



Flower breeding for the global market

UPOV Symposium on the plant breeding of the future

Ulrich Sander

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Introduction: Complexity of the flower market

- Different segments
 - Cut flowers
 - Indoor plants
 - Bedding plants
 - Perennials
 - Grasses
 - Shrubs
 - Trees
- Propagation technology
 - Seeds
 - Cuttings
 - Bulbs
 - In vitro material
 - Grafting
- Wide range of species with a commercial value
 - In Europe
 - 400 species
 - 250 genera
 - 100 families

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Introduction: Company profile Selecta

- Family owned company group with 10 companies focussed on breeding, young plant production and distribution of vegetative propagated ornamentals
- Breeding: approx. 45 species
 - bedding plants, pot plants, perennials and cut flowers
 - 7 breeders located in Germany and Italy
 - Breeding facilities in Germany, Italy, Tenerife, Kenya
 - Laboratory for in vitro culture, biotechnology and phytopathology in Germany
- Production of unrooted cuttings in Kenya, Uganda and Tenerife (30 ha)
- Rooting facilities in Germany and Italy (15 ha) plus contract rooting in 8 European locations
- Distribution worldwide through sales reps, agents, root and sells, wholesalers and retailers








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The global flower market

- Total retail value approximately \$ 100 billion
- Cut flower segment \$ 40 to 60 billion
- North America, Europe and Japan are 80% of the market
- Cut flower markets are declining
- The outdoor segment is moderately growing
- The cut flower market is dominated by vegetative propagated species
- The vast majority of protected varieties are vegetatively propagated

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The global flower market

- Floriculture is in a heavy consolidation process driven by price pressure in retail which effects also the breeding companies
 - In the last years we saw a number of mergers and acquisitions
 - Breeders and young plant producers relocated their mother stock, seed production and tissue culture to low cost countries
 - The vast majority of the breeding activities is still located in North America, Europe and Japan
 - Despite consolidation, there is an impressive number of small breeding companies and private breeders who achieve very frequently important breeding results
 - Huge diversity of ornamentals
 - Enthusiasm achieves sometimes more than professionalism
 - The technical level of breeding is in many species still low

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The global flower market: Trends in gardening

- The classical plant classes like bedding plants, perennials, shrubs and even vegetables are blurring
- Having a nice garden or patio is in, working in a garden is out
 - „Do it myself“ is becoming „Do it for me“
 - Decorating is taking over gardening
- Breeders have to provide solutions
 - Recipes for plant mixes
 - Mixed pots
 - Not the single variety but the combination of varieties has to perform



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The global flower market: Impact of marketing

- The introduction of Surfinia changed the bedding plant market in Europe:
 - Innovated breeding was combined with a strong marketing approach
 - Surfinia became a synonym for all trailing Petunia
 - Surfinia is today one of very few brands in our industry which achieved a certain level of consumer recognition
- Today innovative breeding is nearly always combined with a strong marketing approach and the success of breeding is highly depending on the marketing behind it
- The retail demands today from the breeder a package of new varieties and marketing tools



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Conventional breeding approaches: Bedding plants

- The bedding plant market is driven by the introduction of new commercial products which can be a new hybrid, a new species or even a new genera
- The novelties take marketshare of the existing commodities and can develop into a major product within a few years
- A good example is the genus Calibrachoa
 - First varieties were introduced by Suntory 1996, before that Calibrachoa was not known as an ornamental
 - Today Calibrachoa is already the second biggest vegetative propagated bedding plant in North America and also in Europe and in Japan the product is already a major genus with a strong growth year by year
 - At least 8 companies have established breeding programs and release improved varieties yearly



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Conventional breeding approaches: Bedding plants

- The breeding of bedding plants was driven by innovations during the last years and created new interspecific or even intergeneric hybrids
 - Examples we can find in Osteospermum, Lobelia, Impatiens, Nemesis, Calibrachoa ...
- In ornamentals very often the new hybrid is the variety or the starting point of a completely new gene pool
- Backcrossings to commercial varieties to transfer a single characteristic trait (like a disease resistance) have very little relevance in vegetative propagated bedding plants
- Due to this breeding method we find many varieties with a very limited fertility and complex gene pools with a range of different ploidy levels



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Conventional breeding approaches: Cut flowers

- Cut flower production has been moved over the last decades from Europe and North America to East Africa and South America due to lower production costs and better climate conditions
 - Shipping ability has become an important selection criteria
 - Suitability for sea freight may become a new challenge for the breeders
 - Productivity is also in the low costs countries a major breeding target
- Cut flower breeders have moved their activities to East Africa and South America
 - Trial Stations
 - Purchase of cut flower farms by breeding companies
 - Dislocation of complete breeding programs
- Major cut flower producers in Central America and East Africa have started themselves to invest into breeding

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Conventional breeding approaches: Cut flowers

