PAEONIA

Volume 6, No. 1 March, 1975

REQUIRED READING –

1. "The Peonies" by John C. Wister, $3.50 from American Peony Society.
2. The Bulletins of the American Peony Society.

SUGGESTED READING –

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The PAEONIA is authorized by Miss Silvia Saunders.

Our leader and teacher in hybridizing is Roy Pehrson.

Editors are Chris and Lois Laning, 553 West F Avenue, Kalamazoo, Michigan, 49007.

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Here is a statement of philosophy in the search for facts — I think what we are doing in our attempts to overcome difficulties in peony hybridizing is a search for facts — a statement that I came across in some reading, that I think worth sharing. I've taken a little liberty by pulling it out of context, but not so much liberty as to confuse the writer's meanings:

"How many well-documented data are available for • • •? (substitute the problem at hand). How much is based on direct evidence, how much on indirect evidence, conditions, indications, and pure conjecture?"

"Our reason for raising this question is perhaps partly that we want to be sure we are undertaking a respectable investigation and not something fanciful. We know that facts as such do not guarantee scientific solidity, that a slight misconception in combining them into a theory can give quite a bizarre result. Likewise, it is clear that some imagination is required to make guesses in difficult cases. How sensible a guess is can be seen in the long run, when the idea is inevitably confronted with new facts. What we are certain about here is that we are going to deal with science and not science fiction, that our attempted reconstruction will be as down-to-earth as possible, and that the interpolation of fancy needed now and then will be critically inspected."

(Gosta Ehrensvard, **Life: Origin and Development**, original edition I960, page 60, Stockholm. English translation by The University of Chicago, 1962, the University of Chicago Press, Chicago and London.)

- Submitted by Don Hollingsworth

PEONIES AND COCONUTS
An experiment in Meristem Culture with Ito Hybrids
by Rev. Joseph A. Syrovy

The American Peony Society Bulletin, December, 1959 – No. 155, page 7-10, has an article entitled "Fourteenth Annual Horticultural Council" by Margaret Herbst. On page 8 we find "The final presentation entitled 'Carrots and Coconuts' as given by Dr. F. C. Steward, Professor of Plant Physiology, attracted unusual comment. He graphically explained the interesting and successful experiments which increased carrots 80 times in twenty days due to the medium of coconut milk. The same experiment can be accomplished with the milk of the horse chestnut." (And with the milk of corn, the milk-stage.) I wrote in for the complete "Proceedings of the 14th Annual American Horticultural Congress" and received a copy. On page 36 is the complete lecture of Dr. F. C. Steward on "Carrots and Coconuts — Some Investigations on Growth." This has been in my files these many years until recently when we all began to be interested in "Meristem Culture". I reread Dr. Steward's article and wondered how it was possible that this pioneer in "Meristem Culture" and his experiments had lain dormant for fifteen years and we are now beginning to discover it!

Our primary interest in this experiment was not meristem culture itself, but could we save the stems and buds of the Ito Hybrids which die down each year and induce root growth to propagate them? For several years now, we have bent over a stem of our Ito hybrid, made a cut below a bud, fastened it firmly in the soil, covered it with dirt and hoped it would root and grow. However, each year it rotted and failed to grow.

A chapter on "Growing Nuts in the North" by Carl Weschke describes the method of storing graft wood. Stems of the current season's growth are cut off, disinfected with a solution of Bordeaux mixture, put into a plastic bag and refrigerated. We did this with the Ito Hybrids. They were cut off late in October after several hard frosts, the leaves removed and placed into a plastic bag and refrigerated. The next step was to obtain some coconuts. We finally purchased some in December and having drained the milk from them into a jar, we also refrigerated the same.

Dr. Steward grew his carrots in his experiments in an agar solution complete with nutrients with the addition of the coconut milk. We had on hand a small container of Difco Bacto Orchid Agar dehydrated (a culture medium used in the germination of orchid seeds). For the agar solution, one teaspoon of the agar powder to four and one half ounces of water, boiled for about fifteen minutes. This is poured into the containers you will use while still warm, as it gels on cooling. For containers we used small plastic pill bottles about 2½ inches high and also small wide mouthed glass jars.

