

Canadian breeder ALAN McMURTRIE is revolutionising early-flowering bulbous irises by expanding the range of yellows and introducing new patterns

Iris 'It's Magic' with good yellow colour and striking patterns. Note the wispy standards inherited from *Iris danfordiae*



Breeding new Reticulata irises

CULTIVARS DERIVED from *Iris reticulata*, conveniently known as Reticulata irises, have flowers that are mostly shades of blue or purple. Exceptions include near-white 'Natascha' from the 1970s and pale blue and yellow 'Katharine Hodgkin'. The last, along with the similar 'Frank Elder' and 'Sheila Ann Germaney', are sterile hybrids between *I. histrioides* and *I. winogradowii*.

Other recent developments include sports from 'Katharine Hodgkin' and 'Harmony', wild-collected bicolors, and a couple of sterile hybrids between 'Cantab' and *I. winogradowii*.

New Reticulata iris cultivars are mostly sports from existing cultivars selected by companies growing them at field-scale. They include sports of blue-flowered 'Harmony', such as 'Alida' (pale blue) and 'Pixie' (violet), and an as-yet unreleased purple and a near white. 'Harmony' is a reliable cultivar for forcing, so forcers favour others in its extended family. Purple-flowered 'George' is well known for sporting blue, and what was once known informally as 'Blue George' is now 'Palm Springs'.

However, I am improving the range of Reticulata irises by using material collected from the wild, including *I. danfordiae*, a yellow-

flowered species, that I collected in Turkey 30 years ago.

My aim is to produce cultivars with new colours and patterns that are robust, clump-forming and that come back year after year, while giving a modest number of blooms.

New breeding stock

Iris danfordiae has beautiful lemon-yellow flowers with a pleasant scent, but the plant does not reappear in the garden. Dig it up after its first year or two of flowering and all you tend to find is numerous bulblets. Growers speak of the original bulbs as having 'shattered' – they planted nice large bulbs, but all they find in



Parent species used in the breeding programme: *Iris danfordiae* collected from near Darboğaz in Turkey (left); an unidentified purple-flowered species collected from near Çat in Turkey (centre); and *Iris sphenensis* (right) obtained from a cultivated source

their place is numerous rice-grain-size bulbs. When bought from a bulb supplier they usually have sufficient energy to regenerate two bloom-size bulbs for the following year. But conditions in most gardens are not good enough to produce further bloom-size bulbs. More gardenworthy, yellow-flowered Reticulata irises are needed.

This poor performance is a characteristic of the sterile, triploid ($3n=27$), commercial form of *I. danfordiae*. It was presumably initially selected because of its larger flowers than diploid forms. However, in 1985 I was fortunate to collect *I. danfordiae* in Turkey, and

near Darboğaz I found what turned out to be a fertile, diploid ($2n=18$) form of the species. It also produces numerous bulblets but has been useful for breeding. Hybrids from this diploid *I. danfordiae* can be vigorous enough to rebloom every year.

Diploid *I. danfordiae* and its hybrids tend to bloom in the first half to two-thirds of the flowering season. Partly as a result of this, the flowers are typically up well before the leaves, which shows them off better. *Iris reticulata* hybrids bloom in the final two-thirds of the season and their leaves tend to be at the same level or higher than the flowers.

Iris histrioides and, to a degree, its hybrids, also produce bulblets, but they are less numerous and tend to be slightly larger.

Two other taxa have been important in my breeding work. One is an unidentified purple species I collected near Çat in Turkey. The other is *I. sphenensis* (syn. *I. histrioides* var. *sphenensis*), a blue-flowered species given to me by Frank Kalich in 1987.

Breeding basics

When you cross two species the first generation of hybrids (F_1) tends to be fairly uniform in appearance. Breeders will then cross these hybrids with each other, or back onto their parents, and it is in the second generation (F_2) and subsequent ones that recessive characteristics can express themselves.

