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Table of Contents:

Examining the Fertility of the Intersectional Hybrids	p. 1
Fertility in the Itoh Hybrid, Yellow Crown	p. 7
P. lutea x P. lactiflora	p. 7
Pæonia Correspondence	p. 8

EXAMINING FERTILITY IN THE INTERSECTIONAL HYBRID GROUP

by Don Smith

Fertility in the intersectional hybrid group is known to be extremely low. This low fertility is to be expected as a result of the very wide nature of the cross (herbaceous x tree peony) which produces these hybrids. This lack of fertility shows up in a number of different ways that effect their reproductive capabilities as both male and female parents. For example on the male side, some intersectional hybrids have flowers with no stamens or in other cases flowers with filaments that have no anthers. More often they have flowers with aborted anthers that produce no pollen whatsoever. Still

others have normal looking stamen and anthers but produce negligible amounts of pollen. Only rarely do we find an intersectional hybrid that produces a useful amount of pollen. Even then, there is very little chance that this pollen will set any seeds in backcrosses with either parent (lactiflora or lutea hybrid) or when used on other intersectional hybrids. The whole situation is rather discouraging for the hybridizer who may be considering working with this group.

Unfortunately, the situation is no better when these hybrids are used as seed parents. Although most intersectional hybrids have normal-looking carpels and stigmas, they are usually non-functional. Reports of seeds from intersectional hybrids have been extremely rare. Of those that have been reported, nearly all were hollow or incomplete and thus failed to germinate. To combat this extreme sterility some have taken to mixing pollens from

herbaceous, lutea hybrid tree peonies and intersectional hybrids in an attempt to increase the chances of a "take". I believe that Roger Anderson was the first to advocate this approach and thus far remains the only one to report success, having produced a single F₂ seedling from an F₁ intersectional hybrid pod parent (APS Bull. No. 265, p. 10-11; Mar. 1988). However, in my view, this approach has at least one rather serious drawback which needs to be mentioned. The philosophy behind this approach seems to be "that all progress is forward progress" and that it is far more important to make some progress than it is to know exactly how that progress was made. I do not agree with this premise for a couple of reasons. First, all F₂ intersectional hybrids are clearly not the same. Some do indeed represent a real step forward, but unfortunately some do not. The real problem here, as I see it, is that the crosses that are the most likely to succeed are the ones that will produce advanced generation hybrids that are actually a step backwards. Obviously, this point requires further explanation. To proceed, we need to remember what the intersectional hybrids are and how they were created. The intersectional hybrids as a group exhibit characteristics that more closely resemble their tree peony ancestors than their herbaceous side. This, we are told, is the direct result of having twice as many tree peony chromosomes as compared to herbaceous chromosomes (i.e., they are triploids with a 2:1 tree peony to herbaceous chromosome ratio). Crosses which further increase this ratio such as backcrosses with the lutea hybrids or other tree peonies are clearly taking this line of breeding in the wrong direction. Hybrids produced from such crosses will likely be almost indistinguishable from lutea hybrids and will therefore not represent any real progress in this important hybrid group. Genetically however, the lutea hybrids are the closest relatives to the intersectional hybrids and therefore probably also the most likely to produce advanced generation hybrids. For this reason, I believe that any real progress in this group can only be made by backcrossing the intersectional hybrids to their herbaceous parents. This approach will move the line towards a more equal (and more desirable) chromosome balance between its tree peony and herbaceous ancestors. Unfortunately, this is undoubtedly also a much more difficult direction to pursue. In addition, this direction is also unlikely to result in any dramatic increases in fertility at the F₂ level. To illustrate these two cases I put together pedigree charts for two different hypothetical intersectional backcross hybrids. These are shown in Figures 1 and 2.

The examples used here correspond to actual seeds that I have obtained but not to actual hybrids, although this is still possible in both cases. It is clear from these examples that these two crosses would take the intersectional line in opposite directions. The results of this discussion are summarized in Table 5 which gives the estimated probability and desirability of various crosses (mostly backcrosses) involving the intersectional hybrids.