The next step was to take the Ito stems and cut each one with a sharp razor blade about ¼ inch below each bud. About 2 to 2½ inches of stem was allowed for each bud. Each stem was handled with forceps and placed in a disinfectant solution of Bichloride of Mercury, placed on paper toweling to remove any excess and then handled with forceps and placed into the plastic container with the agar. We always used rubber gloves and burned the toweling immediately as this disinfectant is highly poisonous. The process of disinfection had to be repeated whenever the stems showed signs of mold or decay. If using this disinfectant, perhaps the Bordeaux mixture would be safer as well as effective. Do not refrigerate where food is stored. We use an old refrigerator for storing seeds, keeping things in the dormant stage, and for just these kinds of experiments.

Finally we put a few drops of the coconut milk, using a medicine or eye dropper, into each container with the agar solution and the stems of the Ito Hybrids. For convenience's sake we placed the small bottles into wide mouth jars. These were refrigerated at a temperature of around 40°F. The coconut milk was replenished from time to time.

During this period of several months of refrigeration, some mold appeared from time to time and the stem section began to deteriorate and had to be removed from their containers, washed off in distilled water, cleansed with paper toweling and placed into the disinfectant, then placed back into their containers. The stems and buds which were the weakest and closest to the top of the original stem did not survive. Only the strongest buds closest to the root system survived. (We had two very severe freezes, perhaps they were damaged by the freeze.) We also experimented with some stem by dipping the ends in Rootone and other root producing chemicals. These were also lost when removed from solution.

The remaining strongest buds are healthy and tho cell area around and beneath them is different. Will they produce roots? Perhaps the enforced cold dormancy should be broken by exposing to warmth and light? This we shall do soon. Our project has not been fully completed.

Some observations from this experiment:

1. It is interesting to note that the stem of the Itos between the buds retain their herbaceous character and deteriorate, while the bud area retains its tree peony character to a remarkable degree.
2. An important factor which we discovered in our research is that roots develop much more readily if a callus is formed at the base of a wood cutting. About the first or second week in July we will make a cut about one-fourth inch below each Ito bud being sure to cut through the cambium layer with a sharp razor blade, but not too deeply. These cuts should form a callus. Then protection will be given from severe frosts. Finally we shall try again to see if we can obtain rooted cuttings. If we do these should be equivalent to one or two year old plants, whereas in meristem culture it would take much longer to grow a plant from a single cell.
3. Finally, most of us as amateurs are not equipped with laboratories, nor to work under highly sterile or aseptic conditions. The coconut milk as well as horse chestnuts in the milk stage are easy to obtain and work with.
4. Dr. Steward concluded his paper by naming derivations of several growth substances from his experiments. These are perhaps obtainable by now. We are writing to Dr. Steward or some of his associates at Cornell University for further advice and help in this matter of Stem or Meristem Culture.

EXCERPTS FROM REV. SYROVY'S ACCOMPANYING LETTER:

"I'm really not finished with my project and it will take some time to do so. I do think that cutting below the bud to form a callus is very important — and maybe we may get somewhere with "stem propagation!" Remember it is 15 years since Dr. Steward did this — and like I said, there are perhaps some chemicals on the market that will do the job better than coconut milk. Anyhow I was able to obtain coconut milk. Anyhow for me it was a fascinating study — and something to "play with" during this long, long winter! I thoroughly enjoyed it."

ADDENDUM TO ARTICLE "Peonies and Coconuts" by Father Syrovy —

In the beginning of my experiment I kept my Itoh stems in a cool place of a fluctuating temperature of 48° to 50°F when I noticed the mold and deteriorating of the stems. I then switched to the refrigerator temperature of 40°. I did this to keep the dormancy and to avoid the mold and disintegration of the stems. The keeping of the stems at the lower temperature seems to agree with them, although it seems too low of a temperature for any growth. I have started to take them out of the refrigerator for short periods of time and keep them at room temperature — and so wonder what will happen. As Dr. Steward mentions in his article, the temperature is an important factor and will have to be studied more.

