comprehensive list of scientific literature about all these crops.

The book is not just the result of the work of the research committee, but is also an interesting spin-off for the international flower bulb research and industry. One thing is remarkable: the input from the Netherlands is relatively small. The only five Dutch authors are W. de Munk, M. Benschop, J. Schipper, G. van Brenk and C. de Vroomen. The other 25 came from other countries.

Redwood pine

In 1996, the fifth and last edition of the *Holland Bulb Forcers' Guide* was published. Again, it was more comprehensive than earlier editions. This edition covered thirty years of research by Gus De Hertogh and his colleagues. The tree cited in his work had grown from a young tree in 1965 to a massive redwood pine in 1996. This edition was a bound one and had 570 pages. The book was divided into five chapters, just like the two earlier editions. Section A contains everything you need to know about flower bulbs and how to treat them for flowering in winter and early spring. Complete preparation for forcing is also described here. Section B covers the rooting room and how to work with it. All the flower bulbs you can use for fresh cut flowers or pot plant forcings are described. Information is also provided about spring gardens and spring flowering bulbs for bedding plants and outdoor container usage. In fact, the basic idea for planting forced flower bulbs in pots in the garden in spring originates here. Of course, this chapter also contains a

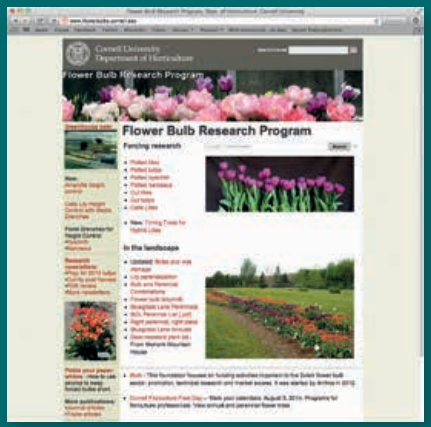
Peter Breed

One of the many students in North Carolina was Mr. Peter Breed. Together with Mr. André Rutte, he worked at NCSU in 1989/1990. Both were students at the Rijks Middelbare Tuinbouwschool in Lisse. The main work they did was the forcing of new cultivars.

"This work was necessary for the new edition of the Holland Bulb Forcers' Guide. We worked not only with tulips, hyacinths and daffodils, but also with calla lilies and Amaryllis (Hippeastrum). *I remember that in the beginning, we were deeply impressed by the immense surroundings of the North Carolina State University."*
Peter remembers Gus De Hertogh as an inspiring teacher, but most of the time they worked with one of his assistants, Ms. Margaret Tilley. "She taught us all the techniques of doing research. We had a very nice time, learned a lot, and the results of trials we performed were published in the Holland Bulb Forcers' Guide."
For Peter Breed, becoming acquainted with the United States had a great influence on the rest of his life. He came back a few years later to study landscape design at Tidewater Community College in Virginia. Once he had completed his studies, he became head gardener on a private estate and the owner of Orchid Classics, a breeding and wholesale company of orchids.

great deal of information about the usable and available range. In the list of potted tulips, you can find the breeding results for this specific aim. Cultivars such as 'Spryng' and 'Lydia' have their place in the list. Section C discusses flower bulbs you can use for flower production without a specific preparation. This information is not new, but cut flower crops such as Alstroemeria, Dutch Iris and paper-white narcissus and pot products such as *Convallaria, Oxalis* and dahlias are now covered. All these products are for growing in a glass house or plastic tunnel, not for in the open air. Crops for that purpose are discussed in Section D and include Alliums, gladioli, *Ixia* and *Polianthes*. The last section includes information about special forcings. The three subjects here are hydroponic forcing, ice tulips, and summer flowering bulbs for hanging baskets, and flower boxes. These were new perspectives for the use of flower bulbs. A lot of work for the marketeers, he writes. Some parting words of the man who made the first thirty years of the research committee an impressive success. It was time for a change.

Looking back on this intensive period of flower bulb research in the USA, Gus De Hertogh concludes that there were two factors that led to the success of the flower bulb research program at Michigan State University and North Carolina State University. "First, I was given freedom to conduct practical and basic research in order to solve problems the industry was being confronted with. And second, the research committee under the Chairmanship of Bill Vandenberg understood that the major objectives of a land-grant university are research and education. So whilst we had open discussion at the committee meetings, I ultimately made the final decision regarding the research to be conducted. All these results were used for the five editions of the Holland Bulb Forcer's Guide and *the Holland Bulb Garden Guide*, and also in the many Holland Bulb Technical Services Bulletins that were published."


Cornell University
Department of Horticulture
Flower Bulb Research Program
Flower Bulb Research Program
Forcing research
In the landscape

The Cornell years

1998 to 2015

1998 to 2015

The Cornell years

Ending the relationship between a person and a university is one thing; starting a new one is another. After thirty years, Professor Gus De Hertogh finished working on the research program. But who could take over the job? And, even more important, which university was interested in this particular project?

