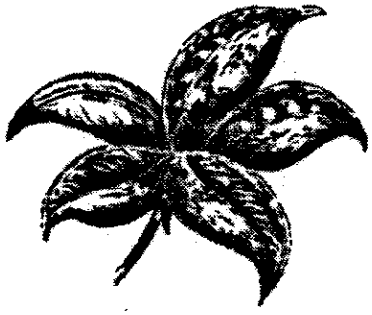

PÆONIA

AN INTERNATIONAL NEWSLETTER FOR PEONY HYBRIDIZERS

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Editor and Publisher:

Donald R. Smith
46 Exeter Street
W. Newton, MA 02165

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LADY TESSERA AND THE PRAIRIE MOON

by Harold Entsminger

It is kind of a love story, how these two got together. Really, a new kind of a thing, a lone seedling babe, now one year old from a cross between the Daphnis F1 tree peony hybrid, *Tessera* (D-4) and the herbaceous hybrid *Prairie Moon* (Archangel x Laura Magnuson).

I had just returned home to Cutbank, Mt. from a trip to Seattle, Washington. As usual I had paid a visit to my friends Don Smetana and Keith Able at A&D Peony Nursery. They are known as the best "Pot Farmers" in the Pacific N.W. because they grow and winter over such beautiful peonies in pots. The temperature there, even a-top beautiful Mt. Clearview, seldom falls below -3°F. So mild is their climate it is usually 3 weeks ahead of Cutbank's peony blooming season. They have mid-season bloom while I still await the opening of my first blossoms. After a week in Seattle, I arrived home on June 7 th, 1995 with a pot in each hand. I immediately checked my hundred plus varieties of herbaceous peonies and my twenty-some varieties of tree peonies for flowers, but only one flower on one plant was about to open, nothing else was close. I was excited that it was *Tessera*! My orange breeding program could go on. But what to pollenate her with? I called around town to some of my peony

friends. "You know the peonies aren't in bloom yet, Harold," came my only answer.

Tessera, my only Tessera at the time, has bloomed for me each of the last 3 years, since being just a little tot. She knows she's my favorite. I have never found pollen on her, and she had never set seed in the three years of pollenating her. I told *Tessera* that was OK, that I knew she was just a baby, and that I still had high hopes for her, because she was the closest thing to orange that I'd ever laid eyes on in a peony. *Tessera* varies in her color. The first two years under warmer springs and winters she was a clear metallic new copper penny color. The last two years under colder conditions, she has been a streaked orange, red, pink and yellow color, not nearly as pretty.

It appeared then, that I had only two choices for pollening this plant, a plant that I have never been able to even self. In one hand I held the potted herbaceous variety *Prairie Moon* and in the other the equally herbaceous *Israel*, both in full bloom. I had to make my choice. I checked my plants, both were full of pollen. You guessed it, I choose *Prairie Moon*! On the older blossoms the ones that come double, there was no pollen. But, on the new shoots with semi-double flowers there was an abundance of pollen on that hot summer-like day.

Now, we hybridizers know that on plants like *Prairie Moon* and *Pink Hawaiian Coral*, you can cut-off those first shoots at the ground while letting those next ones come. It is those (secondary stems) that will produce the fertile semi-double flowers. Many propagators and nurseryman never want to see a pod set on their plants and so they cut-off all the pods as soon as the plant finishes its bloom. So they can't tell you what kind of pods are produced or anything else about fertility. All they know is that pods take strength away from the plant. So it is left to the backyard hybridizer to know about such things.

So I took my curved-Kelly forceps and locked on to some of those *Prairie Moon* anthers and walked them over to *Tessera* and pollenated her with large amounts. Then pulling my trusty paper micro porous tape, folding it over lengthwise, pinching it on both ends, formed the envelope. I slipped it over the carpels protecting the ovaries from any other pollen or contamination of the cross. This is really sticky stuff, this paper tape, and I've never had rain nor wind take it off once it has been pressed on firmly with the fingers. *Tessera* had only one large red seed from that single flower which never had to be striped or even much disturbed. The seed was as big as a chili bean. I planted it outside, but days later I remembered that very cold weather, like -30° F which is average cold around here, can kill tree peony seed, so I dug it up in its buried little pot, washed and cleaned it in 10% Clorox solution, put it in a plastic bag and let it sit on top of the TV. After a couple of months, it developed a long root and I placed it into the refrigerator until a small new root and top grew. Then I put it out in the warm growing house. It soon sported two leaves that were sort of grayish-green. At first, they didn't look very healthy so in mid-May I took it outside in its pot and set it in filtered shade. Soon it looked as green and healthy as any other young seedling.