The coconut milk seems to be doing its work and the cell structure around and below the bud is alive and swollen and expanding.

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LETTER TO: CHRIS LANING DATE: February 5, 1975
FROM: Dara E, Emery, Santa Barbara Botanic Garden, Santa Barbara, Calif.

Silvia Saunders' recent comment that meristem culture has nothing to do with plant breeding would have to be qualified now to be accurate. The techniques for plant reproduction are developing at such a rapid pace. Just prior to reading Miss Saunders' comment I read an article which you might enjoy. It appeared in Bioscience 24:5:259-276 May 1974 – "Model Systems for Somatic Cell Plant Genetics" by H.H. Smith. The excellent article concludes with a list of over 100 references on the subject.

To begin with Dr. Smith states what you may have already read elsewhere, that haploid plants can be produced from pollen grains. These plants can in turn be diplodized i.e. chromosome number doubled, to produce fertile homozygous diploid plants. This is no longer the latest wrinkle. New procedures have been worked out so that somatic cells can be used for plant breeding. The procedure is this. Leaf mesophyll cells of the two desired parental species are treated with enzymes to digest away the cell walls leaving protoplasts. These are suspended in a sodium nitrate solution, centrifuged together, then plated on an agar medium. Only the fused or hybrid cells grow, then differentiate into leaves and stems. This done these are grafted onto parental root stock. The hybrid scion matures into a plant which produces fertile flowers and seeds. The seeds germinate to produce seedlings which are of course F2's and normal in all respects. This has been done with *Nicotiana langsdorfii* x *N. glauca*.

We may not live to see such procedures done with peonies but then who knows? The first step is the meristem culture. Once this is perfected, the technique for the production of both haploid plants or diploids from tetraploids and the para-sexual hybridization as outlined above are only a step away. Probably the para-sexual breeding technique will make possible crosses which are at present impossible because of simple incompatibility problems. Hopefully, the meristem culture technique when developed for peonies will also permit embryo culture of all those recalcitrant hybrid seed.

With this happy thought, have a good New Year. - Dara E. Emery, Horticulturist

P.S. Keep up the good work in 'Paeonia'. It is fine reading.

LETTER TO: Don Hollingsworth
FROM: Roy Pehrson
DATE : January 4, 1975

The many interesting points you raise in your letters cry out for comment, but it is obvious I'll never get around to it. In this letter I am going to up-date my thinking concerning the difficulties encountered with the Ito cross. I have added to my experience with this cross somewhat during the past several years, but I think have not gained any better understanding of what makes it go.

At the time when our attention was first drawn to this cross, we were informed that a Japanese investigator had studied chromosome counts of the pollen mother cells of '**Alice Harding**'. He found more than the normal haploid number. Nowhere have I read of anyone having made a count using the somatic cells of a lutea hybrid. Consequently my guess that the lutea hybrids are triploids may have been a wild one, based as it was on only that inconclusive evidence from '**Alice Harding**'. On the basis of this notion it was logical for me to think that the poor productivity of this cross could be blamed on the "wideness" of the cross and the triploidy of the pollen parent as well.

Extending this idea further, I assumed that any lutea hybrids F2's would be more effective because they would be either diploids or tetraploids. I thought that the tets would probably be the best. I've previously explained why I thought this might be true.

Well, in 1969 I collected a mixture of pollens from a collection of blooms brought to the show by Gary Seaman of Gratwicks. Using this mixture I obtained quite a good number of hybrid seedlings; a result far better than any I had had before or since then.

At first this result seemed to confirm my hunch, but other crossings have done nothing further to confirm it. A fairly large number of pollinations using F2"A" produced only one seedling ('**Westerner**' x F2"A"). F2"A" is not a really robust plant so I assume that it must be a diploid. This experience alone is not conclusive, but there is more evidence that good results do not require the pollens to be from diploid plants. I got several hybrids using "Delavayii - lutea mix" and three more from Ludlowii pollen. This past summer I used suffruticosa pollen on 90 or more blooms and got one seed which may, or may not, be a hybrid. Nothing remarkable about any of these.