When *I. danfordiae* is crossed with *I. sphenensis* the F_1 hybrids are blue, because the blue of the latter parent is dominant over the yellow of the former parent. Whites with blue accents start to appear in the F_2 progeny. This is the result of the blue and yellow genes being turned off, yielding white and revealing an underlying pattern of blue ribbing on the style arms and blue dotted or veined markings on the fall blade. Sometimes there is a yellow infusion around the fall ridge. Occasionally ➤



Iris 'Eye Catcher' is recently released and becoming available commercially

All photographs by Alan McMurtrie



It took ten years for the breeding programme to yield good whites such as *Iris 'Starlight'*

the accents are green, which is a combination of blue anthocyanins and yellow carotenes.

Iris danfordiae has a short bristle as a standard, in contrast to other species where it is 7–10mm in width. In F₁ hybrids with *I. sphenensis* this results in standards that are 1mm or less in width but of normal length. In subsequent generations they are somewhere in between, in both width and length.

Breeding limitations

Working with Reticulata iris is a very slow process as each generation is five years. For crosses that should work, hybridization success rates vary year by year from 25 to 65%. Germination rates are around 30 to 33%, with 5 to 8% losses during that period, giving a net of about 25%. I am now applying gibberellic acid to the seeds at various stages to try to improve this.

Now that I have new seedlings blooming every year, one priority is replanting the promising ones, so bulbs of the most interesting can be sent to the Netherlands for trial as soon as possible. At the same time I need to maintain enough bloom-size bulbs in Canada for use in hybridizing.

An even slower process is the building-up of stock by the grower to the point where sales can begin. It takes at least 12 years to get tens of thousands of bulbs, and after that it might need to increase to hundreds of thousands as, hopefully, demand picks up. For this to work optimally you need good bulblet production in the early years. With typical hybrids the overall increase each year is about 2.1 to 2.4 times. In the case of diploid 2n=18 hybrids, which produce many small bulblets, that rate is more than 3 times.

For common cultivars propagated in large quantities, growers get 3–4 Euro cents per bulb and their costs are perhaps 2.5 cents per bulb. They face a significant risk if bulbs are unsold, as they have already spent money planting the bulbs out prior to orders coming in. Wholesalers and exporters wait as long as possible before placing orders with, so they are not left with unsold bulbs. For 200,000 bulbs a grower's costs are around €3,000, so they need to sell 100,000 bulbs just to break even.

Flower size

Bulb growers usually say that wholesalers and exporters want cultivars with large flowers – 70mm from fall tip to fall tip. Although *I. sphenensis* has flowers of 70mm, the other parents in the 2n=18 group are smaller. For instance, the species from Çat is 38mm, and diploid *I. danfordiae* is 33mm compared to 45mm for the triploid form. I may be happy with the cultivars I have raised, but my primary goal is for



Iris 'White Caucasus' was an early selection from crosses using triploid parents available commercially



Iris 'Spot On' (above left) and *Iris 'Scent Sational'* (above right) were introduced in 2014.

A hybrid derived from '*White Caucasus*', 03-AN-3 (below), produces up to five flowers per bulb, so could be particularly useful in further breeding.



others to grow and enjoy them. This is one of the reasons why I am having a lab create tetraploid versions of some of my hybrids.

One of my cultivars, 'Eye Catcher', is a good size (55mm tip to tip) and should do well commercially. 'Orange Glow' is attractive but at 40mm it is seen as a bit small. A tetraploid variant, which bloomed for the first time in 2015, is 50mm, so should sell better. I therefore have to take a gamble on this as it takes 10 years to build stock to the point where sales can begin, and then two more years to gauge public reaction. With these long timelines you need multiple strategies.

Early cultivars

Crossing existing commercial triploid cultivars essentially gives more of the same. In the early days I tried to break this pattern by introducing fresh wild genetic material into the crosses. Three of those original cultivars are now sold commercially: '*White Caucasus*', from the Lake Sevan area of the Caucasus mountains in Armenia, and purple-flowered 'Spot On' and 'Scent Sational'.