Over the past ten years or more I have made hundreds of crosses using herbaceous (lactiflora) pollen on various intersectional hybrids (cross 3, Table 5) and have yet to produce a single seed, not even a hollow one. Nor have there been many reports of seeds from other hybridizers. Once again, only Roger Anderson seems to have had success with this cross (APS Bull. No. 260, p. 16; Dec, 1986). Based on this experience, it would appear that this cross is probably the most difficult of the various intersectional backcrosses. During this time, I have intentionally avoided the use of lutea hybrid pollens on the intersectional hybrids (Cross 2 in Table 5) for the reasons stated above.

Fortunately, as you will soon see, the reciprocal of the backcross with lactiflora (lactiflora x intersectional hybrid) seems to hold a bit more promise. However, unlike its reciprocal partner, this cross also creates the real possibility of producing contaminated (pure lactiflora) seedlings which could be very difficult to clearly distinguish from genuine backcross hybrids especially during the first few years of growth. This fact and the general lack of adequate amounts of intersectional pollen have kept me from making a large number of these crosses over the years. A summary of the very limited number of these crosses (lactiflora x "i" hybrid) made up to 1998 is shown in Table 1.

This year I changed my strategy somewhat and made more of an effort to work with the intersectional hybrids and as a result had a small measure of success. I collected useful amounts of pollen from three separate intersectional cultivars (*Unique*, *Morning Lilac* and *Bartzella*) and was able to make a reasonable number (17) of crosses on *Martha Washington* and several other lactiflora varieties. These crosses resulted in one seed which may or may not be viable. A summary of the results from these crosses is presented in Table 2.

For the moment, let us return to the discussion of the backcross with the lutea hybrid parent (crosses 2 & 5 in Table 5). Despite the reasons

stated earlier for not making this cross, I did make two crosses in 1999 using the pollen from my own lutea hybrid, *Smith Family Yellow* onto the intersectional hybrid, *Unique*. To my amazement these two crosses yielded a total of 32 seeds for an average of 16 seeds/cross. Although I will be surprised if any of these seeds actually germinate, this seems to be evidence of substantial fertility. I will work more with *Unique* as a seed parent in the next few years to see if this fertility can be successfully tapped. For comparison, four crosses using lactiflora (*M. Washington*) pollen were also made on *Unique*. These crosses resulted in no seeds as was also

the case for another dozen crosses using *M. Washington* pollen on various other intersectional hybrids. This experience appears to be similar to that reported recently by Roger Anderson (APS Bulletin No. 310, June, 1999) for two other F1 intersectional hybrids, *Watermelon Wine* and *Norwegian Blush*. In both cases many seeds were reported, but the source of the pollen was not mentioned. My guess is that a pollen mixture containing lutea hybrid pollen was used and that all the resulting seeds are from pollination by the lutea hybrids.