The case for tetraploids is still unproved. Although some people who have seen them suspect that Gary Seaman may have tets among his advanced generation hybrids, it appears that this has not been confirmed.

I thought for a while that poor germination of the truly hybrid seeds in all but the 1969 crop night be responsible. On further reflection this argument becomes pretty weak. This year germination is exceptionally good. If there should be few or no hybrids in this crop the argument will be weakened further.

Hot weather during the pollination period? Just possible perhaps. The weather was very warm mid-June of 1969. So too in 1973 when reasonably good results were again obtained. More observation is needed. In 1974 the weather was very cold; the seed crop very low. The success ratio won't be known until this summer. Over the years pollinating "in bud" has worked satisfactorily. Is it possible that it does not work well in the Ito cross? It's true that in 1969 many freshly opened blooms were pollinated. In 1973, however, almost all crosses utilized unopened blooms.

Must these lutea pollens be very fresh? I have seen nothing to suggest that it is necessary.

In near desperation I'm willing to entertain just about any sort of explanation. In 1969 Gary found lots of buds which would not open in time for the show. To hurry them up he slipped plastic bags over the buds so that the sun would warm them up and hurry them along. Many were a sorry mess, soggy and parboiled. I took pollens from them anyway. ??????????

LETTER TO: Roy Pehrson
FROM: Don Hollingsworth
DATE: February 8, 1975

Roy: I appreciate very much having the benefit of your recent summarization of experience with the Itoh cross. This provides an excellent gauge against which all of us can examine our own results to see where we have supporting cases — or, conversely, those which do not compare and therefore open additional avenues of thought. This is characteristic of what you have provided leadership in ever since I first began seeing your stuff in writing about six years ago. All of us are indebted. It has only recently come to my consciousness that the technique of case reporting — which this is — is extremely helpful in the development of a common knowledge base among people pursuing a common interest. It magnifies the experience base from which all of us work. This current summation of yours should become the new data base from which all of us work in the Itoh cross.

Thanks very much!

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ARTIFICIAL POLLINATION OF THE PEONY

Don Hollingsworth

In 1940 an Italian researcher. Dr. Matteo Gieseppe Bosio, reported that he had obtained seeds of peony after placing pollen directly into the ovarian cavity (pod), by-passing entirely the stigma and style tissues. The possibility whether hybrid sterility in the Itoh cross is due partly to pollen incompatibility barriers in stigma and style has been previously discussed in December 1974 PAEONIA. Intra-ovarian pollination offers an opportunity to circumvent such incompatibility.

Dr. Bosio used three Paeonia species for the experiment, *P. anomala*, *P. peregrina* and *P. officinalis*. The greater number of seeds was produced by *P. anomala* and it was concluded this was due to the natural presence of a greater quantity of liquid in the ovarian cavity, providing a suitable medium for pollen germination. No carrier was used in placing the pollen into the ovarian cavity so that germination was entirely dependent upon the naturally occurring condition.

Other researchers (Marheshwari and Kanta 1960, 1961, 1962) have reported the successful production of seeds in several poppy species by intra-ovarian pollination using a liquid suspension of pollen "... in 2 mL of sterile, double-distilled water with 0.01 percent boric acid. The flowers were emasculated and the surface of the ovary wiped with cotton soaked in ethanol (ethyl alcohol). Two punctures were made in the ovary — one to allow air to escape and the other to inject the suspension of pollen. After the operation the punctures were, sealed with petroleum jelly. In the injected ovaries germination of the pollen, entry of the pollen tubes into the embryo sack, and fertilization occurred almost as in nature. The ovaries grew normally and developed into capsules containing viable seeds." (Rangaswamy, in Marheshwari editor, Recent Advances in the Embryology of the Angiosperms, 1963).

If we want to make use of the foregoing results as a basis for new techniques in peony hybridization, it makes sense that we should be using a carrier for the pollen which will stimulate it to germinate. Dr. A.P. Saunders made up preparations for testing the viability of peony pollens (reported in APS Bulletin, No. 90, June, 1943). His instructions for the preparations: Measure out 100 cc of water, boil and add in 1 gram of agar jelly. When the agar is taken up, strain through a filter of absorbent cotton. Add enough regular sugar to parts of it to have a 5, 10 and 15 percent sugar solution along with the agar. These preparations will jell when cooled but liquefy when warmed. Put a drop of each one on a microscope slide and stir a bit of pollen into each drop. Since the agar will go hard if it dries, keep the slides in a humid atmosphere such as on a rack over water in a closely covered container. At room temperature in about six hours the pollen will be germinated if it is going to, according to Dr. Saunders.