Since I don't believe in luck or chance, I hope this little guy makes it. Wouldn't it be something if one cross producing one seed from one flower turned out to be a beauteous Orange? Odds are better that it will die in the first winter. But, if it survives, well then we'll see. Maybe it will be protected by the "Grand Hybridizer".

Prairie Moon, its father, I've never noted to set seed and I've not tried other crosses, but you can bet that I will and I'll also try this cross over and over again. I have high hopes for *Tessera* as a mother. I think she will be a great one.

I try to think of a great cross, set a goal, research the proposed parents and then, make the cross if it seems possible. For example, why not try P. *Picotee* x T.P. *Infanta* and reverse. Just see what happens. Hey, those master hybridizers, the bees, have done some impossible things around here. How about Saunders F2-A x *Ariadne*?

Here's all you need to do

- Collect the plants
- Set your goals
- Make your crosses
- Keep records of your results
- Savior your memories

Now, sit out in the yard and enjoy your plants, in or out of bloom and, oh yes tell them of your expectations. Then dream of their little babes. Isn't it there, where it all begins ..... In our dreams?

AND THEN THERE WERE TWO

by Don Smith

First came the report of a genuine intersectional hybrid from a reciprocal cross between a hybrid tree peony and a herbaceous lactiflora type (Pæonia, Vol. 26, No. 1). Somewhat surprisingly, it was again a relatively sterile F_1 lutea hybrid tree peony (not a fertile F_2) that helped make this very difficult cross possible. The pattern was similar to that seen in the original Itõ cross, only in this case, it was the Saunders F_1 hybrid Age of Gold (as a seed parent), rather than Alice Harding, that provided the formula for success.

Now comes a second report of a reciprocal intersectional hybrid that is even more exciting and more improbable than the first one (see previous article by H. Entsminger, p. 1). Once again, the seed parent was a "sterile" F_1 lutea hybrid (Tessera), only this time the pollen parent was an advanced generation tetraploid herbaceous hybrid instead of a diploid lactiflora variety.

Until now, nearly all of the intersectional hybrids produced have been of a similar type. Specifically, they have been triple hybrids containing three species; lutea, suffruticosa and lactiflora in approximately equal proportions. Based on their tree peony-like characteristics and high degree of sterility, they are presumed to be triploids produced by the union of an unreduced tree peony gamete with a normal (haploid) one from the herbaceous parent. Thus, they have one full set of chromosomes from each of the three species in their make-up. Since two of the three species belong to the woody section (Moutan), these hybrids are all heavily influenced by this 2:1 ratio of tree peony to herbaceous genes and thus have exhibited characteristics more closely resembling the woody types.

If the plant described above by H. Entsminger survives and proves to be a true intersectional hybrid, it will in all likelihood be of a new and different type with characteristics resembling the herbaceous species more than the tree peony types. The reason for this is quite simple. Prairie Moon is undoubtedly a tetraploid having originated from a tetraploid (Archangel) crossed with a triploid (L. Magneson). The F_1 lutea hybrids, on the other hand, are presumed to be "sterile" diploids that ocassionally produce viable (normal) haploid and/or unreduced (2n) gametes. Therefore, when these t. p. hybrids are crossed with tetraploids, such as Prairie Moon, both triploid and tetraploid progeny are possible, but triploids are probably more likely. In such cases, however, there are two sets of herbaceous chromosomes to only one set of tree peony chromosomes. This is, of course, just the opposite of the ratio found in all earlier intersectional hybrids. As a consequence of this, such hybrids should be expected to exhibit dramatically different characteristics compared to other intersectional hybrids; characteristics that are much closer to the herbaceous types than to the woody forms. The "family tree" for this exciting new hybrid is shown in Figure 1 below. This can be compared with the similar pedigree chart shown in Figure 2 for the reciprocal intersectional seedling which I reported on in an earlier issue (Pæonia, Vol. 26, No. 1). It is obvious from Figure 1 that the new Entsminger hybrid contains at least 5 different species, three or more on the herbaceous side of the cross and two on the tree peony side. This equals the number of species found in some of the newest tetraploid herbaceous hybrids such as Laning's Sunny Girl and Lois' Choice and Reath's Lemon Chiffon. The species that make-up this new intersectional hybrid are compared with those of several new tetraploid herbaceous hybrids in Table 1-1. It can readily be seen from this table that three herbaceous species, lactiflora, macrophylla and peregrina, are common to all of these new hybrids.

