

Experience ranging from the showbench to government research institutes provided a solid background for an independent plant breeder



Dahlia 'Dark Tiger'

Photographs: Keith Hammett

## Keith Hammett

# The art of plant breeding



Alan Blithan

### GUESS HORTICULTURE IS IN MY BLOOD.

Although I had little contact with either, both my grandfathers were professional gardeners in England and my father and uncles maintained good gardens. One uncle always had a good display of dahlias, while another separated his flower and vegetable gardens with a row of sweet peas.

I was drawn to both plants and at the age of fifteen, with the encouragement of my parents, joined the local Worcester Park Horticultural Society in Surrey. Recreational horticulture was very strong in the decades

immediately following the Second World War and at that time the society had in excess of 2,000 members. Included were many skilled exhibitors who competed successfully at national level with a range of flowers and vegetables. Included amongst them was Pi Ensum, Britain's most successful *Dahlia* exhibitor and breeder.

Even in the 1950s, a teenager interested in horticulture was a novelty, and I received much encouragement and mentoring, which enabled me to compete successfully both at local and national level. This in turn added

relevance to biology classes at school, and I went on to study botany at the University of Southampton.

Throughout my time at university I remained active in recreational horticulture and served on the committee of the National Sweet Pea Society and qualified as a judge with the National Dahlia Society. Although already starting to breed both sweet peas and dahlias, I opted for plant pathology for my PhD topic. Once qualified, I was recruited by the New Zealand Department of Scientific and Industrial Research (DSIR), and came to Auckland, New Zealand in 1967.

Immediately, I broke in a small home garden and continued breeding sweet peas. After six years, I was able to buy a 4ha property on which I built a house. This greatly increased my scope to indulge in further breeding

### An aesthetic activity

I believe that when engaged in any activity, it is important to frequently question what one is doing and why. Over time we should develop and refine an overarching philosophy for our work. For me, breeding ornamental plants is an aesthetic activity comparable to painting a picture or composing a piece of music. In contrast, someone who breeds crop plants is more akin to an engineer.

However, in both cases, plant breeders are privileged to be using plants that have evolved over millions of years and it is important to remember that we have a special responsibility to pass on wild taxa unsullied to future generations.

### Deficiencies of exhibition breeding

Any breeding programme must have a clearly defined goal; simply sowing open-pollinated seed and looking to see what arises is not breeding. Coming from a competitive flower show background, I initially set out to produce cultivars that were capable of winning on the show bench. Currently exhibitors, rather than nurserymen, produce most, if not all, new cultivars of exhibition plants. For an individual, this is a natural progression; to win on the show-

bench an exhibitor must learn to recognise traits deemed desirable and at the same time they will be subconsciously selecting potential parents.

In the short term, exhibitor breeders are often very successful, however, there are longer-term consequences. Hobbyists work with very small gene pools and narrowly defined objectives. Both of these quickly reduce the genetic variability of the material being used. In some genera, this can lead to inbreeding depression. In the *Dahlia*, the pursuit of form has been at the



*Primula* 'Blue Mountain'

**'When I read a plant catalogue, I try to look for things that are missing'**

expense of colour, especially in the UK. While in Australasia, where blooms are exhibited without foliage, no consideration is given to leaves or the plant as a whole.

In as much as the numbers of plants grown on an exhibition cultivar are very low, performance parameters such as propagation ability, garden worthiness and tuber characteristics also tend to be overlooked, and the overall result is the production of a series of developmental cul-de-sacs. In contrast, plants bred for larger scale mainstream commercial production are

subjected to much more rigorous selection pressures.

Competitive flower showing did define my initial work with *Dahlia*. I have always been attracted to neat and tidy, rather than big and blowsy, so I set myself the goal of producing a series of show-worthy Miniature Decorative cultivars in a full range of colours. I remembered one of my early mentors saying to me that it was unwise to cross two cultivars from the same breeder. Consequently, I chose as parents cultivars that had been bred in different countries. While this was no guarantee of genetic distance, it served me well and I achieved my goal. Probably the most successful individual cultivar globally was *Dahlia* 'Elizabeth Hammett', which is still being exhibited today.