Continued on page 4

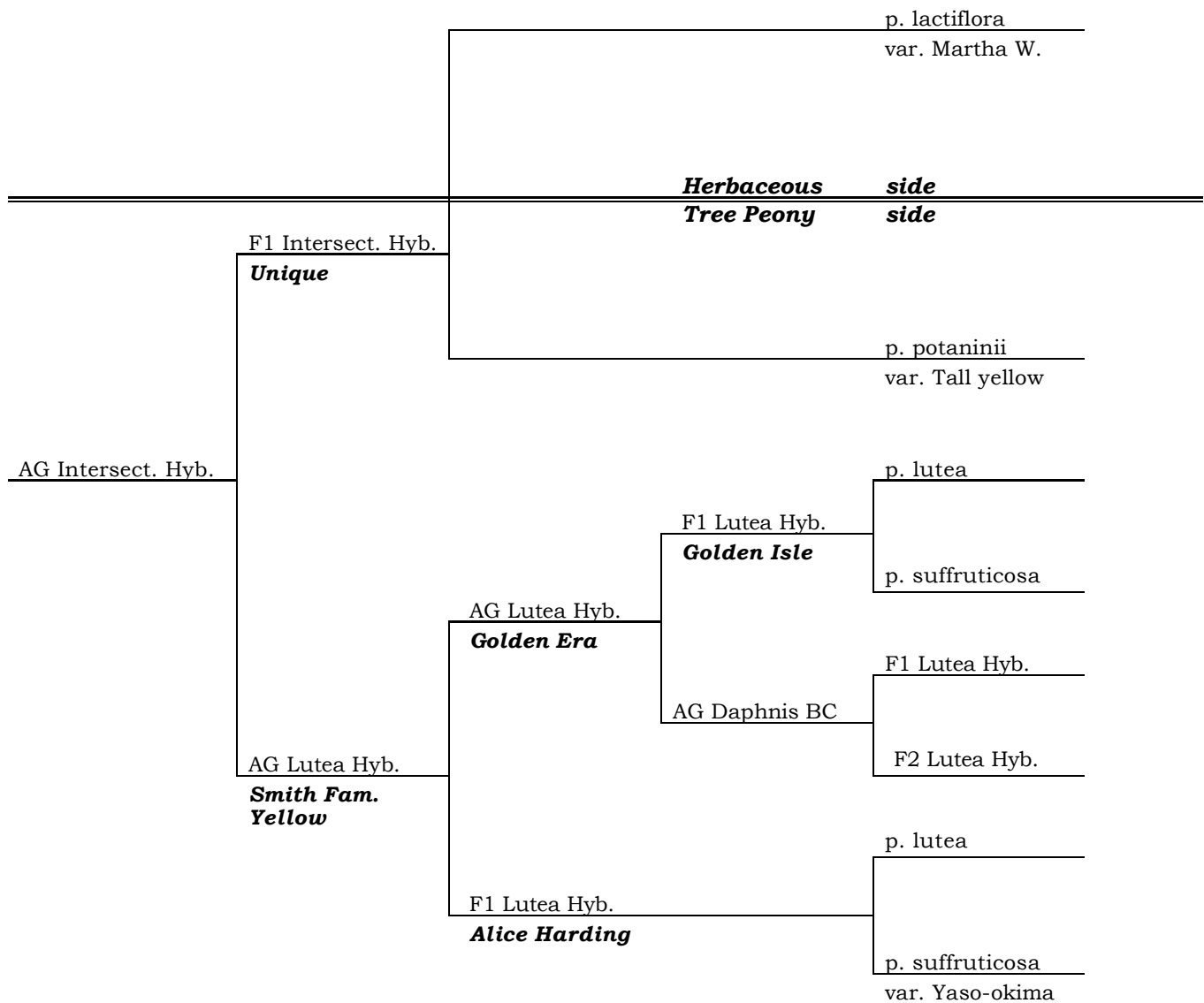


Figure 1. Family tree for a hypothetical intersectional backcross hybrid with predominantly tree peony genes.