If one succeeds in germinating the pollen, then by using a student microscope it can be determined which sugar concentration gives the best results. when the best preparation for germinating a particular sample of pollen is identified, then that preparation would be indicated as the carrier to be used for experimentation with the intra-ovarian pollination technique.

Workers with lily pollen have reported using 1.5 percent gelatin instead of agar in pollen germination preparations. Perhaps gelatin will work for peony pollen as well. It is not clear to me at this time whether or not the agar and gelatin provide a nutrient benefit to the pollen. Perhaps the jell can be eliminated, in which case I would expect the preparation to be more manageable at ordinary temperatures.

There is an almost certain risk that microbes will be picked up in the materials used. How much of this contamination the plant tissues can resist is unknown. It will be prudent to collect anthers from unopened flowers and dry them under cover in a dust free area. The nutrient preparations should also be handled in a manner to keep them as clean and free of dust as is possible.

UGLY DUCKLING

A colored picture of my Itoh '**Yellow Heaven**' which bloomed so beautifully last year and this year, was sent to our good secretary's Greta Kessenich. It is improving with age. I think I reported at first about its first blossom. It was terrible! Most of the petals were green and only a little bit of yellow! Maybe it has to go through those stages at first because it is so new. Therefore, one should not throw away or destroy any "ugly ducklings" at first as they may have to go through this stage. Keep all seedlings for a couple of years anyhow unless you are quite sure after giving them a chance!

- Rev. Joseph A. Syrovy

LETTER TO CHRIS LANING from PEGGY GOLDSMITH ___ January 5, 1975

Dear Chris and Silvia and Dick:

I think we've had '**Red Lacquer**' for the 22 years we've grown peonies. It was shown in the old Peony Society Handbook as a lactiflora x lobata. We could have gotten it from you, Silvia, sometime after our initial plunge, but I think it was among the stock we bought from Roy and Gladys Leighton in 1952 which they had bought from your father. It grows slowly for us too and we've never been able to sell more than one or two a year if that. It's perhaps my favorite red peony (with '**Alexander Woollcott**' running a close second) so I've been careful to always keep at least one small division.

When it first opens, its stigmas and anthers are pale pink and lacquered together — rare and lovely. As it ages the stamens separate and the anthers get the fuzzy "chenille" look you described. Its petals have a heavy texture, are quite wide, smoothly rounded with a slight cup opening almost flat before they fall. Its color is a rich, satiny Chinese red, darker than '**Scarlet Tanager**' with no blue undertone. Its color does not fade. Leaves are clean, dark green, nicely cut, crisp, and it has sturdy stems on a rounded plant. All in all an elegant plant and flower if only it multiplied faster. I'll check for pollen next spring.

Dick, quite a few of our peonies have bulbous roots connected to the crown by slender cords; for example officinalis, '**Laddie**' and '**Good Cheer**'. '**Honor**', '**Mercy**', '**Birthday**', '**Good Will**', '**Hope**', etc. have much the same look but bulge out closer to the crown. (Silvia, I still love this group despite your better judgment.) We found it interesting that when we bought some '**Good Cheer**' divisions back from a plant we had sold to a customer/associate, in his soil it had grown much more of the lobata root look. Our soil is loose and grows loose roots, clay soil around here grows heavier roots and stockier, less graceful plants. I'm sorry you thought we might have misrepresented Red Lacquer as '**Scarlet Tanager**'. We're awfully careful about marking and charting our fields and searching for mavericks.

Chris, enclosed is our list as you requested. Even though we've not hybridizing we'd like to subscribe to "Paeonia" and perhaps send seeds to some of you if you'd like random crosses. Land around us is at a premium and we've never had room to devote to propagation by seed. I do have three of four I must see about officially naming one of these years.