Only in the USA almost every state has its own university. And at many universities, researchers were interested in gaining some extra budget for their department. What else could the Research Committee do but visit serious and interested candidates? At the Anthos office in Hillegom, the Research Committee carried out a lot of homework, thinking about and discussing the specific goals and determining how to continue the project. The research was not only to focus on forcing, but also on dry sales; not just on potted plants, but also on cut flowers; not just on spring-flowering bulbs, but also on summer-flowering bulbs; and not just on flower bulbs, but also on perennials. The Research Committee published an advertisement which appeared in July 1996 in the ASHS Newsletter in the United States, and seventeen universities responded. After reviewing them, five were selected for the second round and an itinerary was scheduled. Time to visit them was relatively short. In just one week (February 2-9, 1997), the following five universities were visited: Cornell University, Michigan State University, Ohio State University/ Oklahoma State University, Colorado State University and the University of California. The Selection Committee consisted of the following people: Henk Westerhof (Chairman), Frans Roozen (secretary), Ruud Westerbeek, Henk Stuifbergen and Andrew Lee. As a consultant, Jacques Beijersbergen, director of research institute LBO in Lisse was added. He was not just a keen researcher, but also an eminent piano player, which he displayed during the trip in every bar or restaurant whenever a piano was present.

The selection criteria were clear and focused on issues such as knowledge of and experience with practically orientated research on flower bulbs, bulbous flowers and perennials, availability of facilities, collaboration with other institutions and organizational and financial aspects of the program. The committee used these criteria during their trip within the USA.

1997

Signing of the Cornell contract Bob Langhans, Leo Berbee, Dean of Cornell University, Andrew Lee, Henk Westerhof, Bill Miller and others.

What followed was an intensive program, a meeting of many people, and discussions concerning a wide range of aspects in relation to flower bulb research.

Henk Stuifbergen and Ruud Westerbeek remember the trip very well. Henk Stuifbergen was lucky, as he was already in the USA when the tour started. Ruud Westerbeek and the others traveled from the Netherlands to Cornell. "It was a week of listening, eating, traveling and a little bit of sleeping", explains Ruud Westerbeek. "Every day we visited one of the five universities selected. Each university aimed to show the best it had to offer. Nothing was too much, but time was limited. At Cornell, Bill gave a rather technical lecture. Cornell promised to invest in new greenhouses and pre-coolers if they were to be rated number one."

Dinner was ready at each university. One of the most spectacular dinners was in Ohio, remembers Henk Stuifbergen. "Flowers were the main ingredients of this dinner."

Each university had its specific positive and negative aspects. The climatic conditions in California and Colorado were not optimal for flower bulb research.

After the trip, it was time for the Selection Committee to make up its mind. This had to happen rather soon, because a NAFWA conference was due to take place two weeks later. "Everyone was eager to hear our decision." remembers Ruud Westerbeek.

Of the five candidates, three remained: Cornell, Michigan and Ohio/Oklahoma. In the end, it was a close tie between Cornell and Michigan. The latter was a strong candidate, but the opinion at Michigan to appoint a specific researcher for this project was clear: we work with a team of researchers and that's all. Henk Stuifbergen explains: "We as exporters had to be aware of the fact that we might have less influence on the program than we had in the past. That was the main argument for not choosing Michigan".

So, in the end, Cornell University stood the best chance. As the committee wrote in its final report: 'Cornell University is also the most interesting partner from a financial point of view. (…) Cornell has an extremely long and prestigious horticultural tradition and offers a very attractive financial package for all parties concerned. Cornell University has research stations in various climate zones and the university is located in the proximity of a large number of growers and bulb import/export companies in the U.S.'

The selected researcher was Bill Miller, son of a lily grower. He had already been working with flower bulbs for a long time, and had written the chapter about Lilium longiflorum in *The physiology on flower bulbs*.

And so the research program started in 1998 with a new man at a new location. Not only had the location and the person changed, but the way of sharing results was also new. The time of massive books with results was over. The computer was as normal in many companies as a coffee machine, so the results were communicated by newsletters sent by e-mail. And Bill Miller started to summarize his results on CD-Roms instead of paper reports.

Over the past few years, the Research Committee has developed a website where all research data can be found. Nowadays, the website *http://www.flowerbulbs.cornell.edu* is the major source of information for American and Canadian growers. This website also integrates the results of the research performed by Gus De Hertogh. Four times a year, Miller sends a newsletter to the growers. All these newsletters are also available on the website.