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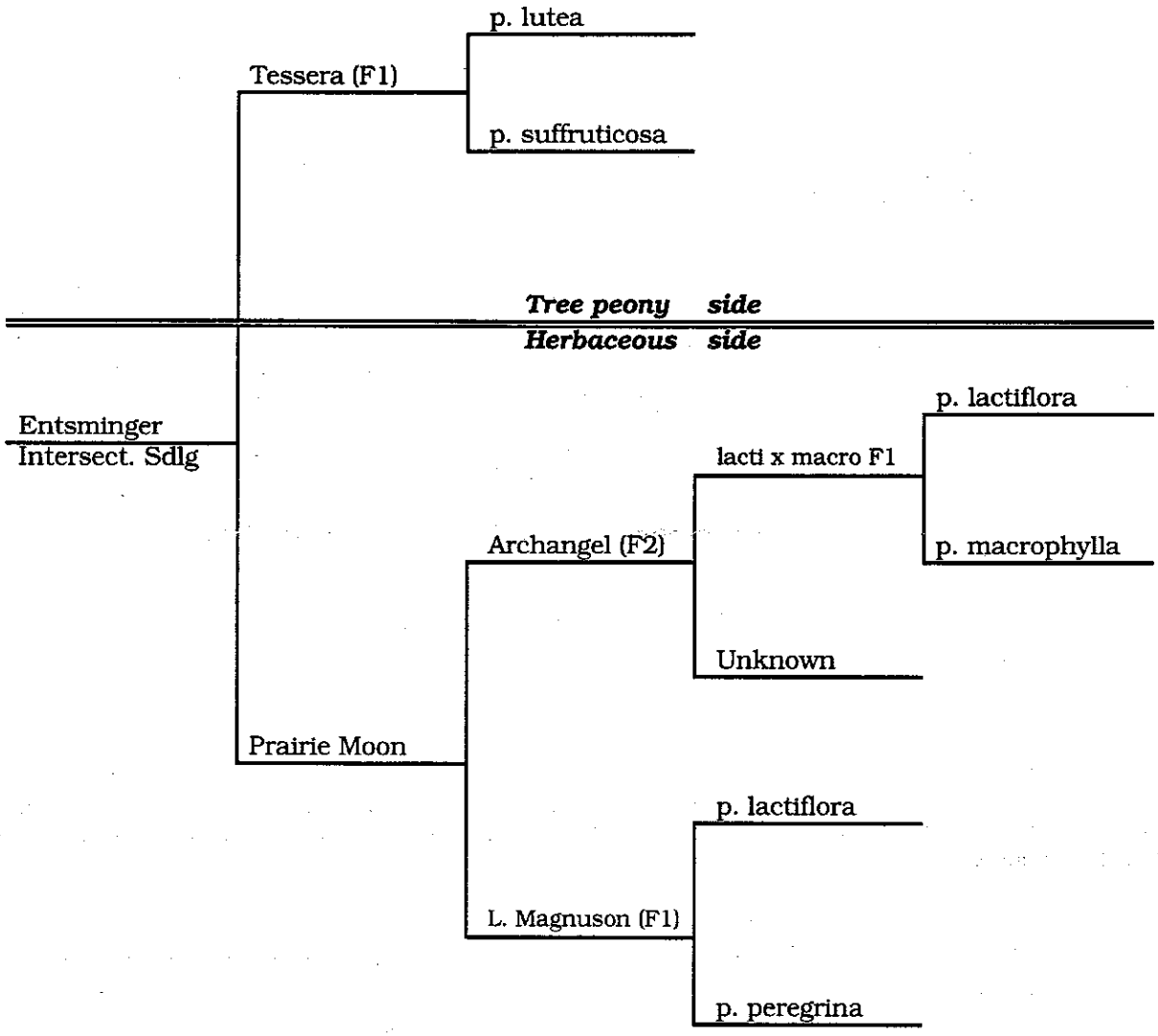