### Leaving the show bench

When I read a plant catalogue, I try to look for things that are missing. When I started breeding sweet peas I was aware that although the original wild *Lathyrus odoratus* is bicoloured, the goal of breeders subsequently had been to produce self-coloured blooms where the standard and wing petals are the same colour. Bicoloured sweet peas were seriously at risk of being lost.

Fortunately, I had acquired a small collection of ancestral cultivars, among which were some distinct bicolours. It was not difficult to create a new strain by crossing the best modern cultivars of the day with some of the old bicolours. I realised from the outset that it would take several generations to fully combine the bicolour characteristic with sufficient other traits to make the cultivars show-worthy, but this did not matter as I was now working in another cultural environment, where the show-bench had little relevance. The bicolour sweet peas and later refinements have been offered variously as *L. odoratus* 'Two Tone', 'Love Match', 'Melody Bicolour' and 'Pathfinder'.

### An excursion into fruit

The success of kiwi fruit (*Actinidia chinensis*) as an export crop from New Zealand in the early 1980s meant that greater emphasis ➤



*Dahlia* 'Timothy Hammett'



An un-named black and white *Dahlia*



*Dahlia* 'New Horizon'

was given to research into possible new crops. When the department I worked for was split in two, I chose to become a new crop specialist rather than a plant pathologist.

The pepino (*Solanum muricatum*) was identified as a plant that might be transformed into an internationally viable fruit crop. Stuart Dawes, who had assembled a unique gene pool over a quarter of a century, was due to retire in two years. My director of the time, Dr Rod Bielecki, had the wisdom to enable me to overlap with Stuart and to expand his breeding work. Low yields, unpredictable off-flavours and a propensity for fruit to bruise limited the success of the few commercial cultivars. However, all the desirable traits needed existed in the gene pool available to me. I developed a number of collaborative studies, the most valuable proved to be with Prof. Brian Murray a cytogeneticist at the University of Auckland. We made considerable progress in developing lines of bruise-resistant fruit and lines with reliably acceptable flavour. Unhappily, a major restructuring of government research institutes took place at the time when I was poised to bring these two lines together. All work on new crops ceased and a number of valuable gene pools assembled at considerable cost, over many years, were lost.

### Going independent

After two years I chose to work as an independent plant breeder, and have been fortunate to maintain my relationship with Brian and a succession of his research students. There is an inherent tension

between pure scientific research, which seeks to expand knowledge, and practical plant breeding which seeks to produce useful plants. However, by working in parallel, we have been able to produce a body of published scientific knowledge that has, at the same time, had considerable practical use.

With any plant there is usually a holy grail to be sought. In the case of the sweet pea it is to introduce yellow pigmentation. To this end, I amassed a large collection of *Lathyrus* species, including all that were reported to have yellow flowers. When *L. belinensis* was discovered and named we obtained seed. Despite the genus being notorious for interspecific breeding barriers, using embryo rescue techniques we were able to produce hybrids and to integrate genes from this species into *L. odoratus* for the first time. Although clear evidence of yellow pigmentation has been elusive, some interesting hybrids, such as *Lathyrus* 'Blue Vein', have resulted from this cross.

After producing the first series of bicoloured sweet peas, it occurred to me that they might be more pleasing if the wings were darker than the standard petal, in effect a reverse bicolour. This was a far greater challenge than rescuing original type bicolours, as there were no obvious parents. However, by careful observation and a stepwise approach over nearly a quarter of a century I did produce *L. odoratus* 'Leading Light', the first reverse bicolour. More recently, modifier genes from *L. belinensis* have enabled a much greater

contrast between wing and standard colour, as demonstrated in the recently released cultivar 'Erewhon'.

### Further questions

*Dianthus* is another genus that has long interested me. As part of our studies into yellow pigmentation we posed the question of why there were yellow cultivars of *D. caryophyllus*, the carnation, but not of *D. plumarius*, the pink. As with our *Lathyrus* studies, we undertook collaborative research with pigment chemist Dr Ken Markham. This in turn led to pigment studies in *Clivia*.