Special program

Senior researcher Henk Gude of the PPO in Lisse has been a member of the Research Committee since 1997. His task is to discuss and comment on the wishes of the exporters in the Research Committee and to discuss if their research ideas are likely to generate the anticipated result. Henk has been working as a researcher on plant physiology for a long time now, and has a good overview of the research of the last thirty years. According to Henk, having a program like this is rather unique. "This is a special program. The research is very market-orientated and primarily focuses on ensuring that North American growers are supported in making bulb forcing or producing potted perennials a profitable part of their business. It is therefore very beneficial that this is carried out in the USA. Flower bulb exporters can use the information to advise their customers straight away.

Over the last 50 years, research has been carried out on growth regulators. Henk understands the reason for so many years of research on this particular topic. "In the USA, it is much more important than in the Netherlands that the bulb flowers or potted bulbs can be delivered to the buyer at exactly the right time and with the required height. It's therefore very important that the growers have access to the latest information. What's more, growth regulators come and go and sometimes there are ideas about new applications. Henk Gude explains: "A good example is Bill's research on Florel, which was used as a spray on potted daffodils for height control, but Bill started research on the effect of drenching the daffodil pots with Florel, which resulted in much shorter plants."

Henk Gude collaborated with Bill Miller on a project called 'the re-growth of bare-root perennials'. Testing different perennials that were planted at different depths proved that many North American growers planted their perennials too deep, which was not necessary, as Bill Miller concluded. And this advice saved North American growers a lot of money.

Pickle your paperwhites

Every researcher wants to claim his fifteen minutes of fame, and Bill Miller was lucky to do so. Starting in 1998 at Cornell, he worked on testing the newer range of flower bulbs for forcing possibilities. But there was also time for some other ideas. And so the story of using alcohol for shortening paperwhites started. Thousands of flower bulb lovers will 'force' paperwhites indoors so they can enjoy their flowers during the darkest days of the year. And thanks to an undergraduate research project carried out by Erin Finan

The Selection Committee , Henk Stuifbergen, Jacques Beijersbergen, Andrew Lee, Frans Roozen, Henk Westerhof and Ruud Westerbeek with Bob Langhans of Cornell University

(2005) under the supervision of Bill Miller, many of those bulb forcers won't have to stake, tie, or otherwise support the usually floppy paperwhites. It all started when Leslie Land from the *New York Times* asked Bill if folk wisdom was true that adding liquor to water that was applied to forced bulbs would keep them shorter and less likely to fall over. Bill answered that it should be possible. Alcohol has a shortening effect on plants, but this specific combination of paperwhites and gin had never been made. With the help of Erin Finan, Miller started running experiments. Land writes in The New York Times:

'To summarize, what they discovered is that stems will end up roughly a third shorter than normal if you take the following steps:

Start by placing your bulbs in plain water. When roots have formed and the green shoot is 1 to 2 inches long, pour off the water and replace with a solution of 4 to 6 percent alcohol. If you are using 80 percent liquor (40 percent alcohol), that works out to one part gin (or similar) to 7 parts water. Keep the beer and wine for yourself, as their sugars damage plants.'

Since 2005, the results of Erin's simple experiment have featured in various magazine articles, gardening columns, newscasts and blogs around the globe, including Parade Magazine, der Spiegel and CNN. How successful can you be?

When Bill started in 1998, he said "Tulips are salad for deer."

Voles and deer

For most growers and exporters in the Netherlands, deer are nice animals that live in the dunes and forests. Only in the Bulb District their increasing population has become a problem over the past few years. But in the USA, deer have already been a problem for decades. Deer are fond of flower bulbs in the garden, so if you have planted over one hundred dollars' worth of bulbs in the fall, you will not be happy if deer eat most of them. When Bill started in 1998, he said "Tulips are salad for deer." In the North East in particular, tulip sales were declining due to the ongoing deer problem. One of the first projects the Research Committee asked Bill to perform was to look for flower bulbs disliked by deer, which is what Bill Miller did. He planted many spring-flowering flower bulbs in pots outside the greenhouse. With the help of the IBC, a range of specialty bulbs was selected. Around 50 species were planted in over 3000 pots. Bill explains: "The idea was to expose them to the natural coldness of winter then place these plants in the landscape in the spring and monitor deer feeding activity."

But something unexpected happened. On March 6, 2000, when pots containing the bulbs were uncovered, the researchers discovered another animal. "During the winter, prairie voles had taken up residence in the stacks of export crates and eaten more than 35% of the bulbs", Bill explains. The experiment had not failed completely. It was already known that voles have similar tastes to deer. And so it was even possible to present some results.

The hyacinths and daffodils were pretty immune to voles, whereas tulips displayed major differences when it came to vole palatability. Some of them were totally destroyed, such as the 'Angélique' and 'Tulipa turkestanica', whereas others were heavily injured, such as the 'Monte Carlo' and 'Prinses Irene'. In the group of special bulbs, 'Camassia quamash' and 'Corydalis solida' were totally destroyed, but 'Fritillaria imperialis', 'Leucojum vernum' and 'Allium christophii' were not injured or were only injured very little. So there is some hope for bulb lovers who have a garden. These results were used in the research to test the perennialization of tulips, hyacinths and

Tim Klaver

In September 2014, Tim Klaver started his nine-month internship at Cornell University.