Figure 1. "Family tree" for the new Entsminger reciprocal intersectional seedling from the cross (Tessera x Prairie Moon). The label for this new seedling has been intentionally shifted to the herbaceous side of the cross to indicate that this seedling is presumed to be 2/3 herbaceous to 1/3 tree peony in its' genetic make-up. Here, I use the classification of Stern/Cooper used by Rogers (Peonies, p. 63). In this classification system p. lobata (also referred to by Saunders as officinalis lobata) is listed as p. peregrina.

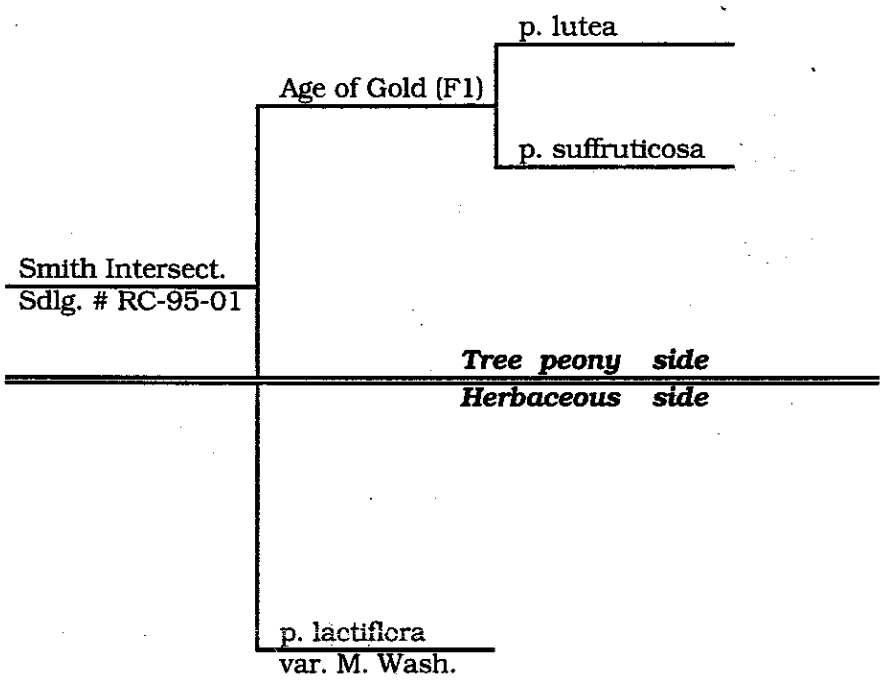

Figure 2. "Family tree" for the new reciprocal intersectional hybrid seedling reported by Smith (*Pæonia*, Vol. 26, No. 1, p. 1) from the cross (Age of Gold x lactiflora var. M. Washington). The label for this new seedling has been intentionally shifted to the tree peony side of the cross to indicate that this seedling is presumed to be 2/3 tree peony to 1/3 herbaceous in its' genetic make-up. Like other previous intersectional hybrids it is a triple hybrid with one complete set of chromosomes from each of three separate species.

Note: In both figures above, the standard convention of the female (seed) parent on top and the male (pollen) parent on the bottom is used.

Table 1-1.

Hybrid Name	lactiflora	macro.	peregrina	mloko.	obovata	tenuifolia	lutea	suffrut.
Entsminger Sdlg	X	X	X				X	X
Sunny Girl	X	X	X	X	X			
Lemon Chiffon	X	X	X	X		X		
Sunny Boy	X	X	X	X				

The likely fractional make-up of this new hybrid (assuming that it is a triploid) is shown in Figure 3. As seen from this figure, this seedling has genetic material from five separate species in approximately equal proportions. Only about 10% of its make-up is unknown.