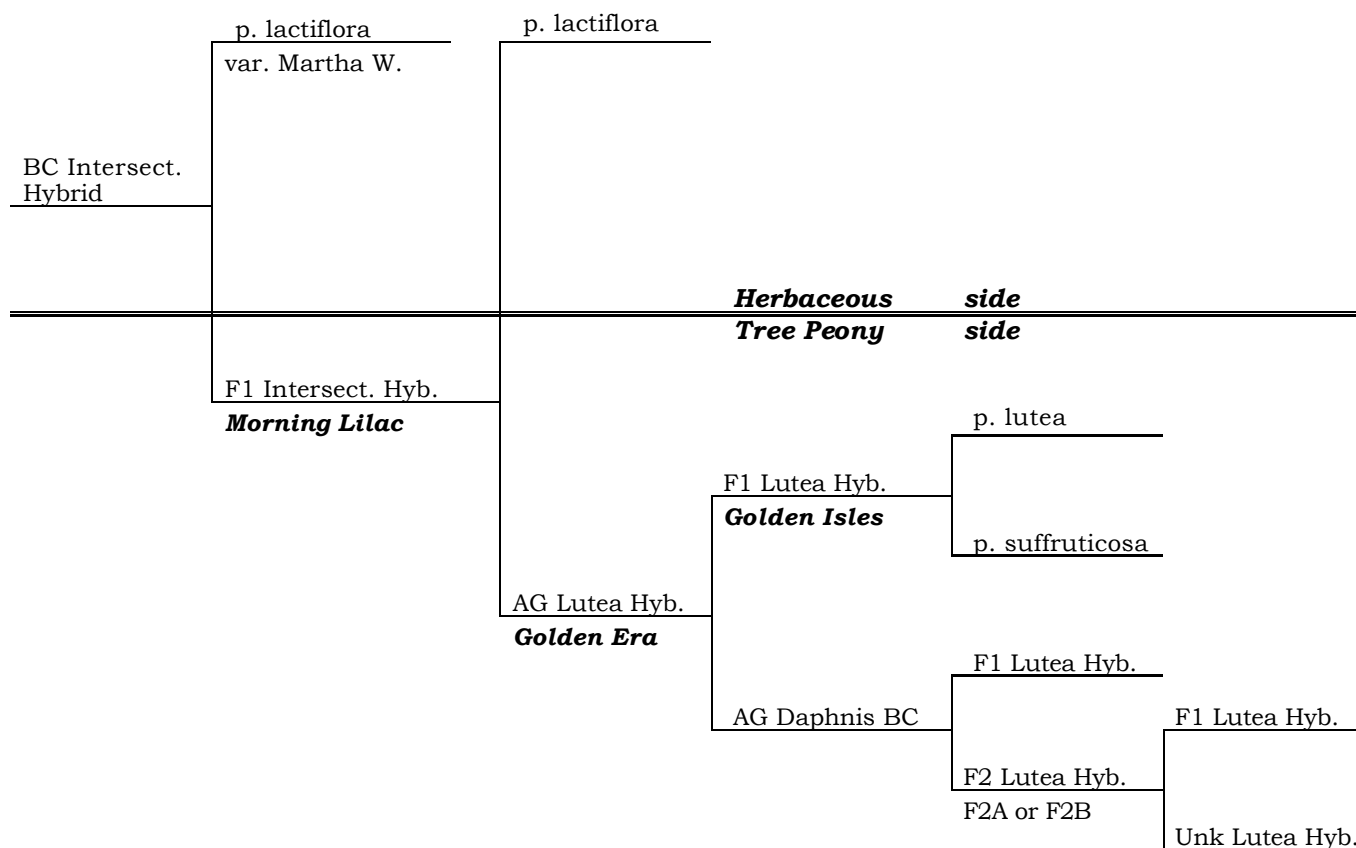


Figure 2. Family tree for a hypothetical intersectional backcross hybrid with predominantly herbaceous genes.

Another example of such fertility was reported earlier by Irene Tolomeo (*Pæonia*, Vol. 25, No. 3, p. 4). For convenience, this report is repeated below:

"I was really surprised when one pollen bearing seedling (own lacti. seedling by Icarus) produced an empty seed this year. Pollenation was by Golden Era (the only pollen available at the time)."

Lutea hybrid pollen may also be the source of the F2 seedling reported earlier by Anderson and

referred to above.

For those wishing to work with the intersectional hybrid group I felt it would be helpful to know which varieties might be useful parents and which ones are not. Table 3 lists 18 intersectional cultivars with information on pollen production and fertility (when available). Table 4 gives a list of those varieties that have demonstrated some fertility as seed parents by producing at least one or more seeds.

Table 1. Summary of intersectional backcrosses (lactiflora x "i" hybrid) made up to 1998.

