FERTILE SHRUB HYBRIDS: DIPLOIDS OR TETRAPLOIDS?

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The last few issues of the Paeonia newsletter have been sent to us recently and the collection is now complete for all to download and read. Bill Seidl, the late American hybridizer, was a regular contributor to it, but not all his writings have been published. This is one of these, as a reply to an article: "Lessons in genetics I: unreduced gametes in interspecific hybrids and their implications for the origin of new polyploid species" by Don Smith. Thanks to Theresa De Jager for typing and mailing me Bill's handwritten letter. Note: when Bill talks about 'moutan' he refers to the shrubby suffruticosa hybrids, be they the Chinese or Japanese ones. So now: enjoy one his peony writings:

In vol 27, #1, Winter 1996, don Smith says (p4) the inevitable transition to the tetraploid level - already a fact in the herbaceous hybrids - "is also well underway in the shrub peony hybrids."

This may seem suprising to many readers who have little or no experience in this area, but it rang true with me. Since the '70's, when I germinated about a dozen seeds from Golden Era (GE) x Chinese Dragon (and reverse). I have found increasing fertility between these seedlings crossed with each other, with seedlings of other crosses, and with other named varieties: Age of Gold, Boreas, etc. I was at first astounded to find 10 or 11 firm seeds ("sinkers" when freshly harvested) in a single carpelhead, then climbing to higher counts. 18 was a record for several years, then 23 appeared last season in a cross of #35 x #97 (Mystic Mood). SH (Shrub Hybrid) #35 is from GE x Chinese Dragon, and this particular carpel head had seven carpels instead of the usual five.

Frankly, however, during all this time, I did not really attribute the increasing fertility to tetraploidy. I thought they were diploids which, because of their increasingly advanced generations (some are F6s or F7s beginning with the F1s that gave rise to Saunders F2A and F2B), were becoming a true-breeding diploid "species" or population. I thought they all were 50% moutan and 50% delavayi/lutea in genetic makeup, being derived equally from those two species ancestors. One reason for that thinking was that all had some of the "lutea hook" - even if it was only a slight bend in the flower stem just below the flower. If any had a preponderance of moutan genes, say 5/8 moutan and 3/8 delavayi-lutea, I figured the "lutea hook" would disappear. To resolve the problem, some backcrosses to moutan were made. All failed except SH13 (Anna Marie) x 'Shintenchi'. This took fairly well and of four seedlings that have bloomed, all had the desired up-facing flowers - no lutea hook, but all were seed sterile. All have "naked" anthers - no pollen - (that, however, seems to be an inherited characteristic going back to 'Anna Marie' and her seed parent Reath's A197). I assumed these four seedlings are therefore 75% moutan and 25% delavayi-lutea, still diploids, albeit sterile. One of them I named Fuchsia Ruffles.

See figure 1 (I've diagrammed their assumed genetic makeup in which I replace Don's "n" (page 5) with "m" and "d" to represent the moutan & delavayi-lutea sets of chromosomes.)

The "lutea-hook"?

The yellow Paeonia lutea is now usually considered to be synonymous with Paeonia delavayi, but still different from the other yellow shrub peony P. ludlowii. Introducing this species into the modern shrubby hybrids has resulted in very pretty colors, but there is a drawback:

"Unlike Japanese P. suffruticosa cultivars, P. delavayi often imparts poor flower carriage to hybrid offspring, in the form of nodding blossoms. Many first generation hybrids (F1's) have a curve in the flower stem, which causes a downward carriage, often referred to as the "lutea hook", directly inherited from P. delavayi. This has been a major impediment to enjoying the large voluptuous flowers in many of the hybrids, as they face down, are hidden in the foliage or touch the ground. The cultivar 'Souvenir du professeur Maxime Cornu' has flowering habits that exemplify these characteristics, as do many others to an equal or lesser degree."
Bramer, Nate."Woody Paeonia. Part 4: The Lutea Hybrids." In: *The American Peony Society Bulletin*, 2019, no 389, p. 28.

Figure 1

Anna Marie

Anna Marie

Figure 2

Thinking along the same lines (i.e.: increasing the moutan, can I push the moutan past the 50% barrier?), I looked for named hybrids to use in breeding that were already over the 50% line, Zephyrus (see figure 2) and Leda came to mind.

Leda seemed sterile both ways, Zephyrus appeared to be seed-sterile, but its pollen, though difficult to extract, turned out to be quite effective. (Under a microscope only 10% of the grains appeared plump/well formed, but that 10% is potent with other fertile shrub hybrids.) I reasoned that if Zephyrus was 75% moutan (it had quite good carriage although short stemmed), that my seedlings were 50% moutan and that if reduced gametes were the rule, crosses between the two would inherit half of 50% and half of 75%, thus resulting in 62.5% moutan genes, enough to provide moutan type carriage to the blossoms (see figure 3).

Figure 3

I harvested ample seeds (#35 produced up to 10 seeds per carpel head), but regrettably planted and germinated relatively few - less than a dozen. #35 x Zephyrus yielded a fine-looking single of pure pink color (no yellow influences) later named Rosalind Elsie Franklin with upright blossoms, i.e. the petal "plane" is perpendicular to the stem. Outer stems may lean, but there is little or none of the lutea hook. It seems to be seed sterile, but it's 10% pollen is potent. #11 x Zephyrus yielded three seedlings: one of them, #58, and very good carriage both ways.

So the results I was observing sort of agreed with what I expected from my theorizing: the diploid state was the ploidy level of the shrub hybrids. If more seedlings were elevated to the 50% plus level, I expected they would be more compatible in backcrosses to 100% moutans and the way would be clear toward a moutan-like race of hybrids that would be 15/16 moutan, 1/16 delavayi-lutea, with the 1/16 carrying the yellow color influence and stoloniferous root. This was the goal stated for the Daphnis line of breeding which seemed quite sensible and proper.

When Don proposed that the shrub hybrids are reaching the tetraploid stage, it immediately seemed quite plausible to me. It explains their increasing inter-fertility and the sterility problems in backcrosses to diploid moutan.