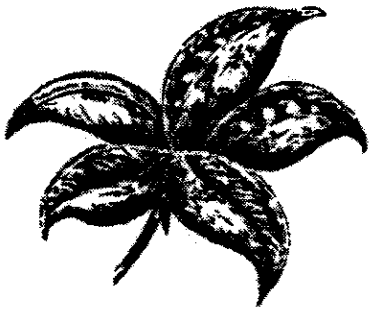

PÆONIA

An International Newsletter for Peony Hybridizers

Volume 25, No. 4 **Fall/Winter 1995**

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Subscription Rates:

U. S. and Canada	Outside U. S.
5 yrs. -- $25.	$35.
10 yrs. -- $45	$65.

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RUPTURED SEEDS, A METHOD FOR INCREASED GERMINATION:

Donald Smith

Anyone who has experienced a degree of success with the intersectional cross, has undoubtedly also encountered the phenomenon of ruptured seeds. Although this phenomenon is certainly not unique to the intersectional cross, it is extremely common when working with this important cross. For example, these seeds generally make-up between 15-30% of the total seeds produced by this cross. It is my impression that the endosperm of these seeds simply grow too large (or too fast) for the seed coats , thus causing the seed coat to split or rupture. Although a majority of these seeds appear to be "viable", most of them (~ 90-95%) will begin to rot before germination can take place, at least under "normal" handling conditions. This has often caused me to wonder whether some special set of conditions or handling would allow these seeds to germinate at a more normal rate. Typically, normal (unruptured) seeds from the intersectional cross germinate at a rate between 30-50%, whereas the corresponding rate for ruptured seeds is only about 5-8%, or approximately six (6) times lower.

In an attempt to find a remedy for this problem, I decided to experiment with an idea aimed at trying to increase the germination rate of these seeds. I am happy to report that this

experiment proved to be a complete success and that a "normal" germination rate was achieved for this year's crop of ruptured "i" seeds. Details of the method developed to obtain these results is described below.

Step 1 Harvest seeds at an early stage, but not before they have turned fully brown. I inspect the seeds as soon as the pods begin to split-open on their own. If most seeds in the pods are brown, I harvest (cut) the stem and put it in water for a few more days inside the house. Any seeds which are loose (no longer connected to the pod) must be harvested and dealt with immediately. When all of the seeds have turned completely brown, remove the seeds from the pods. Once this is done you must attend to the seeds immediately.

Step 2 Carefully inspect all seeds and separate the ruptured ones. You must deal with these ruptured seeds without delay. Normal (unruptured) seeds should be allowed to "dry-out" for at least a few more days, if not a week or more. This will allow sufficient time for the tiny attachment point to "dry-off". There should be no rush to "start" these good seeds. Starting seeds too early offers no real advantage and will likely only increase your rate of loss. The ruptured seeds, on the other hand, can not be allowed to "dry-out", at least not until these seeds have been properly sealed. Since the endosperm is partially exposed, letting the seeds "dry-out" will only allow the endosperm to "dry-up" thus destroying the seed. If "started" at this point, most of these seeds will eventually rot, even when treated with a fungicide. (I use a spray with ~1/4 -1/2 teaspoon of Clorox bleach in about a pint of water). At this point, we must find some way to seal the seed coat.

Step 3 Sealing the Ruptured Seeds

a) Find a short piece of wood (like a 2" x 4")

b) Cover the top of the block with double-sided (double-stick) tape or use regular masking tape with the sticky side up by taping down the edges.

c) Stick the ruptured seeds to the tape with the ruptured area (side) facing up.

d) Mix-up a small amount of 5-Minute Epoxy by squeezing out short strips of resin and hardener onto a disposable plastic surface. Mix the epoxy with the wood end of a wooden Q-tip or similar small diameter wooden or plastic stick (such as a coffee stirrer). At this point you must work fairly fast. Use the epoxy to make thin seals over the exposed endosperms by transferring it to the seeds using the same stick used for mixing. Do not use too much, the epoxy will flow down over the endosperm and seed coat to form a thin uniform layer. Do as many seeds as you can before the epoxy starts to become tacky (~3-4 minutes). Do not try to do more than 6-8 seeds at one time. Once the epoxy becomes tacky, **stop!** Throw-out the epoxy and make-up a new (fresh) batch. Continue until all of the seeds have been sealed. Allow seeds to fully cure for at least 24 hours or more. If you missed a spot, you can not fix it until after the seal has cured (at least several hours).

