Reticulata Iris: Creating a Rainbow

Alan McMurtrie

The first irises to grace the rock garden in spring are the "Reticulatas," or members of subgenus *Hermodactyloides*: the species *I. reticulata, I. danfordiae, I. histrio, I. histrioides, I. bakeriana, I. hyrcana, I. kolpakowskiana, I. pamphylica, I. vartanii, I. winkleri,* and *I. winogradowii*. I started hybridizing them in 1983 and have since opened up a whole new world. I did this by crossing *Iris sophenensis*, a diploid form of *Iris danfordiae*, and an unnamed species I had collected near Çat, Turkey. *Iris sophenensis,* originally described by Foster as a variety of *I. reticulata*, was raised to species status by Dykes in 1930; Brian Mathew in 1981 reclassified it as *I. histrioides* var. *sophenensis*. The Çat Reticulata (photo, p. 279) is illustrated in Mathew (1981, plate 34), and is still under study at Kew. All three are quite prone to "shattering": producing lots of rice-grain-sized bulblets, along with main bulbs too small to bloom the following year. The new crosses, however, show hybrid vigor, with most blooming consistently year after year.

Until now, Reticulata irises have been available mainly in shades of blue, violet, and purple. In the 1970s, William van Eeden produced the near-white 'Natasha', which many find weak, but the best white commercially available. The commercial clone of lemon-yellow *Iris danfordiae* is a triploid, with three rather than the normal two sets of chromosomes, and thus is sterile. Many rock gardeners grow E. B. Anderson's 'Katharine Hodgkin', whose parents are pale yellow *I. winogradowii* and blue *I. histrioides*. Its dark blue spotting on cream ground with yellow flash is stunning. The cross has since been repeated in such clones as 'Frank Elder' and 'Sheila Anne Germany'. All are sterile even though both parents have the same chromosome count (2n = 16), so hybridizers can take them no further.

When Wim de Goede, a commercial bulb grower in Holland, saw my first-generation hybrids between *sophenensis* and *danfordiae* in 1997, he said they were nice, but "just blues." Now I have moved well beyond blues. I'd like to tell you how I got to where I am today, and why.

Reticulata Facts

Bloom starts as soon as the snow disappears, or around mid-February in snowless temperate gardens. The flowers emit a wonderful perfume on warm days. They grow best if lifted, separated, and replanted every two years. They are susceptible to ink spot disease, a fungal infection; damage from it can be prevented by providing good drainage, particularly when the leaves are dying down. These species come from eastern Turkey, Syria, Iran, and the Caucasus, growing in mountains where it's very dry in summer.

The flowers, which look stemless, rise 2.5–4.5 inches (about 6–12 cm) tall and are typically 2.25 inches (6 cm) in diameter. The leaves are square to octagonal in cross-section and elongate to 18–24 inches (45–65 cm) by the time they die down in early summer. The bulbs have a netted ("reticulate") covering called a tunic. Typically, plants take five years from seed to first bloom. Most species have the chromosome number 2n = 20; *histrioides* and *winogradowii* are 2n = 16. The three species I used are all 2n = 18.

For additional information, including numerous pictures, visit my website, <www.Reticulatas.com>. I'd be glad to hear which are your favorites, and which ones you'd like to see commercially available.

A Door Starts To Open

In 1994, my first *sophenensis* × *danfordiae* hybrids (hereafter s×d), started to bloom—16 clones from 3 crosses. I expected them to be sterile because of the parents' chromosome counts, but I just had to try intercrossing them. To my pleasant surprise, I got 130 seeds from 11 successful crosses. I knew fellow iris enthusiasts would be skeptical. Although the seed appeared to be good, it might die when it tried to germinate. For example, out of more than 300 crosses and more than 4800 seemingly good seeds from diploid *danfordiae*, only four or five have produced blooming bulbs (with the exception of those involving *sophenensis*, Çat, and of course selfed *danfordiae*).

The first F2 (second-generation) hybrid bulbs flowered five years later, in 1999. 94-HW-1 (named 'Starlight'; photo, p. 281) is white with lovely blue accents and a touch of yellow. (I had expected the veining of *sophenensis* would be a dominant feature that would take generations to eliminate.) Moreover, 'Starlight' is proving a good doer.

