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Rose Research at Texas A&M - The Future of the Rose

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Dr. David Byrne is a young geneticist in our Department of Horticultural Sciences at Texas A&M University. We are collaborating on the long-range effort to free the rose from some of its worst enemies. Blackspot and thorns are at the top of the agenda.

For 200 years the blooms of the rose have steadily improved, thanks to our breeders, both amateur and professional. It is now time to do the same for the bushes that bear Nature's noblest flower.

Most of our modern garden roses are tetraploids (28 chromosomes). In the wild, however, diploid species (14 chromosomes) outnumber tetraploid species. Many of these diploids possess highly valuable properties that we would dearly like to transfer to our garden roses. This is often possible by a direct cross, but this yields a triploid (21 chromosomes), which is usually a dead end for further breeding. Is there a way to make use of these valuable diploids without being confronted with triploids and dead ends? Yes, there is!

The cross between two diploids will normally yield another diploid. But there are two distinct ways in which Nature can stumble along and produce a tetraploid. In both ways each cell of the tetraploid will contain a complete set of the 14 chromosomes from each diploid! Such a tetraploid is called an amphidiploid. The first way is illustrated by *Rosa kordesii,* whose origin stems from a chance seedling found in a nursery at Pomfret Center, Conn., and registered in 1919 under the name Max Graf, in honor of the nursery foreman who found it. This rose is generally thought to be a cross between *R. rugosa* and *R. wichuraiana.* It rarely sets a hip, which is not surprising since its probable parents lie in different sections of the genus.

In time, Max Graf found its way to Germany and the nursery of the famous rose breeder, Wilhelm Kordes. After many patient attempts by him to self-pollinate Max Graf, success finally came in 1940, producing the tetraploid known today as *R. kordesii.* The tetraploidy of this rose was made possible almost certainly by the rare union of an unreduced male gamete and an unreduced female gamete. This may be the way in which many of our existing tetraploid species have arisen through the ages. And the more sterile the original diploid cross, the more fertile will be the tetraploid, as is exemplified by *R. kordesii!*

The second way in which Nature has stumbled into the secret of producing a tetraploid from a pair of diploids was by guiding man to discover the secrets of colchicine. This alkaloid is found in the corms and seeds of the autumn-blooming crocus, which grows near the Mediterranean Sea and the Black Sea. Colchicine can be used to double the number of chromosomes in a cell. This discovery was first announced in 1937 (Journal of Heredity, Vol. 28: 393-411), and put quickly to practical use, mainly with the food and fiber crops. But 50 years passed before the rose, a mere ornamental, would benefit, with the aid of colchicine, by adding an amphidiploid to her repertoire. For the story of this amphidiploid (86-3), see the 1990 American Rose Annual, page 83 [An Amphidiploid of *Rosa Banksiae* and *Rosa Laevigata* Induced by Colchicine].

At present we have three amphidiploids produced with the aid of colchicine:

84-1000 = *R. roxburghii* x *R. laevigata,*
86-3 = *R. banksiae* x *R. laevigata,*
86-7 = *R. wichuraiana* x *R. rugosa rubra.*

86-7, for example, was obtained by applying colchicine to the indicated hybrid when it was a tiny seedling in the spring of 1985. Most of the plant remained diploid, but one cane was completely tetraploid. Buds or cuttings of this cane were then used to establish the amphidiploid 86-7, each of whose cells contains 28 chromosomes—14 from *R. wichuraiana* and 14 from *R. rugosa rubra.*

The reader will have noted that the parentage of 86-7 is similar to that of *R. kordesii.* A vital difference, however, is the fact that a thornless form of *wichuraiana* was used in creating 86-7. On the subject of thornlessness, I should also mention that a thornless form of the single white *banksiae* was also used in creating 86-3.