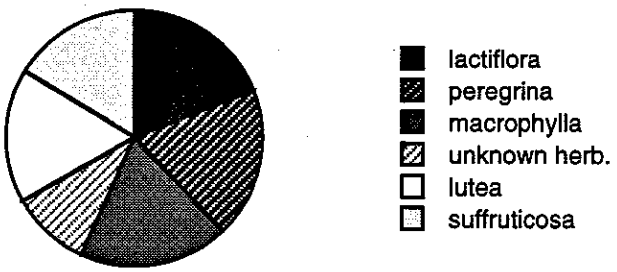

Figure 3

Some of the possibilities from this line of breeding were pointed-out previously by Chris Laning (Vol. 26, No. 3, p.3). Chris has suggested (if I understand him correctly) that tetraploid herbaceous hybrids used as pod parents might produce "fertile" tetraploid intersectional hybrids (presumably from the union of a normal 2n gamete from the tet pod parent with an unreduced (2n) gamete from the t. p. pollen parent). Although I agree with this suggestion, I believe that this is true irrespective of the direction of the cross. Generally, unreduced gametes are more common on the female side than on the male side of a cross (see Pæonia, Vol. 27, No. 1, p. 4). In time, observations of my reverse cross intersectional seedling (see Figure 2) should provide important inputs to help answer this question. If the foliage and other plant characteristics of this seedling are typical of other intersectional hybrids (i.e., it is a triploid dominated by tree peony characteristics), then it is probably safe to assume that unreduced gametes were contributed by its tree peony pod parent, Age of Gold.

In either case, the new Entsminger seedling clearly represents a significant breakthrough in intersectional breeding. One that has substantially expanded the gene pool of this important cross. It has opened a new door for the rest of us to pass through. By using some of the newer quaduple and quintuple tetraploids as suggested by Chris L., we might add one, or two or more additional species to the mix. The possibilities here seem almost without limit. Chris and I have arranged to help each other in pursuing this cross (in both directions) in the coming season by exchanging plants and pollen. I don't know about you, Chris, but I can hardly wait to get started.

PEONY INTERSECTIONAL CROSSES; A BRIEF REVIEW OF THE PROGRESS OVER THE FIRST 50 YEARS

Donald Smith

For generations it was widely believed that crossing herbaceous peonies with tree peonies was impossible; a belief no doubt based on thousands upon thousands of unsuccessful attempts by many over the years. Professor A. P. Saunders (1869-1953), America's greatest peony hybridizer, considered this cross "the impossible dream". Although he had succeeded at crossing "just about everything with everything else" in the peony world, he assigned top place among his failures to the attempt to cross the tree peonies with the herbaceous type. Scores of others had also tried and failed over the past several hundred years. Yet despite the odds, attempts continued and eventually success was attained. Now, today it seems hard to believe that nearly 50 years has passed since Toichi Itō succeeded in producing the first true intersectional hybrid plants. Nevertheless, it is generally agreed that this cross was first accomplished around 1948 or 1949, with the first flowers occurring about 1954. Unfortunately, news of this important development was not widely known until about 1967 or 68 when these plants were purchased, named and introduced into the U.S. by Louis Smirnow. Since then, several amateur breeders have continued to explore and expand the possibilities of this and other intersectional crosses. In time, new, more fertile parents were discovered that greatly increased the seed production and also expanded the range of flower

colors exhibited by the progeny from this cross. Other combinations were also tried and some of these were successful as well. Recently, there have been several new reports of success with a number of different intersectional crosses made in the reverse direction.

One indication of just how far we have already come, can be obtained by examining Table 2-1. This table lists a number of sets of reciprocal crosses (a set being a single cross in both directions) between tree peonies (section Moutan) and the herbaceous types (section Pæon). Clearly, many other similar crosses involving various other herbaceous species are also possible. However, all of the important crosses involving lactiflora and its hybrids are included in Table 2-1. It is surprising to realize just how many of these crosses have been successful to one degree or another. Five of these successes have been reported in just the last two years. Only three of these crosses have so far failed to produce any seeds or plants. However, since these three are all reverse crosses, (where the appropriate source of pollen is usually not easily available) it is entirely possible that these reverse crosses have never been attempted. In addition, it should be noted that in each case the opposite cross has been successful, thus increasing the odds that these crosses can also be successfully made. Overall, more than 3/4 of these crosses have produced seeds and nearly 2/3 have resulted in hybrid progeny.

Based on these findings, I am quite convinced that virtually all tree peony species and hybrids can be sucessfully crossed with herbaceous species and hybrids in both directions. Obviously, some of these crosses will be much more difficult than others, however, I seriously doubt that there are any real barriers preventing such crosses from being successful. The late Roy Pehrson often said "try everything and be surprised". This seems to be especially good advise when applied to the intersectional crosses.