Tim grew up in Spanbroek, where his father and uncle grow tulips and lilies. After completing his curriculum in Commercial Management, Tim attended the Clusius College in Hoorn. During this three-year program, he learned many things about the flower bulb industry at companies such as Jan de Wit & Zonen, Zabo Plant BV and Botanical Trading Company in the USA.

Since his arrival at Ithaca, Tim has worked on several different projects. He explains: "At first I was busy preparing the experiments. All the flower bulbs came in and had to be counted for the specific experiments. Everything had to be planted and then stored in a cooler. Most of the tests start in January or February. At the moment (December), we are conducting two tests with lilies in the greenhouse. The first one is a test involving eight different kinds of peat with three cultivars, and the second one relates to 'the timing tool' for lilies. Sixteen cultivars are grown at five different temperatures. When the buds have been measured at a certain size, the aim is to determine how much time is still needed for the bud to flower."

From the very first beginning, contact with Bill Miller has been very good, Tim explains: "Bill was at the airport when I arrived, and talks to me about the progress of the tests every morning, which is my opportunity to ask questions. If I have an urgent question, I can call him on the phone. We do a lot of work in collaboration with students from Cornell."

Conducting research is a new thing for Tim. "Before this internship, I had no experience with research. Conducting research means a totally different way of working and thinking than at a commercial production company. It's a pleasure for me to work with different crops. I have already learned a lot."

In addition to doing experiments, there is also time for other activities, Tim explains: "I have bought myself a car for visiting some interesting companies. An uncle of mine is growing perennials in Massachusetts, and I also visited a tulip forcing company in Virginia. In January I will attend a trade fair in Baltimore."

2008
Research Committee Meeting

daffodils in the landscape, mostly planted in combination with perennials. "We hope that one day we will discover a method or a way of stopping deer eating tulips and other flower bulb species."

Timing tool

Working for sixteen years on flower bulbs in the Research Program, Bill Miller is still enthusiastic about the aims of the program. "It's still necessary to encourage the export of flower bulbs to the USA and Canada. Sometimes it looks like the same research is being conducted for many years, but that's not the complete overview. Testing new cultivars of tulips and hyacinths in particular is essential for growers. They need new cultivars from time to time, and the circumstances here are not just like in the Netherlands."
In addition to testing new cultivars and growth regulators, Miller is also working on other issues, such as leaf burning in the very susceptible lily cultivar 'Star Gazer'. "It was my PhD student Alex Chang who found out that there is a relationship between spreading the leaves and the possibility of leaf burning. He did it by hand, but that's not practical for the professional grower. Spraying with Florell was the solution. One component of Florel is ethylene, which affects the spreading of the leaves. Growers are now bringing this result into practice."
Another interesting result regarding the growth of lilies is what Bill Miller calls 'the timing tool'. "What we found out was that there is a relationship between the length of the lily bud and the moment of flowering. For a market like the USA, which has peak sales on specific days such as Valentine's Day and Easter, it's essential to sell a perfect product. In a test, we measured the length of the buds of forty pot lilies two to three times a week. The result can easily be applied by growers. If the bud has a specific length, 'the timing tool' will tell you how many days are needed before the buds open and start to flower. We have tested this with various greenhouse temperatures. This had never been researched in the Netherlands."
Another result with growth regulators was research conducted

by Anil Ranwala. Miller explains: "The market for cut flowers is relatively small in the USA, but the cut lily is a growing market. One of the problems with lilies is yellowing leaves during the post-harvest period. Anil tested cut lilies with GA 4/7 or gibberellin. The result was clear: application of such products keeps the leaves green and makes the flowers last longer."

More stakeholders

Bill Miller is aware that he works on behalf of different groups of stakeholders. "At first there was Anthos with its members, second the greenhouse people of the USA and Canada, third individual companies and finally money funding sources. And in the USA, the greenhouse people are not the only group we work for. There are also landscape people and garden centers. All of these groups need information if they are to encourage the use of flower bulbs. With input from the exporters, it was possible to reach that goal. I received not only money, but also bulbs, students and information. If Anthos wouldn't do this, there was no one performing research on flower bulbs in the USA."

Bill Miller cooperates with the growers and the exporters quite intensively. Twice a year he meets with the Research Committee. Results are discussed here and new ideas are suggested. "Some of them come from the exporters, and some of them come from me. I am happy with the very good relationship we have. There is a certain freedom to do things and that pays off."

Very helpful

The users of all these results are the American and Canadian professional growers. Two years ago the NAFWA research director, Mr. Ron Beck, conducted an investigation and asked several North American growers to comment on the program. Some of these comments are listed here.