The next year more 1994 F2s bloomed, along with a couple from 1996. Surprisingly, many of these were whites with a similar pattern to 94-HW-1. I refer to this group as "white-blues" or "white with blue accents." The white of 96-DZ-1 is absolutely pure, its petals glistening in sunlight like fresh snow. That year my first yellow hybrid also bloomed, appearing rather like a more green-spotted *danfordiae*. Most amazing was a beautiful new pattern that I'm calling "spotted light blue-green," coming from a back-cross to *danfordiae*. 96-BN-1 is breathtaking: large blue-green spots on its fall blade, with a predominant yellow blotch in the middle. The style arms have a blue ridge, with the inner portion being light yellow-green.

In 2001 another 13 new F2s bloomed, many of them yellow-blue combinations. One of special interest was 94-AT-2 (photo, p. 280): its falls are dark brown on a rich yellow background. The yellow shows through mainly around the similarly colored central ridge. Its style arms are several shades of dark blue.

In 2002 the number of new F2 s×d hybrids jumped to 57. Of particular interest were: 97-CQ-1, which is sea-green, becoming intriguingly bluer just as the flowers finish; three more "spotted light blue-green" (one without any yellow, making it a gorgeous spotted powder blue); and two cream hybrids without much blue influence. In addition, there were three special second-generation clones involving the Çat Reticulata. One of these I've tentatively named 'Storm' (98-NP-2) because its falls have dense black veins over a bright yellow background, and its style arms are dark blue. In sharp contrast, a sibling is cream with bright yellow around the fall ridge. The third clone (97-VS-1) is a slightly lighter yellow than *danfordiae* with black (or very dark green) markings on the fall and dark green style ribs.

Color Breaks Involving Çat

In 2003, 68 new F2 s×d hybrids bloomed, and in spring 2004 there were 100 more. Most amazing was the number of color breaks. In the past I wrote, "I would classify my second most promising line as involving Çat x *danfordiae*: 88-AX. I believe their biggest potential is in intercrossing with *sophenensis* × *danfordiae* hybrids." The 98-NP group realizes that potential, with 11 clones ranging from white, to plum, to pale yellow, to rosewood, and one I can only describe as "chameleon." All are of pretty good size, too, even though both the parents are small, and all appear to be good doers. A dozen other crosses with high potential are on the small side, but this means they're great for rock gardens. For the mass market, where it seems "bigger is better," a few more bulbs would be needed for a showy display.

Of particular interest, several of these hybrids are halfway between yellow and orange. In many, the color lightens toward yellow as the flowers age. The most steadfast is 98-ND-2, whose fall is unmarked except by a few light dots near the fall ridge. It's quite striking, especially blooming alongside the bright yellow 98-ND-1. If you want more than pure color, 98-OO-4 (photo, p. 282) fills the bill. I personally like 98-OO-6, which is less orange but has dark-green style ribs and nearly black variably sized spots on its otherwise evenly colored fall blade. Now that yellow-orange has been accomplished in just two generations, the question is no longer "Is orange possible?" but "How soon will we have a large-flowered orange?"

Other unusual things starting to show up include very dark colors, such as solid dark violet with yellow in the areas around the fall ridge that would typically be white. There's a gray, yellow, and black combination that I refer to as 'Evil' (98-GZ-3). There are also several different patterns of fall dotting and veining.

Sophenensis × *danfordiae* Color Breaks

I hope to determine that *danfordiae*'s lemon yellow is actually made up of a number of different carotenes. This would increase the range of expression possible in the offspring. We know pale yellow is possible in Reticulata irises because of *I. winogradowii*. To increase the color range requires the genetic capability to produce the chemical compounds that give the other colors, along with the genes ("switches") to turn those expressions on or off. You can cross two blue or two purple Reticulatas until you are blue in the face but you'll never get a yellow, because in all parents the yellow switches are off. Even though the genes to produce yellow are there, they can never express themselves. Thus, my goal has always been to shake up the genes as much as possible by working with widely varying clones from the wild. To pull out recessive characteristics takes more than two or three generations. We'd all like to create the *pièce de résistance* right away, but I'm quite pleased with what I've achieved so far.

Carotenes are fat-soluble pigments in plant cell walls that give the yellows, oranges, and pinks we see. A number of my hybrids hinted more was possible. One of the first hints was the amoena 98-MN-1. The term "amoena," to iris specialists, means its styles and standards are white (here, with pale greeny-yellow style markings), and its falls are a color, in this case pale yellow. The similar 98-JI-2 bloomed this year, slightly smaller with more dotting. I intercrossed the two and was rewarded with 54 seeds, an unusually high number.