With all my work I have attempted to amass as large a collection of taxa, both wild and cultivated, as possible. This is something that is becoming increasingly difficult to achieve with increasingly rampant parochialism and draconian



*Lathyrus* 'Blue Vein'

biosecurity barriers. I do not believe that anyone can claim to own plants or animals that have evolved over millions of years. Mankind has contributed nothing positive to this process. I do, however, fervently believe that we have the responsibility to act as custodians of biosecurity and that this is a global, not just a local responsibility.

To this end, I brought together the largest and most diverse collection of *Clivia* in New Zealand, which enabled a comprehensive cytogenetic study of the genus and the naming of a new species, *C. robusta*. I have raised a number of interspecific hybrids, including yellow-flowered cultivars such as *C. 'Sandra'*.

Increasingly, I think it important that horticulturists and plant breeders should see the plants with which they work, growing in the habitats where they have evolved. Visits to Mexico for *Dahlia* and to South Africa for *Clivia* were humbling and fundamentally altered both my paradigms and the direction of my breeding programmes.

### Dahlias and chromosomes

My *Dahlia* species collection enabled a detailed cytogenetic study that resulted in a greatly enhanced understanding of the nature of polyploidy in the genus. Knowing the chromosome number of individual cultivars and species variants has enabled their genes to be used. In addition to the genomes of *D. coccinea* and *D. pinnata* already present in the garden *Dahlia*, new



*Clivia 'Sandra'*

species have been crossed with it for the first time since its genesis over two centuries ago. *Dahlia 'Titoki Point'* and *D. 'Home Run'* are examples of cultivars with *D. australis* genes.

Possibly most significant has been the raising of tree dahlias with a range of colours other than lavender and white. This was only made possible by an understanding of the ploidy level of specific *D. coccinea* accessions in relation to the various species of tree dahlia. Tree dahlias with greatly enhanced garden performance have been produced by the use of species other than *D. imperialis*, the best-known tree dahlia. The mauve-flowered *D. 'Timothy Hammett'* (putatively *D. tenuicaulis* x *D. apiculata* x *D. coccinea*) and its yellow flowered offspring *D. 'Conundrum'* are the first to have been released, but others, in a range of colours, are in the pipeline.

A concept conceived with one genus can be extrapolated to another. The notion of reverse bicolor sweet peas led me to realise that Colletterte dahlias were either self-coloured, or if there was a contrast, the ray florets were darker than the collar. Now, after many years work, I have produced reverse Collettertes which have a collar darker than the ray florets. The first of these were *D. 'Dark Tiger'* and *D. 'Pale Tiger'*.

Where does one stop? The attractiveness of finely divided foliage in species such as *D. dissecta* and *D. apiculata* led me to develop the Mystic Series with divided foliage, albeit in this case also darkly pigmented. I am also trying to perfect a *Dahlia* cultivar with a

black disc and white ray florets.

I also work collaboratively on other genera such as *Helianthus*, *Nemesia* and *Primula*. With the latter I have raised a number of laced polyanthus cultivars such as *P. 'Blue Mountain'*. However, with the introduction of student loan schemes, undue emphasis on molecular biology and poor career prospects in horticulture and biological science, it is getting increasingly difficult to recruit students of a suitable calibre.

### Commerce and fashion

Philosophically, it has been a privilege to approach plant breeding as an artist / scientist and not simply as a generator of new product. I have managed to survive as an independent plant breeder, largely because I established an infrastructure while working as a full-time scientist. However, I seriously doubt whether a young person today would be able to contemplate doing anything similar.

To disseminate cultivars internationally and to garner royalties takes an enormous amount of time and effort, which detracts from the time available for breeding. Plant Variety Rights, Plant Breeder's Rights and Plant Patents are a good idea, but only work if a sound, long-lasting propagation and marketing infrastructure can be established. The breeder, most often, is the last person to receive any reward for his or her efforts, while hard-won commercial arrangements can easily be overturned by corporate machinations.

All too often, a one-off chance seedling will do better commercially than the product of a coherent long-term breeding programme. Ornamental plants are a fashion industry and the ornamental horticulture industry provides very little input into research and development. Can you imagine the car industry relying on weekend hobbyists for future developments?

Notwithstanding, I am a plant breeder by choice and give thanks that I have been able to indulge myself in this way

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*Lathyrus 'Erewhon'*