Another exciting seedling from triploid crosses is 03-AN-3, because it can produce up to five full size flowers per bulb. Occasionally, 'Scent Sational' will give three flowers per bulb.

My more successful breeding is with $2n=18$ parents. It took 10 years to get my first white-flowered F_2 cultivar, 'Starlight', and several more years to see further F_2 hybrids.

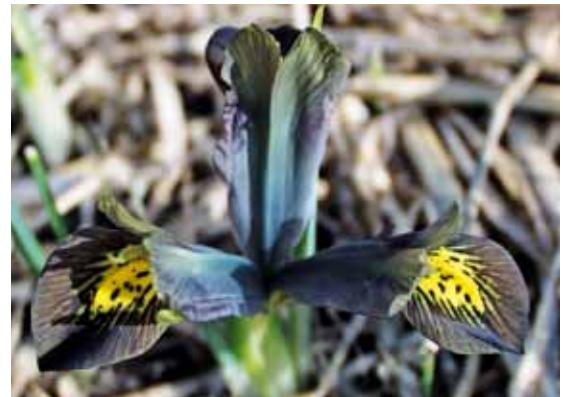
When the F_1 first bloomed from diploid *I. danfordiae* crossed with *I. sphenensis* the next question was what to cross them with. The pollen looked good under a microscope, so crossing them with each other was most likely to work, which is what I did. This is in contrast to existing cultivars, such as 'Harmony', which seemingly produce good fluffy pollen, but under a microscope you can see the pollen grains are misshapen.

Three of the F_1 plants showed a bit of yellow influence, which made their blue look a touch dark. I thought the F_2 plants might turn out muddy and would need cleaning up in subsequent generations. I was therefore overjoyed when the first F_2 bloomed and turned out to be a lovely creamy white. I suspected that the blue F_1 plants might hold something valuable, so I started keeping records and statistics of crosses made with them.

As well as blues (pale blue to dark blue and violet), whites (typically with blue or green accents) and yellows, the F_2 hybrids also included yellow-and-blues (yellow with blue spots, yellow with blue veins, and greens through to browns).

Back-crosses to *I. danfordiae*





Examples of more unusual colours with shades of green and brown include *Iris 'Sea Green'* (left) and *Iris 'Down to Earth'* (above).

occasionally produced spotted, pale blue-green hybrids.

The problem with some of these hybrids from a commercial point of view is that the flowers are on the small side, due to diploid *I. danfordiae* having smaller flowers than the sterile, triploid commercial form. Also, at least one Dutch commercial bulb grower thought buyers would not accept them if they did not have 'normal' standards. Although *I. danfordiae* and some of its hybrids only have bristles as standards, its falls are held quite upright and it has wide fall blades and style lobes, so the flowers still look full.

These early hybrids are limited to the colour categories mentioned above. It was when I started using the unidentified purple species from

Cat that things started to open up. It became apparent that even orange was possible!

***Iris danfordiae* hybrids**

New cultivars that I have raised using diploid *I. danfordiae* have revealed a broad range of colour possibilities. These include whites such as 'Starlight' and other unnamed ones, and white and blue ones.

Yellow-flowered cultivars include some with full-size standards which could supersede the triploid clone of *I. danfordiae* currently offered commercially. Others combine yellow and green, yellow and black or brown, and yellow and wine-red.

Seedling 08-FW-2 may be purple, but its ground colour is orange, and that colour is the best orange



so *Iris 'Sunshine'* (above) is a good yellow without standards, and wispy standards are evident in 06-EJ-2 (left). *Iris 'Orange Glow'* (below) shows promise.





Seedling 06-CC-3 (above) is pale blue and *Iris 'Plum Cuddles'* (right) is a good purple. Extra flower parts sometimes appear in *Iris 'Eye Catcher'* (below).



Iris 'Sea Green' (above) fades to blue and *Iris 10-BL-1* (below) has unusual dark shades with yellow



far. Also, the colour lasts for two days, not the usual half-day. The breeding challenge here is to turn off the purple.