"The research that Bill and the team have done at the "Flower Bulb Research Program at Cornell University" continues to be extremely valuable to us, and we continue to pursue crop improvements of all kinds. Ways Bill has interacted with us over the years include:

1) Research on cut lily bud scorch, which has helped us to eliminate that defect in our oriental lily crop, saving us thousands of dollars in downgrade and dump product.
2) We have consulted on how to properly pasteurize and re-use media for cut and potted tulip production, which has saved us $60,000.00 per year on buying new media.
3) We consulted heavily in 2007 (when Bill came to visit) and again last year when we made a significant decision to move from soil production for cut tulips to hydroponic production. I took note of all hydroponics work carried out by Bill and his team."

"Dr. Miller's extensive research in the use of PGRs on flower bulbs has been particularly beneficial to us. With this "tool" that Dr. Miller has made available to us we are now able to use a much wider range of varieties in our pot production of flower bulbs. We are now able to grow varieties that are difficult to keep short enough to a perfect height for finished pot crops, which in turn has increased the market for the many varieties of bulbs available. Having the ability to control height on a much wider range of bulbs has also been very helpful to us in our choices to use varieties that best fit the varying markets we are challenged to force for. Flower bulb species such as Crocosmia, which were not possible to force very successfully in pots, are now being used in much larger quantities than before. Colors for important holidays, such as red for Valentine's Day, are much easier to provide as a good-quality product with the use of PGR information from Dr. Miller."

"Potted bulbs are a large part of our production and have proven to be one of the most profitable. We look forward to continued growth in the use of bulbs in pot forcing, and would like to express to you how important continued research is in promoting this beautiful product from the Netherlands."

"I have had numerous conversations and correspondence with Dr. Miller over the years on his research and how we can best use it in our company. Dr. Miller is very easy to talk to and is always prompt in returning my calls or e-mails with help or information."

The Flowerbulb Research Program was a project that deeply affected the North American flower bulb and perennial market. A project that has a history and a future.

Looking further

This information was very helpful to the Research Committee. In 2013, the Research Committee was busy preparing a memo for the board of Group I (USA/Canada) of Anthos. The contract with Cornell needed to be renewed in July 2014 for another four-year term. The board of Group I asked the Research Committee to describe the added value and benefits of continuing the program. This request must be viewed with regard to the fact that we are currently living in an era where collective initiatives financed by an obligatory levy are under a lot of pressure. For example, in 2013 the Dutch government decided to terminate all Product boards (Productschappen') and therefore *Productschap Tuinbouw* would also cease to exist. The board of Group I wanted to make a balanced decision about whether or not to continue the research program, especially since the annual budget for the program amounts 150,000 euros and some of the members were questioning the need to continue.

In its memo, the Research Committee concluded that the Flowerbulb Research Program is still very valuable. In fact, the Flowerbulb Research Program can be compared with Van den Hoek's Broeiproevenbedrijf, but in this case for the North American market. Based on this memo, the board of Group I made a unanimous decision to renew the contract. They made clear to the Research Committee that they needed to make sure that proportional parts of the trials were spent on forcing, dry sales, landscaping and perennials. So the result of this discussion was clear: a new four-year period commenced. The Flowerbulb Research Program was a project that deeply affected the North American flower bulb and perennial market. A project that has a history and a future. A project with debits and credits. As Ruud Westerbeek explains: 'We have had a lot of results for the money we've spent."

Henk Westerhof, Chairman of Anthos, estimates that the Dutch flower bulb industry has invested 6 to 7 million dollars in the Flowerbulb Research Program over the past fifty years. Initially, it was funded entirely by collective money, first of the PVS and later by *Productschap Tuinbouw.* In 2000, the funding was privatized by Anthos for practical reasons. For that purpose Anthos established the foundation *Afzetbevordering Bloembollen en Boomkwekerijproducten USA/Canada* (ABBUC), which would be responsible for collecting the money needed to finance the Preclearance Program but also to finance the Flowerbulb Research Program. So now, only the members of Group I were contributing financially, rather than the flower bulb industry as a whole. The *Productschap Tuinbouw* continued to contribute a small part of the research budget and iBulb took over this annual contribution in 2012.

Roos de Wit collecting research data

Thoughts on the future after 16 years of the Flowerbulb Research Program at Cornell University

Bill Miller

I have been very fortunate to have been involved in flower bulb research since I started my PhD in 1983, and I "grew up" with lily bulbs at our family farm and greenhouses in Northern California. It is now 32 years since 1983, and we are currently in years 17-20 of research with Anthos. More than half of my professional career has been involved with Anthos, the Flower Bulb Research Program, and the members of the Research Committee.