Step 4 After 1-2 days, the sealed seeds can be handled like any normal seeds. I start my seeds by placing them in moist (not wet) long grain (not milled) sphagnum moss in plastic sandwich bags (I use the Ziploc type). I rarely place more than 15-16 seeds in a single bag. Leave the bags in the house at normal room temperature (~60-80° F).

Step 5 Check the bags after 5-7 weeks and many of the seeds will have already germinated. Replenish lost moisture in the bag by spraying several times with water/Clorox mixture (see above). Check the seeds about once a week thereafter.

Step 6 Transfer all germinated seeds (in bags with moist sphagnum moss) to a refrigerator (34-38° F) when the roots are ~ 1-1.5" long. Do not wait for all seeds in a bag to germinate before moving seeds to the refrigerator. Some seeds will take weeks longer and by then, the roots on the early ones will be too long for easy handling. Don't forget to label all bags with the number of seeds, type and transfer date.

Step 7 Check seeds after ~ 11-12 weeks for signs of root splitting. The average refrigeration time is ~ 18 weeks. (see Vol. 25, No. 1, Pg. 4 for more details)

Step 8 Remove seeds from the refrigerator at the first signs of stem (plumule) emergence. This will usually occur 2-3 weeks after root splitting has occurred. Once again, do not wait for all of the seeds in a bag to send up shoots. Transfer those

seeds which are ready to new bags with slightly moister sphagnum moss and leave at room temperature for several days (never more than about a week) prior to planting.

Step 9 Plant in loose soil before the plumule becomes too long (less than about 1/2" is probably ideal). Plant with the tiny stem pointing up and (to the extent possible) the root facing downward or sideways, with the seed case and emerging stem just barely below the soil level. I use a mixture of potting soil (~1/2), milled sphagnum moss (~3/8), and perlite (~1/8) with no fertilizer. I plant only one seed to each 4" plastic pot.

Step 10 Place pots under artificial "grow" lights such that the foliage is approximately 4-8" from the fluorescent bulbs. Raise the lights as plants grow to maintain this 4-8" distance. Gradually increase the duration of light from ~8 hours to ~16 hours and then back to 8 hours again as the season progresses.

The results obtained from this method are compared to those of previous years in Table 1 below. In previous years ruptured seeds were not given any special treatment but were handled like all other seeds.

Table 1

	Total No. of Seeds		No. of Ruptured Seeds		Ruptured Seeds, % of Total	Germination Rate (%)		Plants from Ruptured Seeds, % of Total
	Total	Started	Total	Started	T/S	Normal	Ruptured	
1993 & 94 Totals	258	214	55	50	21/23	35	6	5
95 Totals (Epoxy)	195	187	55	55	28/29	50	56	~32

It is clear from the results shown in Table 1 that this new method for germinating ruptured seeds was extremely successful. The germination rate of these seeds was increased by nearly a factor of 10 (from 6 to 56%) when compared to previous years. In fact, this rate was not only significantly higher than the rate for normal seeds but was also the highest germination rate which I have ever achieved with any group of intersectional seeds. It will be very interesting to watch the development of the plants from these seeds (as a group) compared with those resulting from normal seeds.

A SUMMARY OF REGISTERED AND NAMED INTERSECTIONAL HYBRIDS

Due to an unfortunate dispute over nomenclature between the APS and the majority of the current breeders of intersectional hybrids, most new "i" hybrids are no longer being registered with the APS. This has resulted in a near void of information concerning the newest of these important peony hybrids. In an attempt to fill this void, I have compiled a "complete" list of all the named "i" hybrids of which I am aware. These 34 hybrids are listed below (in no particular order). I would appreciate hearing from anyone with corrections or additions to this list.