Cross	No. of crosses	No. of seeds	No. of plants
G. Allen x "i" Hyb (Mix #3)	1	4*	0
M. America x "i" Hyb (Unk. Mixed)	1	2*	2*
M.W. x "i" Hyb (Mix #1, 2, 3)	3	0	0
M. America x "i" Hyb (Mix #3)	1	0	0
Total	6	6*	2*

* It is unclear whether any of these seeds or plants were or are true IBC hybrids

Mix #1 --- First Arrival, Pehrson Red I and Morning Lilac - A little pollen, not very much

Mix #2 --- Cora Louise, Yellow Emperor and Hillary - Very little pollen, almost none

Mix #3 --- Unique and Canary Brilliants - Some pollen, more than any of the others

Mix #3 was tested under a microscope (800x) on 6/15/97, it showed quite a few "good-looking" grains

Notes: Based on my 1999 experience, *Unique* is probably the source of the bulk of the pollen in Mix #3, whereas *Morning Lilac* is the most likely source of the pollen in Mix #1.

Table 2. Summary of intersectional backcrosses (lactiflora x "i" hybrid) made during 1999 season.

Cross	No. of crosses	No. of seeds	No. of plants
G. Allen x "i" Hyb (M.L.)	1	0	0
M. America x "i" Hyb (M.L.)	1	0	0
A. Roberts x "i" Hyb (M.L.)	2	0	0
M.W. x "i" Hyb (M.L.)	8	1	?
M.W. x "i" Hyb (Unique)	4	0	0
M.W. x "i" Hyb (Bartzella)	1	0	0
Total	17	1*	?

Table 3. Summary of intersectional hybrid pollens based on my own observations and reports by others.

Variety	Stamen	Pollen	Fertility
Yellow Emperor	Many	Almost none	-
Morning Lilac	Some	Adequate amount	Yes
Unique	Many	Some	Possible
First Arrival	Some	Very little	
Canary Brill.	Some	?	?
Cora Louise	Some	Almost none	-
Callie's Memories	None	None	-
Pastel Splendor	None	None	-
Pehrson's Red	Some	Small amount	
Hillary	Many	Almost none	-
Julia Rose	None	None	-
Garden Treasure	Many	Almost none	-
Bartzella	Many	Small, but useful amount	Possible
Luxuriant	Yes	Some	Seedlings reported
Sonoma Sun	Yes	Some	?
Prairie Charm	Yes	Small amount	?
Rose Fantasy		No pollen	-
Dark Eyes	Many	Some	?

Table 4. Summary of intersectional hybrids as seed parents.

Intersectional Variety	Comments
Bartzella	Reported to have produced an F2 seedling
Norwegian Blush	Sets many seeds (of hundreds collected so far, only 2-3 have germinated, but to date <u>no</u> plants have been produced)
Unique	Very large number of seeds from lutea hybrid pollen
Watermelon Wine	Sets a lot of seeds, so far none have germinated
Yellow Crown	One report of several firm seeds from unknown pollen

Table 5. Summary of the probability and desirability of various intersectional crosses and backcrosses.

	Cross	Probability of Success	Desirability of Offspring	Comments Concerning Offspring
1	"i" Hybrid x "i" Hybrid	Extremely low	High	Increased fertility
2	"i" Hybrid x Lutea Hybrid	Moderate	Low	Too much t.p. "blood"
3	"i" Hybrid x Herbaceous (lacti)	Very low	High	More balanced genetic mix
4	Herbaceous (lacti) x "i" Hybrid	Low	High	More balanced genetic mix
5	Lutea Hybrid x "i" Hybrid	Moderate	Low	Too much t.p. "blood"

FERTILITY IN THE ITOH HYBRID, YELLOW CROWN

by Harold Entsminger

Yellow Crown has some unusual characteristics. It wants to behave like a tree peony rather than an intersectional hybrid. It grows from it's past years old growth from the snow line down, instead of dying to the ground each winter. This year it set 5 big healthy-looking seeds all from one pod in the manner of a herbaceous peony. This is the first year it has ever done this since I purchased it from Reath Nursery about 34 years ago. I hated to do it, but I cut one of the seeds in half after pinching it to find it very firm right out of the pod. It also sank in a glass of water. After cutting the seed in half it looked fully developed. I planted the remaining four seeds and I am hopeful one or two will grow. If they do, just think of the possibilities; Itoh - Itoh, Itoh - herbaceous, Itoh - Tree peony? Who knows, but it is very exciting to think about!! Last year I thought *Garden Treasure* had done the same, only to see its seeds shrivel and die as small black specks. But this year I believe I have the genuine item. Perhaps I'll know more next century! Has anyone else experienced

healthy looking developed seeds from *Yellow Crown*?

