HOW TO BREED ORNAMENTALS?

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Abstract

The focus in this presentation will be on practical breeding of ornamentals. Breeding means making many choices, not only about the plant material, but many other aspects like consumer’s behaviour, the type of company and the grower’s needs are important.

1. Introduction

Classical breeding is usually not given enough exposure at a scientific breeding congress. The main focus in this presentation will be on the practical breeding of ornamentals. Prego Rijsenhout B.V. is a breeding company that is specialised in this field. Breeding at Prego Rijsenhout B.V. is confined to four cut flowers; Chrysanthemums, Alstroemerias, Gerberas and Roses. The more important aspects of ornamental breeding will be discussed and illustrated in this presentation with some examples obtained from rose breeding and are based on experience gathered from years of breeding in the four different crops. Some specific issues will be addressed for example; a) What is special about ornamental breeding? b) Planning and carrying out procedures to achieving of set breeding targets. c) Commercial exploitation of the finished products. Many decisions have to be made in order to establish a profitable business.

2. What is special about Ornamental Breeding?

Several different aspects make ornamental breeding special. Most of the crops are cross-fertilisers and are polyploids. For example, the rose is a tetraploid and the Chrysanthemum is a hexaploid. This makes breeding rather complex, resulting in a huge variation in the progenies. To introduce only one new characteristic in a variety whilst preserving all of its original characteristics is almost impossible using conventional breeding methods.

A large number of different varieties are needed in order to satisfy the customer demand. Within this wide range of varieties there needs to be a lot of variation for example in flower colour, shape, size, etc. This variation is needed to allow proper profitable commercial placement of the product. Consumer behaviour is difficult to predict and ever changing and it is therefore essential to have a large and ever changing variation in your varieties.

Uniformity is essential within a variety. The easiest and safest way to obtain uniformity is by means of vegetative multiplication. Many ornamentals are easy to propagate whilst multiplication through F1-hybrid seeds is very difficult because the essential inbred lines are difficult to obtain. Inbreeding in ornamentals is generally very difficult due to the low fertility of the inbred population.

Relatively high investments are needed per new variety. The relatively low number of plants sold per successful variety means a high cost per plant from
development work, breeder’s licences and promotion. A good variety will sell only 3 to 4 million plants and a top variety 15 to 20 million. The relatively short commercial life cycle of most varieties adds to the costs.

2.1. Difficulties in ornamental breeding

Due to the relatively lower economic significance of ornamental crops in relation to vegetable and agricultural crops, most ornamental breeding companies suffer from a comparative lack of knowledge. Knowledge of breeding techniques and consumer’s needs are essential for ornamental breeders to produce successful new varieties.

Research topics at institutes are often chosen and managed by the institutes themselves and there is often a gap between the research performed at institutes and the research that is needed by the breeding companies, and the latter generally fail to communicate to the research institutes.

3. Breeding aims

Breeders can focus the breeding targets for their varieties in two ways, either for consumer needs or for the economic benefit to the grower. The two are closely related.

3.1. Consumer’s needs

The new varieties should contain the specific characteristics which make the consumer want to buy the product, for example a specific shape, long vase life, size, striking colours, etc. This is an ever changing pattern. A good example is the changing in demand for different colours (Fig. 1).

Changes in consumer’s behaviour are often subject to trends, for example the dramatic changes in the colour pink over the last year. These changes, however, can also indirectly be caused by the fact that certain varieties become less popular. For example, the pink rose ‘Motrea’ is losing its dominant position because of its small size flower heads and short stems and this causes a further decrease in the amount of pink roses sold.

Some varieties occupy very dominant positions. The yellow rose ‘Frisco’ represents 50 percent of yellow rose flower production. It became popular because of its long vase life and high production. In other colours the differences are less striking. However for each type of rose there is usually one dominant variety (Fig. 2).

In recent years the number of small flower varieties has decreased, consequently the large flowered ones have increased in number (Fig. 3).

As mentioned earlier, consumer behaviour is ever changing and subject to trends. Some general remarks can be made concerning flower colours; approximately 80% of flowers sold are standard colours, whereas 20% are subject to trends. Additionally, there are huge differences between regions in the world. There are several reasons for these differences. Generally the consumer is prepared to pay more for larger, luxury and exclusive flowers and for flower arrangements.

3.2. Economic benefits for the grower

New varieties must be safe to grow from an economic point of view and therefore must have the following important characteristics: high production with adequate quality through all seasons, low costs for crop maintenance, low energy requirements, resistance to major diseases. An indication of the breakdown in growing costs for roses in the Netherlands:

<table>
<thead>
<tr>
<th>Description</th>
<th>Percentage</th>
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<tr>
<td>Regular expenses</td>
<td>15-20%</td>
</tr>
<tr>
<td>Labour</td>
<td>30-35%</td>
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<tr>
<td>Energy and light</td>
<td>30-35%</td>
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The grower also has to decide which varieties he wants to cultivate in order to follow trends in consumer needs. Usually varieties that are subject to trends have a shorter commercial life.

4. How to set your breeding objectives?

Gathering information is the first and most important task in setting your breeding objectives together with an understanding of the supply chain from grower to consumer. It is quite difficult to obtain this information in the ornamental sector because there is a lot of information but it is not available in a consolidated form, meaning that the breeder has to gather and combine segments of information from the different sectors. The breeder needs to divide his objectives into sub-objectives and concentrate on these. Commercial targets can be different markets like Western Europe, Eastern Europe, the USA or Japan, and selling points like traditional flower shops, market places and super markets. Technical targets for growers can be cultivation techniques (the greenhouse, substrate cultivation, etc), labour needs of the crop (easy to handle, processing and sorting, regular growth), low energy needs of the crop and resistance to pathogens. Consumer’s targets can be quality aspects like long vase life and transportation tolerance (no damage). In general the broad range of possibilities enforce the need to determine targets accurately and develop means for selection.