I have cut and arranged our peonies each spring for 22 years for our display and have never stopped enjoying their subtle differences and the beauty of Professor Saunders' crosses, '**Red Lacquer**' among them.

Sincerely,
Peggy Goldsmith

P.S. Keith and I hope all you enthusiasts profit from Mr. Pehrson's sad experience with stakes pulled out by mini-vandals and always chart your plants or seeds as soon as they are planted. It doesn't take much time and is invaluable.

P.S. Mr. Edblom said '**Red Lacquer**' was mentioned in an earlier Paeonia -- could you fill me in.
ED.: Vol. 4, No. 1, March, 1973 - F2 albi x lobata — two seedlings in this group.
Dick, where is the information in Paeonia that the Goldsmiths would like? I can't find the issue.

VISIT to the UNIVERSITY of ILLINOIS

On a sunny day in February, February 20 to be exact, Lois and I traveled to Urbana, Illinois, to keep an appointment with Roy Klehm and Dr. Martin Meyer. On the agenda of this meeting was just one subject, tissue culture. You and I are very much interested in meristematic tissue culture, remember? And while all of us (the hybridizers and peony seed sowers) had contemplated asking Dr. Murashige of California to investigate peony tissue culture, we were reminded that Klehm's nursery establishment had already mentioned that they planned to have Dr. Meyer of the University of Illinois investigate its possibilities. This meeting convinced me that we should join the Klehms in this venture, thus avoiding duplication.

PAEONIA, as a group, lacks the prestige of a great organized society which, in this case, is a handicap. Dr. Meyer would like to be able to say, "A grant from the American Peony Society for the purpose of investigating peony tissue culture has been forthcoming!" This sort of recognition would be of value to him, so in the long run would be of value to us, the peony lovers.

So now I suppose you're mad and want to go home! And you want to fight, too! Good, we can use a little fighting spirit!!! Sensing that we can't lick 'em, we'll join 'em and all together go forward with Dr. Meyer and the Klehms.

The "test tube nursery" that we saw at the University is a room lined with shelves brightly illuminated with, fluorescent lights which were about foot above the flasks and test tubes in which were iris and day lilies (hemerocallis) plants in various stages of growth. Evidently the project is not yet nearing completion since these plants are not being reproduced by the thousands. It is wonderful to behold the process though, and see the actual progress being made in this field — plants from the incubator.

In one of the greenhouses, blooming size iris and day lilies are growing. These plants were shown to us — plants with no papa and no mama. I doubt that these orphans could be different from normally produced plants, though.

We talked of many things and, believe it or not, all those big words that Dr. Meyer used didn't scare me! If and when he writes for PAEONIA we'll just run the article through the computer and cut it down to our size. I must act like a gentleman, however, since he gave me a test tube of little orchid plantlets which are growing happily here beside me right now!

After reading this over, I noticed that nothing nice was said about Roy and Sarah Klehm. Oh well, —hi Sarah and Roy — you're nice.

- Chris

Kindred, North Dakota
January 16, 1975

Dear Mr. Laning,

Thank you for your check to cover peony order which I have booked for early September delivery. I still have not prepared my 1975 pricelist but you will receive one as soon as ready. The response to my letter in Paeonia was much greater than I had expected and half of the '**Multiflora**' divisions I will have available this fall have already been ordered.

Thank you so much for your help in getting this event before the Peony people.

- Ben Gilbertson

BORON DEFICIENCY: A POSSIBLE FACTOR IN POLLEN FAILURE

by Don Hollingsworth

Progress with the Itoh Cross (Paeonia lactiflora x P. Lutea Hybrids) has been painfully slow for peony hybridists. Not only has seed production been unpredictable, but erratic pollen production in the Lutea Hybrids has made pollen supply uncertain. For example, I have been able to collect good pollen from a long established plant of '**Banquet**' and obtained hybrid plants of it. Yet, a younger plant of '**Banquet**' which had grown enough to produce several flowers in a season nevertheless gave no pollen. Chris Laning has much more experience with Lutea Hybrids than do I and he has been prompted to declare, "Lutea Hybrids, pollen poor, potency not good and quantity scanty."