The five species used to produce the three amphidiploids are long-lived and completely immune, or nearly so, to blackspot. The foliage of *laevigata, banksiae* and *wichuraiana* is semi-evergreen. Both *wichuraiana* and *rugosa* are very hardy, while *banksiae* and *laevigata* are quite tender, with *roxburghii* somewhere in between. *Wichuraiuna* is a Climber, easily trained to any trellis, but making horizontal growth if left alone. It is in the parentage of many of our Climbers and Groundcover Roses. In mild climates, both *banksiae* and *laevigata* grow into huge and graceful mounds. And *R. rugosa,* even in northern climates, is a repeat bloomer, mingling its autumn flowers with ripening red hips.

To plot our future course in the improvement of the rose, there may be no better guide than what Nature herself has done in the past. Tetraploids are quite common in many genera of the plant world. It is now believed the vast majority of them are amphidiploids resulting from crosses between diploids in the same genus. This can happen on the rare occasion that both male and female gametes of the two diploid parents are unreduced when they unite. In this case an amphidiploid is born instantly. A second way is for the diploid cross to produce a normal diploid which, when self-pollenated, produces a tetraploid by virtue of the male and female gametes being unreduced, which again would happen only rarely. This is the probable origin of *R. kordesii.* A third way, using colchicine on the diploid cross while still a tiny seedling, was described earlier. A fourth way, using colchicine and tissue culture, is now being explored by Dr. Byrne.

Thus it is our conviction that the most effective way to improve the bushes that bear our roses is not only to make wise, selective use of the wild tetraploids that already exist, but also to create new amphidiploids from the most promising diploids.

An interesting fact about amphidiploids is that, the more sterile the diploid cross that precedes, the more fertile the amphidiploid that follows. For this reason it is usually best to choose the two parent diploid species from different sections of the genus. This was done for 84-1000, 86-3 and 86-7.

We believe the genes associated with thorns are few in number, and that the thorn problem will prove to be not too difficult. Blackspot, however, presents a real and difficult challenge, and commands our highest attention. We hope that the three amphidiploids, reinforced with many others in the near future, will provide the means to conquer blackspot, rust, mildew and other diseases, and increase hardiness.

I want to mention now the rose research that blossomed in the late 1930s and 1940s right here at Texas A&M University. Several professors did work with diploid and polyploid species. I am sure you will appreciate these references if you wish to pursue the subjects. Please see the bibliography.

The basis for all this activity in roses was a large collection of species roses that had been assembled at the experiment station near Tyler, Texas, prior to World War II. It was most unfortunate that Dr. J.C. Ratsek, who was in charge of the experiment station and a motivating force in all this rose work, died suddenly during the war. About this time, Dr. W.S. Flory left and went to the University of Virginia. It was not long after this that Dr. S.H. Yarnell also left Texas A&M University.

I should mention one last spin-off from all this rose activity, an activity which is now in the process of dying out. In the late 1940s a young Canadian, Walter H. Lewis, had just finished writing his master's thesis on the taxonomy of American wild roses. Deciding to migrate to the United States, he was attracted to the University of Virginia, where Dr. Flory had recently gone. Under Dr. Flory he wrote his doctoral thesis on the cytotaxonomy of American wild roses. Later he came to Texas where he taught for several years at Stephen F. Austin University in Nacogdoches. It was in those early days that he gave me my first lesson in counting somatic chromosomes. Later he settled at Washington University in St. Louis, where he has been for many years.

A replica of the species collection at Tyler had meanwhile been established at the Horticulture Farm at Texas A&M. Fondly do I remember the many trips I made after the war to the Horticulture Farm to study those wild roses and propagate many for my own garden. But alas, the men behind them were all gone, and this was soon to be the fate of the roses themselves. Should we try again? Yes, of course we should, but this time under the stabilizing influence of a university chair. The establishment of this chair is already underway here at Texas A&M University.

Recent crosses with the amphidiploid 86-7 show high resistance to blackspot, and a few are thornless. Our ultimate aim will be hardy bushes that are free of disease and thorns and that continue to bear blooms as perfect as those we now have.

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