Table 2-1.

	Intersectional Cross	Type/ No. of Species	Seeds	Germ	Hybrids	Hybridizer	Reference
1.	lactiflora x lutea hybrid	IC/3S	X	X	X	Itō (1967)	APS Bull. (Mar 1967)
2.	lutea hybrid x lactiflora	RC/3S	X	X	X	Smith (1996)	Pæonia Vol 26, No.1
3.	herb. hyb. x lutea hybrid	IC/4+	X	X	X	Krupke (1996)	Pæonia Vol 26, No.1
4.	lutea hyb. x herb. hybrid	RC/4+	X	X	X	Entsminger (1997)	Pæonia Vol 27, No.1
5.	lactiflora x suffruticosa	IC/2S	X	X	X	Itō (1967) ?	APS Bull. (Mar 1967)
6.	suffruticosa x lactiflora	RC/2S	X	X	X	Smith (1996)	Pæonia Vol 26, No.4
7.	herb. hyb. x suffruticosa	IC/3+	X	X	X	Laning (1986)	Pæonia Vol 17, No.2
8.	suffruticosa x herb. hyb.	RC/3+	X	?	?	Hollingsworth (72)	Pæonia Vol 3, No.4
9.	lactiflora x potaninii	IC/2S	X	X	X	Anderson (1986)	Pæonia Vol 17, No.1
10.	potaninii x lactiflora	RC/2S	-	-	-		
11.	lactiflora x lutea	IC/2S	X	?	?	Pehrson (1975)	Pæonia Vol 6, No.1
12.	lutea x lactiflora	RC/2S	-	-	-		
13.	lactiflora x delavayi	IC/2S	X	X	X	Pehrson/Laning (96)	Pæonia Vol 26, No.3
14.	delavayi x lactiflora	RC/2S	-	-	-		

In addition to the intersectional crosses listed in Table 2-1, there are many other intersectional crosses that are possible (see "The Other Intersectional Hybrids", Pæonia, Vol. 25, No. 4, p. 5). Generally, these are crosses involving one of the two N. American species (p. brownii and p. californica) that make-up the section Onæpia. Recently, there have been several reports of seeds from some of these "other" intersectional crosses. These crosses, along with others reported over the years, are listed in Table 2-2 below. However, it is probably reasonable to assume that the majority of the possible combinations have yet to be tried.

Table 2-2

	Intersectional Cross	Type/ No. of Species	Seeds	Germ	Hybrids	Hybridizer	Reference
•	**Moutan x Onepia** and Reverse						
1.	delavayi x brownii	RC/2S	X	X	?	Burrell (1995)	Pæonia Vol 25, No.4
2.	lutea x brownii	RC/2S	X	?	?	Burrell (1995)	Pæonia Vol 25, No.4
3.	lutea x californica	RC/2S	X	No	No	Hollingswth (72)	Pæonia Vol 3, No.4
4.	brownii x potanini	IC/2S	X	?	?	Oveson (1995)	Pæonia Vol 25, No.4
•	**Peon x Onepia** and Reverse						
5.	lactiflora x californica	RC/2S	X	?	?	Laning (1976)	Pæonia Vol 7, No.1
6.	lactiflora x brownii	RC/2S	X	?	?	Waltz (1995)	Pæonia Vol 25, No.4
7.	officinalis x brownii	RC/2S	X	?	?	Saunders (1927)	Pæonia Vol 2, No.4
8.	brownii x tenuifolia	IC/2S	X	?	?	Saunders (1934)	Pæonia Vol 2, No.4
•	**Peon x Moutan** and Reverse						
9.	suffruticosa x tenuifolia	RC/2S	X	X	X	Gilbertson (77)	Pæonia Vol 8, No.1

Note: In the above tables, IC refers to a forward direction intersectional cross and RC refers to the corresponding reverse or reciprocal cross. The assignment of direction being based primarily on the order of flowering, such that a forward direction cross is defined as one where pollen from an earlier flowering variety is used on a later flowering plant. This is the normal or easy direction to make a given cross, since pollen from the earlier flowering types is always readily available for use on the later

flowering ones. In most cases, tree peonies flower well before the herbaceous types. Therefore, the above convention dictates that (herbaceous x tree peony) crosses be referred to as forward crosses and hence, (tree peony x herbaceous) crosses must then be regarded as reciprocal crosses. Assignment of direction in the Peon x Onepia herbaceous intersectional crosses is clearly somewhat arbitrary due to the unusual (winter) flowering time of the two American species.