You may notice in the photos that the standards are "missing" on some of the s×d hybrids. If you look carefully you will see them; they've just been reduced significantly in width: 0.3–3.0 mm, versus typical *Iris reticulata* standard width of 7–10 mm. Most F1 standards are 30 mm in length, compared to more typical ~40 mm. F2 hybrids are much more variable at 5–35 mm. This is due to *danfordiae*, which has just short bristles for standards. Personally I don't really care whether a flower has standards or not; I'm more concerned with how it looks overall.

Genetic Switches and Color Depth

Now that I have a reasonable number of F2 s×d progeny, I can start to analyze the high-level genetic switches that are at work. If I had tried this earlier, I would have come to the wrong conclusions. Fundamentally, flower color is made up of anthocyans (blues and purples), which are water-soluble pigments in each cell's vacuole, and carotenes (yellows, oranges, and pinks), fat-soluble pigments in the cell's walls. True red is also an anthocyan, but unfortunately, it doesn't appear that irises can produce the chemical compounds that reflect fire-engine red back to our eyes (as in geraniums or roses)—specifically, the compounds paeonidin (crimson), pelargonidin (scarlet), and rosinidine (crimson). Reds of a sort are possible in bearded irises; these maroon or brownish reds come from combining the right shades of purple and yellow, which to our eyes gives the illusion of red. This is what makes 94-AT-2's falls appear dark brown.

Moreover, various shades of blue and purple contribute to the exact coloring we see. Each is controlled by one or more switches. Think of the flower as a chemical factory. The genetic switches control what compounds are produced, and hence what colors are reflected back to our eyes, from light to dark blue, to violet, through various shades of purple. With yellows, too, there are a number of switches at work, though with *danfordiae*'s yellow-orange being so dominant one might think there was only one. It's a nice color, but I'm now starting to break its dominance so I can get at the others. A beautiful pink reticulata or a rich orange would certainly be nice (perhaps I'm dreaming, but it turned out to be possible in bearded iris). If these anthocyans and carotenes don't combine just right, you end up with a muddy mess.

Detailed analysis of my hybrids has shown that two dominant genes B_1B_2 are required to turn blue on, and a recessive gene y is required to turn yellow on:

sophenensis	$B_1B_1B_2B_2$ ~~YY~~
danfordiae	$b_1b_1b_2b_2$ yy

This doesn't explain why three of the 56 F1s had a reasonable amount of yellow on their falls. Is there a second path for synthesizing yellow, involving several genes? At some future point I hope to understand what's behind the "spotted light blue-green" pattern, as well as the yellow streaking or blotching effect seen on some clones. Of course, by that time there will be other mysteries.

The velvety surface effect that seems to accompany some reticulata colors, particularly dark ones, is due to papilla-shaped epidermal cells. It is a physical, not a chemical phenomenon. If you take a velvety fall blade such as that of *I. bakeriana* and turn it, it shows pure color at every angle. You never see any solid white light bouncing off it as you would if the surface were flat. With iris petals, you see a glistening effect when each of a multitude of cobblestone-shaped cells reflects white light. The back of a fall is duller, while the top of the fall is "alive," because the depth of the cobblestone cells is less on the back of the fall. Additionally, the light we see is saturated with color. Before reaching our eyes, it has been bounced around several times among the papilla-shaped cells, in the process "picking up" more and more color. This can be seen by the fact that the intensity of color changes as you change the angle of the blade.

More Noteworthy Hybrids

98-OK-1 (91-FC-1 × *danfordiae*) was the sixth "spotted light blue-green" to bloom. This pattern only occurs occasionally in back-crosses to *danfordiae*. When my wife Lynda saw it, she called it "icy green," so I named it 'Green Ice' (photo, p. 281).

'Tiger' (97-AG-6; photo, p. 279) has dark green stripes on a lemon-yellow background—not quite the black stripes on orange ground the name evokes, but close enough. There are green dots around the fall ridge, and the arm portion of the style arms is wholly dark green. 94-AT-2 (photo, p. 280) has falls of dark brown on a rich yellow background and style arms in shades of dark blue.

Perhaps most interesting of all is 'Sea Green' (97-CQ-1; photo, p. 280). It is an evenly colored blue-green with yellow tones. The area beside the fall ridge is bright yellow with dark blue-green dots. Its style arms are much bluer. Just as the flower finishes it becomes bluer. Without question, it's unique.