Although I am told there are enough blue-flowered cultivars in existence, I have raised some notable selections in this colour. Seedling 06-CC-3, for example, is a lovely pale blue with excellent form. Additionally, 'Sea Breeze' is a lovely blue with white style lobes and a large white patch infused with a bit of yellow. From a distance clumps seem white. When purple colours arise they tend to be combined with blue.

Other colours include various shades of green, brown and black (actually intensely dark blues or purples). Some of the more unusual ones include 'It's Magic' (photograph, p20) and 10-BL-1 and those with unusual marginal patterns.

The fading of flower colour in Reticulata iris is not normally favoured. It is best if colours are bright and sun-fast. However, in some cases it can be an attractive feature. For example, my 'Sea Green' holds its green colour until close to the end, then changes to an attractive pale blue. Others also fade in appealing ways. Streaks in the flowers are another colour variation that arises in some hybrids.

In addition to colour fading, selections can vary quite surprisingly

depending on the location where they are grown. For example, 'Pristine' looks very different when grown in the Netherlands, where it has thin flower parts, to what it looks like in my garden in Canada, where it is more substantial.

Other variations include extra flower parts, such as an additional style arm, or a fall in place of a standard. In 'Eye Catcher' this behaviour is now quite common, although it was not when I first raised it.

Future hybridizing goals

My long-term aims are to continue creating new, unusual colours and patterns. An early goal was to create a pale yellow, effectively to break the lemon-yellow mould of *I. danfordiae*. I did that a few years ago, in particular with the lovely 01-FS-2, and 03-CC-3. The former was exhibited at a RHS show in February 2016 and the latter may be exhibited next year.

In the short term I would like to produce a bright, non-fading orange. In 2003, when 'Orange Glow' and similar colours bloomed for the first time, it was clear that one day this will be achievable. However, I need a stronger, more intense orange, and it needs to be sun-fast. In 2015 seedling 08-FW-2 showed a big step in that direction but now I need to get that orange ground into a ➤

large flower with nice form, and improve the sun-fastness.

I am also aiming for white with dark cherry-red accents, and an elusive goal is to create a pink, just as we now have with tall bearded iris.

Polyplody possibilities

I hope that Reticulata iris breeding can be enhanced by developing polyploids; essentially tetraploids ($4n$), and possibly octaploids ($8n$). This can lead to flowers being 20–30% larger, and having more substance. They can then tolerate poor weather better and last longer. For instance, diploid 'Orange Glow' has flowers 40mm across, but they are 50mm in the tetraploid version.

Another benefit of polyplody is intertype hybrids. This means being able to cross $2n=20$ plants with $2n=18$ plants and having the progeny remain fertile, thus being able to go further with breeding. First, the parents would need to be made polyploid, giving respectively $4n=40$ and $4n=36$, and then their progeny would be $4n=9, 9, 10, 10$. Since the two $n=9$ chromosomes pair up and the two $n=10$ chromosomes pair up, the plants should be fertile.

The full benefits of this have not been determined, but it could have lots of potential. For example, you could take one parent with very large flowers, another with significantly more flowers per bulb, and mix them in with a couple of parents that have interesting colours or patterns.

To develop wider ranges of colours and patterns I need to pull out recessive genetic characteristics. Unfortunately, this is harder when working with polyploids, so there is an incentive to continue breeding at the diploid level and have a laboratory convert the most interesting to polyplaid for breeding or commercial purposes. This is an expensive proposition, and I do not



Iris 'Mars Landing' is an unusual combination of reddish brown and yellow.

foresee sufficient income to support it. There will be advances from polyploid breeding, but overall there may be more advances from the existing momentum at the diploid level. Time will tell.

My first polyploid bloomed in the Netherlands in 2015, and it will take longer to get more tetraploids to seriously breed with. I will get bulbs of these first few into Canada in 2016 and hopefully have hybrid tetraploid seed in 2017, which will potentially bloom in 2022. Assuming something worthwhile is produced it will take at least 10 years to bulk up the bulbs for early sales, which takes me to 2032.