Can something be done to improve the certainty of having pollen? Since the Lutea Hybrids are not widely distributed, most of us are handicapped by the relative inaccessibility of mature plants. We are trying to correct that by growing our own and perhaps time will take care of the matter. However, we are faced with the question whether there is some environmental factor which may be operating when no pollen is produced. One of the possibilities is boron nutrition. This mineral has long been known to be necessary in small quantities for plant growth. Researchers working in several species have found boron nutrition is associated with pollen formation and necessary for healthy pollen tube growth in the tissues of stigma and style during fertilization.

The amount of boron needed for normal growth is very small but it must be supplied continuously, for it is not readily translocated from old leaves. Much of the boron for current growth comes from the decay of soil organic matter. When crop residues are not returned to the land, the organic matter reserves will eventually become depleted which may lead to the appearance of boron deficiency symptoms. Deficient soils have been found throughout the humid areas of the United States, including all of the states in the Eastern half of the country and in the Pacific Northwest. In useable form, boron is soluble and subject to being leached downward with soil water. Plant deficiency symptoms are more often found on well-drained soils that are high in lime.

A typical symptom of severe boron deficiency is the death of growing points and subsequent emergence of new growth points which die in turn if the deficiency continues. Plants may be stunted and brittle with a scorching of the tips and margins of younger leaves. Just how these effects might be manifested in peonies is uncertain.

No reports of diagnosed deficiency in peony have been uncovered in this study. However, the late Art Murawska told an interviewer for the American Peony Society Bulletin (No. 123, December,, 1951) that he had come to suspect a boron deficiency in his soil. He reported that on an area about 50 x 60 feet he applied two pounds of borax after planting about 1500 peonies. He was quoted, "The peonies that grew in this field came through perfectly . . . and all plants had the most lush, healthy growth that I have ever observed on one and two year plants." Murawska's observation does not prove that the boron was responsible, for there is no comparison with an untreated, check plot. However, it does suggest the conclusion and demonstrates that the level of treatment did not give toxic effect. What catches my attention most is that this veteran grower considered the result **remarkable for young plants**. It is young plants of the Lutea Hybrids and Itoh Hybrids in which we have been finding poor pollen production. Is it possible this problem is associated partly with a boron deficiency?

Treatment for boron deficiency involves adding small amounts of borax to the soil (one ounce borax per 100 to 200 square feet) or foliage feeding with boric acid or other products designed for the purpose. A recommendation for apple trees calls for 0.1 to 1 percent boric acid sprayed on in two applications. To be most available for pollen development the spray would have to go onto peonies while leaves are unfolding. A second treatment might be given while buds are enlarging. Because of the waxy foliage a spreader sticker may be helpful.

Use care in determining amounts to be applied, for excess boron is poisonous to plants. It has been used as a chemical weed killer. In dry regions irrigation water sometimes carries enough boron to hurt crops.

This is an experimental idea that I think is worth trying. Each experimenter is on his or her own. If you want to be more certain of understanding the results, leave untreated check plants for comparison. Or, better yet, make a rigorous test by using several plants, all alike, both treated and untreated, writing down what happens to each as the season develops.

COMMENTS FROM ROY PEHRSON ON BORON DEFICIENCY — February 20, 1975

Dear Don:

A few years ago I bought a couple of boxes of Borax at the grocers and scattered it over the garden “just in case."

I really haven’t believed that my soil is deficient in this for several reasons:

1. Fertilizer use by area farmers is becoming fairly sophisticated, and up to now there has been no use of micro-nutrients.
2. The soil here is developed on deep glacial till. The material came from many rock ledges in the glacier's path, both sedimentary and igneous in origin.
3. I once read somewhere that garden beets grow badly in boron deficient soils and develop hollow centers. It does not happen here.

I'm not trying to dissuade you from carrying on your study of the effects of boron deficiency on the viability of peony pollen. Obviously soils differ widely.