On another subject, Galen Burrell sent me what he says is an orangish lutea t.p. hybrid which has bloomed for him. So I will be excited to see it bloom in a year or two and to begin hybridizing with it. It is so exciting to have the color orange in peonies. Now 4 or 5 people have them and probably more. Now to get a bright orange that is vivid. Then orange and red, orange and yellow, orange with white picotee edging etc. Great! I live to see it! It can be done! I get excited about peonies, they are such fun!

P. LUTEA X P. LACTIFLORA

by Don Smith

While looking through some old articles on hybridizing I came across this interesting report by A.P. Saunders on an unusual reciprocal intersectional cross*.

"Last year I had a strange disappointment in connection with *P. lutea* as female parent. I had some crosses on this species using pollen from Chinese peonies (*lactiflora*), and was rewarded with half a dozen immense pods of seed. When the pods burst, there they were, --- two or three dozen big black glossy seeds. But when I got them out, I noticed that they gave a little under pressure between the fingers, and on breaking one open, I found that the seed was nothing but a tough shell, there was nothing inside. And so it proved with all of them."

I am struck by the similarity of this report to my recent experience with another reciprocal intersectional cross (*lutea* hybrid x *p. lactiflora*). My experience with this cross has been reported in a number of newsletter articles over the last few years (see for example Vol. 25, No. 1, p. 1; Vol. 26, No. 1, p. 1; Vol. 26, No. 3, p. 1; Vol. 26, No. 4, p. 1 and Vol. 27, No. 4, p. 5). Based on this experience, I would expect that a persistent effort with the *p. lutea* x *p. lactiflora* cross might produce an occasional viable seed and eventually also a reciprocal intersectional hybrid seedling or two. Such hybrids would be interesting and unique, especially if double *lactiflora* varieties were used as pollen parents. Unfortunately, I do not grow *p.lutea*, so I will not be making this cross myself anytime soon. However, some of you who do grow this species should definitely give this cross a try. It will be easy to get lots of seeds, on the other hand it will probably take several hundred seeds to get one that will grow. In addition, seeds from the reverse cross (*lactiflora* x *lutea*) have also been reported (Pehrson, 1975, *Pæonia*, Vol. 6, No. 1). In this direction, there will be significantly fewer seeds, but germination will likely be much better. So why not try this cross in both directions and see what happens. One way or the other something good could result.

* From "How to Hybridize Peonies" by A. P. Saunders (APS Bulletin, No. 8, May 1919). Reprinted in the "Best of 75 Years" , 1979, p. 108-110.

COMMUNICATIONS FROM READERS

On 12 April 99 I received a phone call from Zlatana Draskovick of Gary, Indiana concerning my editorial comments on Harold Entsminger's article "Comments on the Effects of Soil on Flower Color Expression in Peonies" in the spring issue of the newsletter (Vol. 29, No. 2, p. 3). She claims to have a plant of the *Daphnis* hybrid *Leda* from Reath which she divided in two a few years ago. Zlatana now has two plants that have distinctly different characteristics especially regarding flower type. One of these divisions bears single to semi-double pink flowers while the other has flowers that are generally much more double. Since both of these plants came from the same original plant, these cannot be different varieties. Although the effects of soil (since they are not planted in the same location) cannot be completely ruled out, I suspect that the plant with the more double flowers is simply a sport (mutation) of the more normal (single-flowering) clone, that was somehow accidentally isolated by the process of division. Zlatana seems to agree with this analysis. Naturally, this could also be the explanation for Bill Seidl's more double flowering *Leda* plant as well, which is undoubtedly what prompted Zlatana to call. Clearly, there are at least two plausible explanations for the observations reported by Harold Entsminger and myself.