Altogether, there are at least 20 different intersectional crosses that have produced seeds. Undoubtedly, many of these seeds failed to germinate and some may have come from contaminated crosses and thus were not true intersectional hybrids. Nevertheless, at least half of these 20 crosses have produced true intersectional hybrids. This is really quite remarkable for a cross that was once considered impossible. I would certainly say that considerable progress has been made over the past 50 years. It is fun to try to imagine what progress the next 50 years might bring.

ARTICLES FOR FUTURE ISSUES

Articles that I am working on for the next issue include the following:

1. *Breeding Fragrant Tree Peonies*
2. *Analysis and Comment on the 1986-1996 Peony Checklist*

   This article will compare the results of the last 10 years with those of the previous decade (1976-1986).
3. *Continued Observations of a Reciprocal Cross Intersectional Seedling*

Note: I need many more letters and articles from those working with herbaceous species and hybrids. The newsletter needs more diversity of material but, I need your help to achieve this goal.

RECIPROCAL DIFFERENCES IN INTERSECTIONAL CROSSES ; OBSERVATIONS AND PATTERNS

by Don Smith

In a previous issue of the newsletter (Vol. 26, No. 4) I summarized some of the important reciprocal differences observed by Prof. Saunders while crossing various herbaceous tetraploid species with lactiflora in both directions. For this issue it seemed appropriate to make up a similar table to look at reciprocal differences in various intersectional crosses. Although lactiflora, suffruticosa and presumably the lutea hybrids as well, are all diploids, there may nevertheless, be some similarities with the tetraploid - diploid herbaceous crosses discussed in the above mentioned article. This is because intersectional crosses between the diploids species mentioned above seem to be successful only when unreduced gametes are involved on one side of the cross. Thus, these diploid - diploid crosses effectively become tetraploid - diploid crosses that produce triploid offspring.

Unfortunately, there is at present little or no information about the plant or flower characteristics of reverse cross progeny for comparison with their opposite direction counterparts. Therefore, only comparisons of cross effectiveness and seed germination rates can be made at this time. These comparisons suggest that although reciprocal crosses (tree peony x herbaceous peony) are generally more productive (produce more seeds), the seeds from these crosses do not germinate and grow well. This seems to be especially true with the more fertile F2 and advanced generation lutea hybrids. For this reason it is strongly recommended that F1 t.p. hybrids be used when attempting to made these reverse intersectional crosses.

Table 2-3
Reciprocal Differences in Intersectional Crosses

Normal direction of cross based on flowering time	Reverse direction of cross based on flowering time
Lactiflora x Lutea Hybrid ($2n \times 2n_u$)	Lutea Hybrid x Lactiflora ($2n_u \times 2n$)
Takes fairly well (~4 s/c) *	Takes very well (~8 s/c) *
Good germination (~30%)	Extremely low germ. with F2's, Germination much better with F1's
Lactiflora x Suffruticosa ($2n \times 2n_u$) ?	Suffruticosa x Lactiflora ($2n_u \times 2n$) ?
Takes very poorly (~0.01 s/c)	Takes much better
Germination unknown, probably OK	Germination- fair to good, but root growth slow and weak
Herb. Hybrid x Lutea Hybrid (4n x 2n)	Lutea Hybrid x Herb. Hybrid (2n x 4n)
Takes poorly (< 0.1 s/c)	Takes fairly well (~2-3 s/c)
Germination- unknown	Germination- poor with F2's, Germ. with F1 seeds-much better
Herb. Hybrid x Suffruticosa (4n x 2n)	Suffruticosa x Herb. Hybrid (2n x 4n)
Difficulty unknown probably fairly difficult	Difficulty unknown probably less difficult

* Seed production rate numbers are for crosses involving A-199 and /or Martha W. as either pollen or seed parents, crosses with all other parents are considerably less productive.

Note: Use of the subscript $_u$ indicates a presumption that unreduced gametes are present on that side of the cross