I often say I had no gray hair when I started working with Anthos, but I don't know if there is an actual correlation or not. That said, I cannot imagine what my academic research, extension and teaching career would look like if I had not had this extraordinary opportunity. Following immediately in Gus De Hertogh's footsteps provided certain benefits (and occasional difficulties). I would like to take this opportunity to thank Gus for his monumental effort on behalf of the product and the industry and thank Anthos for its stewardship of the whole program. And I would especially like to thank the Research Committee and exporters who have welcomed and supported me in this work since 1998.

What does the future hold? Predictions are dangerous, often dead wrong, or at least way off in terms of timing or end result. I can be certain of a few things, however. First, the problems will be interesting and will seem unsolvable at times. Second, funding by Anthos and similar industry groups will be critical in order to maintain market-oriented, practical research, worldwide. We all know that less and less public investment is being made in agricultural research, and ornamental work in particular, and trade organizations are increasingly "filling the gap". At the same time, an increasing amount of research is proprietary, so access to certain kinds of knowledge will be increasingly difficult as the generation of and access to information becomes more and more "privatized".

I sincerely hope that some of the structures and the ways of working that we have established will help to address these concerns. In the US, the land-grant universities (of which Cornell is one) are known to be reliable and non-biased sources of information. The value of this fact will only increase over time. Our website (www.flowerbulbs.cornell.edu) is open to anyone in the world who chooses to use it. While we have close contact with and input from the Research Committee,

as Gus mentions in his section, the professor's ability to have the "final" authority is key to maintaining credibility in this changing environment. Ideas come from many places, and observations in one area might spark entirely new ways of thinking about an unrelated problem. For example, Alex Chang's manual bending of leaves to improve calcium uptake and reduce upper leaf necrosis in 'Star Gazer' lilies ultimately led us to the approach of using Florel (ethephon) as a potential growth regulator in some types of lilies. Chance conversations on growth regulator effects in narcissus caused us to put ethephon into potting mix and we thereby "discovered" the excellent effect of ethephon as a soil drench on narcissus and hyacinths, and may have created new understandings on the variable effects of ethephon as a spray.

The ability to pursue such leads is a hallmark for the future.

A ripe area for future research efforts is ethylene and tulips. The last 10 years have seen more progress and change in this area than at any other time since the early 1970s and Wim de Munk's work at the LBO. Anti-ethylene treatments (FreshStart) are now available in Holland for storage rooms, and ethylene monitors attached to ventilation systems allow safe ethylene concentrations to be maintained while saving a great deal of energy (work by Henk Gude and PPO).

Our work at Cornell feeds into this as it has led to the understanding that something like 25% of tulips cultivars are highly resistant to ethylene when it is given during later summer and fall bulb storage. We have proven this to be consistent across sports families (sports of resistant cultivars are resistant, susceptible cultivars yield susceptible sports). We continue to evaluate cultivars on an annual basis, so our knowledge base will grow. Even at this time, however, we believe breeders can make use of information on the more highly resistant cultivars and could begin breeding in this area. If this were to happen, we could have a new generation of ethylene-resistant tulips in 25 years' time.

2014
Research Committee

Over the next several years, we at Cornell hope to develop the next generation technology for tulip height management. We believe that tulip growth can be controlled with more environmentally friendly products and in a more economically sustainable way for the North American forcer. What could be better? This is win-win situation for the environment, the forcer, customer, and presumably exporters as increased success should result in increased bulb sales. Such a virtuous cycle is what this program has been about since the start. Bud sticks and timing tools for the main hybrid lily cultivars are similarly useful for the trade. Useful work is not always "cutting edge" in terms of technology. Decent temperature monitors and a ruler are all that's needed here.

Ultimately, the user of the information, that is the North American forcer, must be able to adapt the results and findings to their own situation. Horticultural research and development result in more efficient production and higher-quality products. The trick for industry is to maintain profitability in the face of rising production and operation costs. While we can help a grower save 5 or 10 cents in production costs for a potted tulip, the harder task remains for them to maintain or increase their own profit margin with these savings. This is hard to do and is one of the real keys for the future.

I would now like to say a few words about dry sales, specifically tulips, lilies and deer: I have been quoted as saying "Tulips are salad for deer". I am constantly asked if we can't just put a gene into tulips to make them resistant to deer. Sounds like a great, very long-term project. In theory, this is possible, especially for lilies, as they are technically easier to work with in the lab. With enough money (always the key point), genes could be put into the plants that would probably reduce deer injuries. This would initially cost several million euros, then more after that for proofs, and much more after that for introducing the

I hope it finds us involved in this program for many years to come, and that our intellectual products are still being used and are important for the industry.

gene into other cultivars, or even to breed new cultivars if the gene is stable and expressed after crossing. After all that, genetically modified (GMO) tulips or lilies are almost certain to never see a commercial field or home garden due to public distaste for GMOs. The common idea that the public will accept GMO flowers but not GMO food is, I think, false. But that's just an opinion…only the future will tell!