97-DG-1 is a unique purple with blue tones, striking for its blue flush around the yellow fall ridge. The purple and blue contrast is quite distinct. This characteristic comes from a Reticulata I collected near Van, Turkey; it shows up best in contrast with "redder" purple falls.

Bulblet Production

A common characteristic of *I. danfordiae*, *I. sophenensis*, the Çat Reticulata, and their hybrids is that each blooming-sized bulb typically produces about eight bulblets. If left alone, many of these will die because they can't get their leaves above the soil surface—they use up all their energy trying. It's best to replant the bulblets close to the soil surface. In four years they will bloom. Thus, they can be used to increase a given clone faster than with most other Reticulatas. The problem with the species themselves is that their main bulbs (which dwindle to almost nothing during the flowering phase of their annual cycle) don't regenerate large enough to bloom again soon. This is why people say *danfordiae* "shatters": they find only bulblets and medium-sized bulbs when they dig up bulbs planted in previous years. What's needed is plants that regenerate blooming-sized bulbs year after year. The optimal practice is to plant several bulbs widely spaced and leave them to form clumps. These will reach equilibrium, giving five or six blooms year after year. Thus, one of my F1 hybrids left behind in a replanted seedling patch, finally dug up in 2001, contained 6 blooming-sized bulbs, 5 medium, 23 small, and 163 bulblets.

A blooming-sized bulb can produce as many as 25 bulblets. The main difference between Holland and Toronto is that bulblets attain blooming size much faster in Holland, blooming in just three years, or even two. Rate of increase of a given hybrid is not really an issue in your and my gardens—the clone just needs to give consistent bloom year after year. Before you know it, you have a nice large display. Rate of increase is an issue for a new hybrid intended for use in hybridizing or showing. It is much more important when you want to build up stock to sell, especially on the Dutch scale: I've been told 25,000 blooming-sized bulbs are needed before starting sales.

In Holland, large bulbs tend to give two blooms per bulb. Some of my F1 bulbs I got back from Dutch grower Wim de Goede in 1999 were even large enough to give three, though the third flower was much smaller than the first two. In my own garden, I now get just one flower per bulb. These days my bulbs are planted too close together, and I don't have the space to practice crop rotation and give the soil a "rest.". In Holland, Reticulatas are replanted in the same soil about every seventh year.

A Goal for the Garden

My goal is to create interesting new hybrids that do well in many North American gardens. I've often heard people complain that they've bought named varieties, only to have just a few leaves come up after a couple of years. More than six years ago I bought a dozen bulbs each of *I. danfordiae* and *I. reticulata* hort. (the purple clone sold under the species name) from a local garden center. As expected, they all bloomed. The following year each group produced 24 flowers; the third year, and essentially every year since, only about 6 flowers of *reticulata* hort., and none of *danfordiae*. This might seem good from a bulb grower's perspective because it essentially means people have to keep buying imported bulbs, but in truth it isn't. Buyers likely end up disappointed and won't buy more irises, preferring something else that lasts longer.

I really don't know exactly where I'm going with all of my crosses—I just know the general directions. With 5 years from seed to flowering, like the captain of a huge cargo ship I need to make course corrections well in advance. This is why I make so many crosses. Of course, one could easily make thousands of crosses and get absolutely nowhere. The key is to know the theory behind the practice, then work in several directions at once; you never know exactly which is going to be the most important. Starting with widely different clones from the wild is critical; currently available commercial clones are too similar to one another genetically.

Working with two parents that are widely different is like opening up the potential expression of a two-dimensional plane, as shown in Figure 1. If the two parents are pure species, then the first-generation progeny will all be very similar (the "X" in between) because the genes on each parent's set of chromosomes are essentially uniform. In the second and future generations, after intercrossing the offspring plus back-crossing to the parents, the possible range of expression is the whole plane. It's up to the skill of the hybridizer to bring out this full expression. For example, a recessive gene from one species and a dominant gene from the other will always give a dominant expression in the first generation. In the second generation, there's a 25% chance that the recessive characteristic will be expressed. In the case of *sophenensis* × *danfordiae*, the first-generation hybrids are all "just blues." The second generation yielded whites, yellows, blues, yellow-blues, and "spotted light blue-greens." Now other expressions are starting to appear, such as pale yellow and brown. With three widely different species in play, the range of expression expands tremendously: it's three-dimensional (Figure 2).