- The carnation breeding program of Selecta benefits from the assets of the different locations of the company and is adapted to the needs of the key markets
 - Gene pool and candidate stock is kept in Germany
 - Crossing work is done in Tenerife
 - Seedling selection takes place in Kenya
 - Trials of the selected clones are in Germany, Kenya, Italy, Japan and Columbia
- Breeders need strong management skills and have to be prepared to travel



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Genetic engineering in ornamentals

➤ Examples 1987 to 2005

- Anthurium
- Antirrhinum
- Begonia
- Calendula
- Dendratherma
- Dedrobium
- Dianthus
- Eustoma
- Gentiana
- Gerbera
- Gladiolus
- Osteospermum
- Pelargonium
- Petunia
- Rhododendron
- Rosa
- Torenia

- Flower colour
- Fragrance
- Vase life
- Production characteristics
- Stress tolerance
- Pathogene resistance

aus: Chandler & Lu (2005) In vitro Cellular & Developmental Biology 41 (5):591-601

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Genetic engineering in ornamentals

➤ Commercial examples

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Biotechnology in ornamentals: Genetic engineering

➤ Breeding companies today have very limited activities in the field of genetic engineering

- Small markets even of the most important ornamentals
- High deregulation costs
- Lack of access to intellectual property rights of enabling technology and interesting trait genes
- High costs for research and development
- Fundamental opposition against GMO's in Europe

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Biotechnology in ornamentals: Genetic engineering

➤ Ornamental Bioscience was founded in 2007 as a joint venture of Mendel Biotechnology and Selecta Klemm

- Mendel Biotechnology has characterized transcription factors from Arabidopsis
- Transcription factors which give increased abiotic stress tolerance and disease resistance are tested in ornamentals
- Ornamental bioscience has access to the enabling technology of Monsanto

➤ The vision is to create a new generation of convenience plants which are easy to handle, stay healthy and are tolerant to reduced water supplies

ornamental bioscience

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Genetic engineering of ornamentals

➤ First results of Ornamental Bioscience

- Improvements in Petunia:
 - Reduction of the water demand of 30 %
 - Tolerance against long drought periods
 - Normal plant development also after several periods of drought stress

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Biotechnology in ornamentals: Marker technology

➤ Molecular markers have been applied in a huge amount of species (160 before 2006)

➤ Fast majority of applications in ornamentals is in the field of fingerprinting research for identification, diversity and taxonomy studies

➤ The history of the gene pool of ornamentals is very often unknown in ornamentals. Fingerprints are a powerful technology to get an understanding of the relationship between different genotypes and to make the start of a new breeding program more effective.

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Biotechnology in ornamentals: Marker technology

- Marker assisted selection is still - with a very few exceptions - not used in ornamental
- One reason is that the research applied before marker assisted selection is long term and costly
 - Exact phenotyping
 - Clarification of the inheritance of important traits
 - Genetic linkage maps
- Ornamentals have very often a complex cytology which increases the complexity
- Roses are the best studied groups in ornamentals. A linkage map is available and disease resistance genes have been characterized. Nevertheless to my knowledge the markers are not used in the commercial breeding programs
- Before marker technology will be applied in breeding programs much more research has to be done. A development as we have seen it in the breeding of vegetables is very unlikely.

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Double flowering Calibrachoa: A case study

- The breeding program was established in 1996 with the focus on colour, production characteristics and early flowering
- In the 2006/2007 the first variety with double flowers was introduced by Selecla and recognized as a major step in the Calibrachoa breeding
- In the US a Utility patent was filed and granted with the title "Double Flowering Calibrachoa Breeding Methods and Plants Produced Therefrom"
- In the breeding process of the Double Flowering Calibrachoa new technologies had to be developed or adapted for this species and contributed to the development of the new trait
 - Protoplast culture
 - Induction of mutations
 - Anther culture




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Double flowering Calibrachoa: A case study

- Beside the implementation of the technology a new species was integrated into the breeding program
- Already in 2008 a competitor presented on the US Pack trials a Calibrachoa variety with double flowers
- AFLP and cytology analysis proved that the variety was a hybrid of the first commercial variety
- It took years and a highly sophisticated breeding approach to develop this new character in Calibrachoa
- Unfortunately due to the relatively simple inheritance of the double flowering it can be transferred very easily to new varieties

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Intellectual property rights and breeding progress

- Effective Plant Breeder Rights are a precondition for the commercial breeding of vegetatively propagated ornamentals
- The UPOV convention from 1991 has improved the position of the breeders
 - Vast majority of the growers accept that mutations belong to the breeder of the original variety
- Illegal propagation is still a severe problem and breeders have to defend their position constantly
- We have today more conflicts between the breeders in the field of EDV's and patents
- Patents can be an important addition to plant breeders rights for the breeders of ornamentals

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Thank you for your attention !

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