Our work (and Gus' work before us) is important as it is immediately useful to companies and individuals in the US and Canada. Growing better plants means a greater economic return for the forcer. When we solve real problems we prevent losses and increase profit margins from growing flower bulbs. In 2013-2014, the Research Committee asked for input from North American growers regarding their opinion of the value of the research program. The response was overwhelmingly positive. It is clear that growers in North American appreciate and value the work we do.

To keep the North American and Canadian market in first place, we have to continue the Research Program in order to keep the customers informed about the new developments of growing technics, varieties and methods to get the best quality of our bulbs and perennials to the consumer.

So what does the future hold? I hope it finds us involved in this program for many years to come, and that our intellectual products are still being used and are important for the industry. We aim to keep the Research Program relevant and valuable to all involved. When we cease to be valuable, the program will no longer have a future.

Acknowledgements

For this book, I have used two main sources. The first main source was books, articles and publications from the *Koninklijke Algemeene Vereeniging voor Bloembollencultuur* (KAVB) library in Hillegom. Most of the results from the Research Program can be found in this library. Also very helpful was the overview that Gus De Hertogh sent me of all his published books, chapters in books, scientific and popular articles. I submitted this interesting overview to the library.

The second, even more important source of information was the people I spoke to who were involved with the Research Program over the past fifty years. In alphabetical order, they were: Leo Berbee, Peter Breed, Henk Gude, Gus De Hertogh, Anneke van den Hoek, Tim Klaver, Hendrik Jan Kloosterboer, Bill Miller, Joost Pennings, Frans Roozen, Henk Stuifbergen, Maarten Timmer, Connie Van den Berg-Berbee, Dolf Westerbeek, Ruud Westerbeek and Kees Zonneveld. I would like to thank all of them for their time and the information they shared with me. It was very helpful for me and it really enhanced my understanding of what it takes to export flower bulbs worldwide, specifically consumer requirements of the US market and the importance of the research program for North American growers.

I would also like to thank Marieke Dwarswaard, who verified the text in terms of the English language used.

in pictures

50 years

1965
Signing of the contract at MSU

Gus De Hertogh with
the Research Committee

1966

Firsrtst exporter meeting 4 March1966

Meeting of Minds

Marketing Man of the year

Marketing discussion

1976

The U.S. Bicentennial Planting at MSU

Inspection of the Research Trials

Nic Zonneveld,
Jan Heemskerk,
Henk van der Berg,
Wim Witteman,
Siem Ruigrok,
Wim van der Berg and
Dick Wilbrink.

NAFWA Meeting Research

Presentation 5th edition Bulb Forcers Guide
Nic Zonneveld, Gus De Hertogh, Leo Berbee

Garden Trials at Cornell

Dinner in the Boatyard

Appendix 1

Members Research Committee throughout 50 years of the Flowerbulb Research Program

Member	Company	Period
G. Springer	Neth.Flowerbulb Inst.	1965 - 1981
G. de Jongh	Vanhof and Blokker	1965 - 1988
C.J. Freriks		1965 - 1994
D. Westerbeek	C. Westerbeek en Zn. B.V.	1965 - 1995
J. van den Hoek	V.d. Hoek's Broeiproevenbedrijf	1965 - 2011
J. van Reisen	Jacob L. van Reisen	1965 - 1983
C. Verdegaal	H. Verdegaal and Sons	1973 - 1978
J. Heemskerk	Witteman & Co. B.V.	1973 - 1991
N. Zonneveld	C.J. Zonneveld & Zn. B.V.	1973 - 1995
G. de Jongh	Van Hof en Blokker	1983 - 1988
Ph. Van Bourgondiën	K. van Bourgondiën en Zn. B.V.	1983 - 1995
F. Roozen	IBC	1983 - 2012
J. Zonneveld	Van Waveren USA	1985 - 1986
D. Smith	Skidelsky USA	1987 - 1988
R. J. Bogers	LBO	1987 - 1993
J. Langeveld	Langeveld USA	1989 - 1990
S. Ruigrok	C.J. Ruigrok & Zn. B.V.	1989 - 2002
J. de Vroomen	Jac.Th. De Vroomen B.V.	1991
J. Doornbosch	International Bulb USA	1991 - 1992 & 2008 - 2011
G. van Buuren	Witteman & Co. B.V.	1991 - 2002
H. Stuifbergen	Stuifbergen Bloembollen Export	1992 - present
R. Westerbeek	Westerbeek Bulb Co.	1992 - present
K. Zonneveld	C.J. Zonneveld & Zn. B.V.	1992 - present
J. VandenBerg	Vandenberg USA	1993 - 1994 & 2002 - 2008
P. Borst	Van Zanten Flowerbulbs B.V.	1994 - 2003