Commercial Cultivation

Currently there are over 40 hectares of Reticulatas under cultivation in Holland, which produce some 50 million bulbs for sale annually. Sales for cultivation in pots have become a significant portion of the market, influencing which varieties sell in large numbers.

I now have six Dutch bulb growers testing my hybrids. One is solely interested in Juno irises, which I also experiment with. It would be nice to get something back for all my hard work and expense. Following the 2003 bloom, Wim de Goede proposed to introduce four of my hybrids. It will still be a few years before enough stock is built up to begin sales, and a number of years more before you'll be able to buy them in your local nursery.

My pure white Reticulata was registered last year as 'White Caucasus' (photo, p. 279). It's from the Lake Sevan region of Armenia, hence the reference to the Caucasus mountains. The typical form is pinkish-purple, with various clones containing differing hues and tones. It will be years before there is enough stock to introduce this lovely form commercially. To speed things up, I started having it increased by tissue culture in a laboratory late in 2002. A few hundred bulbs were delivered at the beginning of this year, with more ordered for early next year.

Reticulata Culture

Reticulata irises like well-drained soil such as sandy loam or other sandy topsoil, with lots of moisture in early spring (in the wild and in the colder parts of North America, this comes from melting snow). However, the soil should be fairly dry around the time the leaves are starting to turn brown. They should have at least half a day of sun. It's a good idea to replant them every two or three years, preferably into a new spot in the garden.

In Toronto, Reticulatas generally start blooming at the end of March and continue for about three and a half weeks, with individual flowers lasting seven days or longer, depending on temperature. *Sophenensis* × *danfordiae* hybrids tend to bloom at the beginning of the season. If your garden has reliable winter snow cover, I suggest planting several varieties both where the snow first melts, and in a shaded area where it lies later. That way, you'll extend your bloom season, and even get to enjoy each variety twice.

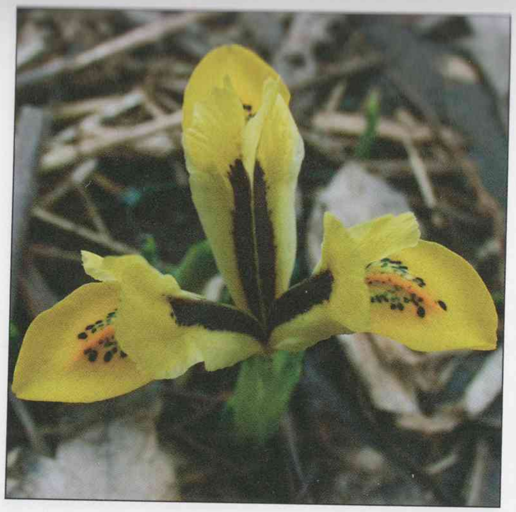
Remember, the bulbs need to regenerate, so the last thing you want to do is disturb them while they're in growth. Some people find daffodil leaves messy so they either cut them shorter or tie them up. It's bad for the daffodils, and I certainly don't advise it for Reticulatas, either. Wait until the leaves start to turn brown, then do what you will. Otherwise you're only ruining next year's bloom. A little bit of low-nitrogen fertilizer at the beginning of the bloom season is good for bulb regeneration; some growers advocate fertilizing more heavily.

Alan McMurtrie lives in Toronto, Canada, and has been hybridizing Reticulata rises for more than 20 years. In 1985 and 1986 he traveled extensively in Turkey, studying both Reticulata and Juno irises. He is an electrical engineer specializing in computer software applied to the electrical utility industry. During the summer, he can be found canoe camping in Algonquin Park with his two sons.

Arisaema dracontium

Unusual colors appear in McMurtrie's hybrids (p. 266). Above left, 89-A-3; above right, 94-AT-2; below left, 'Sea Green'; below right, 97-CC-2.

Additions to the white and light color range (p. 266). Above left, 'Starlight'; above right, Green Ice'; below left, 94-AK-1; below right, 98-NP-4.



Reticulata irises bring color to the late winter garden. Above left, 98-OO-1; above right, 98-OO-4; below left, 96-WR-1; below right, 98-OO-2.

A rainbow of Reticulata irises hybridized by Alan McMurtrie (p. 266). Above left, the Çat Reticulata, one foundation of the breeding program; above right, 'Tiger'; below left, 'White Caucasus'; below right, 95-FB-1.