REGISTERED AND NAMED INTERSECTIONAL HYBRIDS

Hybrid Name/Breeder	Flower Color	Flower Type
1. Yellow Heaven (Itō)	Bright yellow	Semi-double
2. Yellow Emperor (Itō)	Bright yellow	Semi-double
3. Yellow Dream (Itō)	Bright yellow	Semi-double
4. Yellow Crown (Itō)	Bright yellow	Semi-double
5. Yellow Gem (Higuri)	Bright yellow	Semi-double
6. Garden Treasure (Hollingsworth)	Bright yellow	Semi-double
7. Border Charm (Hollingsworth)	Yellow w/ red flares	Single
8. Prairie Charm (Hollingsworth)	Light yellow	Semi-double
9. Bartzella (Anderson)	Bright yellow	Double
10. First Arrival (Anderson)	Lavender pink	Semi-double
11. Cora Louise (Anderson)	White w/plum flares	Semi-double
12. Julia Rose (Anderson)	Light cherry red	Single-Semi-double
13. Morning Lilac (Anderson)	Bright fuchsia purple	Single
14. Court Jester (Anderson)	Yellow w/ red flares	Single
15. Callie's Memorie (Anderson)	Light yellow w/ red flares	Semi-double
16. Little Darlin' (Anderson)	Lavender pink	Semi-double
17. Luxuriant (Anderson)	White w/ lavender flares	Semi-double
18. Scarlet Heaven (Anderson)	Bright scarlet red	Single
19. Mercedes Renee (Anderson)	Deep pink	Semi-double
20. Joanna Marlene (Anderson)	Cream suffused pink	Single
21. Sequestered Sunshine (Anderson)	Bright yellow	Single-Semi-double
22. Lemon Dream (Anderson)	Bright yellow	Semi-double
23. Viking Full Moon (Pehrson/Seidl)	Light yellow	Single
24. Lafayette Escadrille (Pehrson/Seidl)	Black red	Single
25. Rose Fantasy (Seidl)	Dusty rose	Single

26. Hidden Treasure (Seidl)	**Yellow w/ red flares**	**Single-double**
27. White Emperor (Seidl)	**White mutation of Y. Emperor**	**Semi-double**
28. Pastel Splendor (Anderson/Seidl)	**Cream yellow w/ pink highlights**	**Single**
29. Oneida Chief (Seidl)	**Black red**	**Single**
30. Unique (Anderson)	**Deep rose pink**	**Semi-double**
31. Hilliary (Anderson)	**Light red fading to Cream**	**Double**
32. Canary Brilliants (Anderson)	**Bright yellow**	**Full double**
33. Tinge of Yellow (Anderson)	**Light Yellow**	**Dble.- Semi-dble.**
34. Evelyn Marie (Smith)	**Light Yellow w/ bright red flares**	**Semi-double**

Table 2
Distribution of Named Intersectional Hybrids by Color and Flower Form

Flower Type/ Color	Bright Yellows	Light Yellows	Pinks	Whites	Reds	Others	Totals	% of Total
Doubles	2	2	-	-	-	1	5	15.0
Semi-Doubles	8	3	4	3	-	1	19	56.0
Singles	2	1	2	2	3	-	10	29.0
Totals	12	6	6	5	3	2	34	100.0
% of Total	35.5	17.5	17.5	14.5	9.0	6.0	100.0	-

THE OTHER INTERSECTIONAL HYBRIDS

Donald Smith

Intersectional hybrids are defined as plants produced from crosses between representatives of two different sections of a genus. Thus, peony hybrids produced from crosses of herbaceous peonies (section Pæon) with woody (tree or shrub) peonies (section Moutan) are correctly referred to as intersectional hybrids. However, these are not the only intersectional peony hybrids, for several recent reports have indicated the existence of other intersectional hybrids.

It is generally accepted that there are, at least, three sections within the genus pæonia (all authorities seem to agree on this point), therefore, several types of intersectional peony hybrids are clearly possible. One classification assignment which, to my knowledge, has never been disputed, is that the North American species (p. brownii and p. californica) makeup a separate section (section Onæpia) within the genus as established by Lingley in 1893. Consequently, hybrids of these two N. American species with any other peonies are by definition intersectional hybrids.