5. Achieving your breeding objectives

5.1. Financial means

Several pre-requisites are needed for breeding: greenhouse space, supplies, labour, office supplies, computerisation, laboratory facilities, climate conditioned rooms, test space. Enough finance should be available to cover these items. Estimates show that approximately 500.000 Euro per crop type per year is required to maintain a basic breeding program. At the start of a breeding program an investment of 3-4 million Euro is required before it is possible to make profit. Additional costs can be the larger investments needed for expensive research such as transformation techniques, marker techniques, etc.

5.2. Labour

For breeding there should be a highly educated and skilled team able to implement research needs, customer demands etc into practical breeding programs, a number of specialists for product registration, legal issues for control of products/rights, and product managers who can introduce and exploit your products successfully.

5.3. Facilities

Greenhouses, offices, laboratory and plant materials are a pre-requisite for breeding.

5.4. Creating genetic variation

In general a lot of genetic variation is present within a crop meaning that a lot can be achieved using conventional breeding techniques. The reason to create genetic
variation should always be to achieve products suitable for both consumer and grower.

5.5. Breeding for resistance to pathogens

Resistance to pathogens will lower the entrepreneurial risks of the grower because less damage can occur in the crop during cultivation and transportation. Through legislation the use of chemical treatments will become less acceptable and so the need for breeding for resistance is higher on the agenda. Integrated pest control management will be the future. A problem here is the zero tolerance. Several countries ask for completely disease free products (no viruses, red spider, thrips, leaf miner, white fly) on imported flowers. For ornamental breeding this means that a lot of different pathogen resistances are required in the coming years, and consequently higher investment.

5.6. Genetic modification

Transfer of genes by means of genetic modification seems to be ideal, but for practical breeding there are many questions and problems to solve. The high expectations of this technique for ornamental breeding have not been fulfilled; progress has been slow, only a few genes are available, patents and licences are a concern, large investments are needed and consumer acceptance is unsure.

5.7. Selection techniques

To utilise the obtained genetic variation in the crop, selection techniques are needed. First requirement is the ‘breeders eye’, which is an emotion-based subjective method. Several tests can be developed to produce hard data that support breeding like for example vase life data and resistance data. In addition, other techniques like elisa, electrophoresis and marker techniques might produce objective data that can be utilised by breeders. However, as mentioned above, marker techniques in polyploids are difficult and therefore expensive.

5.8. Means of protecting varieties

There are three different ways to protect your varieties from unauthorised propagation. Breeder’s rights can be obtained for each specific variety. It is possible to obtain these rights for individual countries for each variety. In addition, in the EU it is also possible to directly obtain these rights for the whole EU. However, in several countries it is not possible to obtain breeder’s rights at all. The cost for ‘world-wide’ breeder’s rights per variety is approximately 10-20.000 Euro. The right is determined by specific descriptions of the variety that show it is original, stable and uniform.

A trade mark is linked to the name of the product. It is possible to obtain this right per country. It is an effective method but there are limitations.

Patents are relatively new in ornamental breeding. It is generally used for biotech products. Still a lot is unclear especially concerning owners rights, the costs and the rights to utilise these products.

To fully protect your varieties from illegal use it is necessary to control your right and if necessary to defend it by guarding your licence agreements, checking imported products and confiscating illegally produced products.

5.9. Life time of varieties

In the past ornamental varieties had protection periods of twenty years or more, like for example ‘Baccara’, ‘Sonia’ and ‘Motrea’ in Roses, ‘Sim’s’ in Carnations, ‘Spider’ in Chrysanthemums. Nowadays, the life time of varieties is becoming much shorter. In general growers do not replant the old varieties, but will change to new ones. The main
reason is the progress with new varieties and their better price compared to old varieties. Consumers are prepared to pay extra for these new varieties. Therefore breeders have to supply new varieties quickly.

A high level of breeding will stimulate this process of introducing new and better varieties. In addition competition between breeding companies will result in introduction of even more varieties. This can be shown by the increasing number of rose varieties sold in the past few years (Fig. 4). Approximately 15% of these varieties in 1999 were new introductions.

5.10. Ornamental breeding - a situation scheme

A manager of an ornamental breeding company must decide the kind of breeding company he wants to have. There are many choices to be made; ranging from being an amateur or a professional company, one or multiple crops, to be a private or a multinational company, produce varieties for local or international markets, be a trend-follower or a developer, act in competitive or non-competitive markets, be research based or not.

6. Concluding remarks

Breeders have to make many choices. There are many opportunities but also many risks.

It is possible to influence the chances by changing our point of view that breeding is more than just development of new varieties. Breeding has to be a total of product-development, protection and exploitation. The most important selection a breeder has to make is to decide his favoured type of company out of the many possibilities. Finally breeding companies always have to adjust their objectives to an ever changing demand for their products.

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Figure 1: Changes in the percentages of different coloured roses sold over the last years.

Figure 2: The strong dominant position of the rose ‘First Red’ in relation to the other top 10 varieties.
Figure 3: Changes in amounts sold of three different types of roses.

Figure 4: The increasing number of rose varieties sold over the last years.