The process could possibly be speeded up by micropropagation, but I think it is more worthwhile spending my profits on creating the polyploids in the first place.

Cultivation and propagation

These hybrids have been raised under reasonably harsh conditions in Toronto, Canada, so they are fairly robust.

For long term plantings, resist the urge to initially plant large bulbs close together to get an instant clumping effect. Give the bulbs

a reasonable amount of space. I recommend replanting Reticulatas every two or three years, especially if bulbs are planted close together. It is actually a good idea to plant some in another part of the garden. And if you plant some in a sunny location and some in a shady location, you can extend the growing season. It is also a good idea to plant some early varieties and some later ones.

If you plant seeds or bulbils, be sure to cover them each winter with a mulch of leaves, or better yet, straw to keep the soil surface frozen and prevent premature germination or growth. Once the snow has melted you can remove most of the straw.



Iris 'Velvet Smile' received a Certificate of Preliminary Commendation from the RHS in 2016



Seedling 05-GQ-3 dates from 2012 and is one of the best yellow and reddish purple selections

By the time the leaves die down in late June they have grown to 45–60cm in length. A bulb forms at the base of each leaf, so if you damage the leaves you are directly damaging next year's bloom.

If you need to store the bulbs out of the soil then dig them up just as the leaves are dying down. Store them over summer in mesh bags hanging in a cool, dry location. If you dig up bulbs at the end of summer or early autumn, and leave them unplanted for a couple of weeks, they can go soft. If you do this, make sure you replant them within two days. Bulbs dug up in early summer and properly dried are fine in storage.



Iris 'Storm' will hopefully be made available commercially by UK nurseries

Gardeners can benefit from the production of numerous bulblets. You can use them to multiply a cultivar faster than it would otherwise. Simply replant them closer to the soil surface, like first-year bulbs from seed, at 1–1.5cm depth. If they are left at the base of the bulb, as they would be when in a clump, not all of them will have sufficient energy to get a leaf up. For instance, in my garden mature bulbs typically place themselves at 7cm depth. They will form clumps. For fun, try planting a few individual bulbs or bulblets around the garden and what happens after a few years.

If you have problems with bulbs rotting or not reappearing, make a mound of soil and plant them in that. If you have problems growing them in a trough then change the compost to improve drainage.

Conclusion

I have come a long way from plant collecting in Turkey 30 years ago, which gave me the foundation for the work I am doing today.

Every year it is amazing to see new Reticulatas blooming for the first time. I look around the garden each spring day to see buds coming

through the ground, then I watch as the first colour appears. Some buds that look interesting, like they are going to produce something amazing, turn out to give just something ordinary. Then every so often you do get something amazing, such as the first yellow and reddish purple combination in 2011, followed in 2012 by the even more exquisite 05-GQ-3.

I am fortunate that several of my cultivars have been recognized with RHS awards. In 2015, 'Sea Green' received an Award of Merit and 'Eye Catcher', 'Spot On', 'Storm' and 'Sunshine' received Certificates of Preliminary Commendation. In 2016, 'Spot On' received an Award of Merit and 'Pristine', 'Scent Sational' and 'Velvet Smile' received Certificates of Preliminary Commendation.

I hope I can successfully get more of these into the market so that gardeners enjoy them. Stocks of many are being built up in the Netherlands. Three large-scale Dutch growers have rejected both 'Storm' and 'Sea Green' but I am working with Jacques Amand International to introduce them in the UK. I have also managed to regain control of 'Orange Glow' and intend to introduce that as well. In the meantime, several of my other cultivars are available from UK nurseries such as Avon Bulbs, Jacques Amand International, Pottertons Nursery and Rare Plants.

I hope gardeners will like what I have raised and will want to try a few more cultivars every year. What we are seeing at the moment is only the tip of the iceberg. The future looks extremely exciting.

ALAN MCMURTRIE is an amateur plant breeder based in Toronto, Canada
www.reticulatas.com