Member	Company	Period
A. Lee	Fred C. Gloeckner & Co. Inc.	1997 - 2002
P. van Eeden	Van Bourgondiën B.V.	1998 - 1999
T. Langeveld	Gebr. Langeveld B.V.	1998 - 2002 & 2010 - present
H. Gude	PPO	1999 - present
F. van de Lende	Anthos	2001-2002
P. de Wit	Van Bourgondiën B.V.	2001 - 2007
R. Immerzeel	De Vroomen Export	2002 - 2008
H.J. Kloosterboer	Anthos	2003 - present
V. Kuyvenhoven	Van Zanten Flowerbulbs B.V.	2004 - 2007
S. Liou	Agrexco	2004 - 2008
H. Glorie	Van Zanten Flowerbulbs B.V.	2005 - 2006
M. Pennings	Westerbeek Bulb Co.	2005 - present
P. Kok	Kapiteyn B.V.	2006 - 2007
D. Warmerdam	Van Zanten Flowerbulbs B.V.	2006 - 2008
H. Arentshorst	C.J. Ruigrok & Zn. B.V.	2007 - 2010
G. Veeken	Kapiteyn B.V.	2008 - 2011
E. van Tongerlo	Zabo Plant B.V.	2009 - present
L. Berbee		2010 - present
R. Beck	Fred C. Gloeckner & Co. Inc.	2011 - present
W. Kleine	Kapiteyn B.V.	2011 - present
Chairmen Research Committee		
B. Vandenberg	Vandenberg	1965 - 1983
N. Zonneveld	C.J. Zonneveld & Zn. B.V.	1983 - 1996
R. Westerbeek	Westerbeek Bulb Co.	1996 - 2006
P. Kok	Kapiteyn B.V.	2006 - 2007
H. Stuifbergen	Stuifbergen Bloembollen Export	2007 - present

Appendix 2

Dutch interns throughout 50 years of the Flowerbulb Research Program

Year	Name
1967/1968	Connie Berbee
1967/1968	Kees van Zanten
1967/1977	Theodorus Breg
1968/1969	Dirk Everaars
1968/1969	Maarten Benschop
1968/1969	Maarten Bos
1969/1970	Chris Verdegaal
1969/1970	Ed Pennings
1969/1970	Pieter op den Kelder
1970/1971	Ed Grevers
1970/1971	Piet Nijssen
1971/1972	Kees Pennings
1971/1972	Pieter de Wit
1972/1973	Piet Dekker
1972/1973	Ton Pennings
1973/1974	Engelbert Vandenberg
1973/1974	Ton Nijssen
1974/1975	Kees Westerbeek
1974/1975	Vincent de Waard
1975/1976	Antonius Ruigrok
1975/1976	Leo Van der Vlugt
1976/1977	Leonardus van Reisen
1977/1978	Kees Lommerse
1977/1978	Kees Zonneveld
1978/1986	no students

1986/1987	Andre Zonneveld
1986/1987	Kees van Diest
1987/1988	Elleke Boogert
1987/1988	Josi Ratsak
1988/1989	Kees Winters
1988/1989	Rene Huurman
1989/1990	Andre Rutte
1989/1990	Peter Breed
1990/1991	Desiree de Vries
1990/1991	Richard Janssens
1991/1992	Antonius Geul
1991/1992	David Ligtvoet
1992/1993	Jan Willen van Straten
1992/1993	Joost Pennings
1993/1994	Marco Bron
1993/1994	Marco Groot
1994/1995	Edward Dekker
1994/1995	Maria Slippens
1999/2000	Dirk Warmerdam
2000/2001	Jeffrey Wagemaker
2001/2002	Peter Heemskerk
2002/2003	Rob de Groot
2003/2004	Martijn Verlouw
2004/2005	Frans Reijerink
2005/2006	Ben Biersteker
2006/2007	Dirk Jan Feenstra
2007/2008	no student / Cornell student Mateus Mularski assisted
2008/2009	Simon Laan
2009/2010	Martijn Pepping
2010/2011	Simon de Waard
2011/2012	Amanda van den Bosch
2012/2013	no student / Cornell student Ms. Allison Hrycik assisted
2013/2014	Roos de Wit
2014/2015	Tim Klaver

Colophon

Accountability for used images

Images from the presentation of Prof. Dr August (Gus) A. de Hertogh during the NAFWA meeting at Cornell University in 2008
Images Hendrik Jan Kloosterboer 2004-2015
Images Arie Dwarswaard, from library KAVB
Images Anthos archive
Images Richard Janssens
Images Chris Verdegaal
Images Dick Wilbrink
Images Piet op den Kelder

Accountability for the text

Arie Dwarswaard
Prof. Dr. Gus De Hertogh
Prof. Dr. Bill Miller
Dr. Henk Gude
Leo Berbee
Hendrik Jan Kloosterboer
Henk Stuifbergen

Printed by Groen Media
Design & lay-out by Elburg Smit B.V.

ISBN/EAN: 978-90-9028971-7

Royal Dutch Trade Association for Flowerbulbs and Nursery Stock