Although neither of these two species are particularly easy to grow (under garden conditions) or hybridize, several recent reports have indicated success with crosses involving each of these species. The first report, made by Nancy Halas (Pæonia, Vol. 25, No. 2, p. 7), referred to hybrids of P. californica with other peonies produced by Harry Pruet of Studio City, Ca. Unfortunately, no additional details were given on which or how many other peonies were involved. A second account, which appeared in the first issue of the SPIN USA newsletter published by Galen Burrell, reported on several successful mating of p. brownii. Galen indicated that he had been successful in crossing p. brownii with several types of tree peonies. More specifically, he reported seeds from p. lutea x p.brownii and also p. delavayi x p. brownii, with some of the seeds from the latter cross having already germinated (as of 15 Nov 95). In addition, he also reported that Anne Oveson (Wallowa, Oregon) had been successful in producing seeds from a (reverse type) cross of p. brownii x p. potanini trollioides. Galen also indicated that Peter Waltz (Exeter, N. H.) had reported success using p. brownii pollen (supplied by Galen) on (unspecified) herbaceous peonies. I will try to get more details on these exciting new crosses for future issues of the newsletter, but clearly these are important new developments in peony breeding. Whatever these new hybrids turn-out to be, they will surely make-up a new class of intersectional hybrids with characteristics very different from those exhibited by their better known intersectional relatives.

The herbaceous intersectional hybrids produced by crossing a species from the section Pæon with a species from the section Onæpia might be referred to as Pæonæpia hybrids or simply as Peonepia hybrids. Likewise, the shrubaceous intersectional hybrids produced by crossing a species from the section of woody peonies (section Moutan) with a herbaceous species from the Onæpia section could then be called Moutonæpia hybrids or just Moutonepia hybrids.

THE IMPORTANCE OF BEING PRECISE

As a scientist I am particularly sensitive to the importance of being precise about things. In botany for example, when describing a particular cross, the order of listing the parents is important and must follow accepted convention, otherwise many people will needlessly be confused as to which way the cross was made. The accepted notation is seed parent name x pollen parent name. The "x" in this case is read to mean "pollinated by" or simply just "by" for short. Therefore, when we write A x B this states that pollen from plant B was used on plant A (i. e. plant A is the pod parent and plant B is the pollen parent). B x A however, is the reciprocal or reverse cross. On the other hand, if we write, for example, that we have crossed A with B, we are not being precise and no one can know for sure which cross we have really made. I would probably interpret this to mean A x B, but this may not be what is meant. If we write A on B this is more precise, but will usually be interpreted to mean B x A (i. e. pollen from plant A used on plant B). It is simply not acceptable to use these various terms interchangeably.

I raise this issue here because I have received several recent letters where it is obvious that people are not being precise when describing their hybridizing work. At times, this can be a very important point. For example, some years ago I was trying to determine the (precise) parentage of the now famous (and apparently also extinct) intersectional hybrids reported several years earlier by the late Louis Smirnow. Private letters to me (from Louis) and several published accounts of the parentage of these hybrids were either ambiguous about the direction of the cross or at various times listed the parentage both ways

(i.e. p. suffruticosa x p. lactiflora and p. lactiflora x p. suffruticosa). Although I believe that the latter mating is the more likely of the two, we may never be completely certain about this important point.

Since some important characteristics can be transmitted to offspring through the mechanism of maternal (non-chromosomal) inheritance, a reverse cross can result in a noticeably different set of offspring than its' forward direction counterpart. Often crosses are much more difficult in one direction than they are the opposite way. For these reasons, we should explore all crosses in both directions and be careful to be precise when labeling the crosses and when describing our work to others.

Don Smith

LETTERS TO THE EDITOR OF PÆONIA:

The following paragraphs were excerpted from a recent letter sent by Irene Tolomeo of Sonoma, Ca.

My germination efforts provide me with a lower percentage of success than you achieve so I'm hoping through Paeonia you will detail your germination practice, particularly with respect to temperatures during the several phases of germination. I was intrigued by your reference to tetraploidy in ruptured seed.

So you see there are many questions I'd like to ask. It has occurred to me that perhaps your readership could be encouraged to submit questions, a few published in each edition, with other members invited to provide answers direct to the questioner.

You mention two Age of Gold seeds which germinated and then refused to grow. I've noted a similar "stalling" and eventual loss in seed from difficult crosses. This year I soaked three such seeds in 1tsp Vitamin B-1 in 1 qt. water. (Alaskan Fish Co. B-1) for 15 minutes, after which the seeds were replaced in their growing medium. I am sure the seeds were not adversely affected and the condition of two of them seems to be improved, with signs of resumed growth. A sample of three is not definitive but I would repeat the treatment if confronted with another recalcitrant seed.

Irene Tolomeo

The following paragraphs were extracted from a 3 Nov. 95 letter by Jackie Janson of Kansas City, Missouri.

This year I used A-199 on M. Wash. with about 5 firm seeds out of 10 flowers pollinated. There were a few ruptured seeds that did not make it. My results do not match yours, however. I have a M. Shaylor F_2 that has produced a couple of seeds in the past, but this year had none, much to my surprise. Perhaps if I refrigerated my pollen I would have better results; will do that next year. Also, I did not cover the pods after pollinating, i.e. with an envelope stapled over it. Do you think this is necessary?

I have crossed M. Wash. with A-199 for a couple years now with no resultant plants. One year I had 6 sprouted seedlings that were planted outdoors, but all rotted due to excessive rains.

I was inspired by the results you obtained with Ruffled Sunset, so I ordered one from David Reath this October. Also, I like the seed production you received from Dewey's HP-1-61 and would like to acquire a piece of it. I was corresponding with Mr. Dewey before he died. He sent me a couple seeds of some treated JTPs two of which are in my garden. One is a very excellent bright pink which I used A-199 pollen on (no success). I will continue with this cross. I do have some selfed seeds from it though. It was a beauty in bloom this spring and a couple people got out of their cars when passing by our home and asked what that was.

Jackie Janson

ANSWERS AND COMMENTS TO LETTERS:

Several of you have written to me indicating that you are not getting results comparable to those I have reported for the seed production or germination rate for the intersectional cross and asking why. Such questions are difficult to answer without rather lengthy discussions to determine what we may be doing differently. I believe the best way to address these questions is for me to describe in some detail what my methods are. I will try to do this in the next few issues of the newsletter (see pages 2-3 of this issue, steps 4-10 for details on my germination technique). If my methods are noticeably different from yours, you might try my approach and see if it gives better results for you. I will begin here by trying to point-out a few things of which you should take special notice, because I believe they are particularly important. However, often times it is hard to know which things really make a difference and which do not. Also, some techniques may not be fully transferable from one cross to another. What works best for one cross or set of seeds may be relatively unsuccessful when applied to another. With these caveats in mind, you should take special note of the following:

1. Make sure you have the right parent plants (i. e. the plants you think you have). Don't dismiss this point too quickly unless you are very sure of the identity of your plants. Several times in the past I have wasted more than one season working with plants only to find out later that they were not the plants which I had ordered. Carefully check the characteristics of your plants against the written descriptions, remembering that fertility is the most important characteristic of a breeder plant. If you have any question about the identity of your parent plants (and you should if you are not getting results, at least, somewhat comparable to those reported by others working with the same plants), buy another plant from a different source and try again.

2. Pollen must be completely dried-out prior to storage if you expect it to remain viable for more then a few days. Normally, this takes about 2 days (spread-out on aluminum foil) under a 60-100 watt incandescent bulb. Once dry, it should be stored in some type of air-tight opaque container (I use black plastic 35mm film canisters). Keep these containers in the refrigerator at all times when not in use. Various tests have shown that pollen degrades rapidly at high temperatures (85-100° F). When in the garden keep your pollen cans out of the hot sun. I use a small 6-pack size insulated cooler to carry my pollen to and from the garden, any cans not in use are always kept in the closed cooler shaded from the sun.

3. Open flowers 1-2 days prior to normal opening and pollinate immediately. I believe the stigma are most receptive at this time and this also greatly reduces the chances of self contamination when working with pollen bearing types.

4. Transfer pollen to the flower using your pinkie finger, making certain to completely cover the entire receptor of each stigma with pollen. The stigma should not be sticky when this is done.

Don Smith

ACKNOWLEDGMENTS:

My thanks to Don Hollingsworth for responding to my note (request) in the last newsletter and sending me (gratis) a very nice plant of the rare Daphnis hybrid (D-63). It is the sharing and trading of plants, and seeds, and pollen, and ideas that is the essence of what *Pæonia* is all about.