On January 10, 11 and 12 we had a snowstorm which has been declared the “blizzard of the century.” This has to be true even though the storm of November 11, 1940, was more lethal. This one came later and preparations for it were better too. Snowdrifts in wooded farmsteads and around my place at the very west edge of town are simply fantastic! Our nearest neighbor, a widow, lives in a mobile home. The front end of this was covered about three feet deep. This drift is not less than 12 feet deep. She won't be able to use two of her doorways until the snow melts. After the storm, our newsboy took a path directly over the top of my car for three days before he noticed this.

All the little winter birds were destroyed; the chickadees, juncos, nuthatches, downy woodpeckers and even the blue jays. They will have to re-colonize this area from outside. Severely reduced, but not completely wiped out, are the house sparrows, starlings, crows, pheasants, squirrels and rabbits. Electric power outages caused a lot of discomfort to thousands of householders. The snow cover over my peonies varies between six or eight inches and eight feet.

Germination of seeds has been very good this winter. The last of them went into the frig last week.

PEONY TALK
by Bill Seidl

I'd like to update several topics previously discussed by myself in Paeonia. First, no seed germinated from my 1973 crosses of LACTI x LUTEA F2 hybrids. This past September, though, I started to dig away some of the ground in the seedbed and finding the first exposed seed to be rooting immediately replaced the soil without further investigation. So my fingers are still crossed in hopes of some success with this seed crop. Hardly any other seed germinated either — the seed being carelessly allowed to go dormant before planting.

Second, plants from Dr. Henry Tod's mloko-delavayi hybrid have, I believe, gone successfully into winter dormancy — in winter. The seeds were inadvertently rooted in April of 1973, refrigerated all summer, and then potted in Novembers showing one or two leaves all winter (73-74) while setting on a window sill. These plants, seven in number, ware transplanted to open ground in May, 1974, whereupon the leaves soon began to yellow. By mid-June none of the plants showed any life. Towards the end of July new top growth was appearing on all the plants — a few plants now having three leaves — and this growth remained green until well into November. (With protection, they had survived an unusually hard freeze in September.) This was a long enough period, I believe, to develop buds capable of winter survival and spring growth, putting the plants' growth cycle in tune with the seasons. The foliage of these plants was not hybrid (herbaceous x tree) in appearance, looking like ordinary lutea hybrid foliage. Considering the flower description of Dr. Tod's parent plants, I think these may turn out to be Lutea-Delavayi hybrids. It might be well to note that, although winter dormancy lasts about 5 months (November thru March) in this climate, these plants renewed their growth after about a six-week rest in June and July, This could be the minimum rest period required of plants propagated by meristem culture.

Third, of six seeds harvested from '**Age of Gold**', three planted in the open ground, fall of 1973, did not germinate and have been left undisturbed. Another three, all from the same pod, were planted indoors in damp vermiculite. None germinated during the winter of 73-74 but in early August, 1974, they were knocked out of their containers and found rooting. They were immediately transplanted to open ground. The pollen parent was either Reath's Potanini Tall Yellow Seedling F1 or a lutea F2 hybrid. Although this cross is a first with me, it apparently has been pursued for many years by Gratwicks and by Dr. Reath.

So much for updating.

Of the few new seed germinated, six plants were from '**Laddie**' x '**Sparkling Windflower**'. I'd like to make this cross again as it is a rather uncommon combination of several species. The seedlings should produce flowers in the red shades with comparatively fine-cut foliage.

'**Alice Harding**' pollen is prized for the Ito cross. But might it be practical to use that variety as the pod parent? I found one large black, but hollow, seed in one '**Alice Harding**' pod this past season. If a variety like '**Age of Gold**' will produce seed with the right pollen, there is hope that '**Alice Harding**' will do likewise.

On a first-year plant, '**Burma Ruby**' set a few seeds. I recall Dr. Reath had recommended it as a pod parent. '**Coral Fay**' also produced a few seeds with pollen from a lobata. Of seedlings that bloomed this past year, most were single and marked for discard. A few had up to 13 or 20 petals and were saved automatically. I think a single has to have exceptional beauty, substance, lasting quality, or other merits to compete with the fine named varieties already on the market.

At the Hamilton show I saw the dark red blossom from Roy Pehrson's Ito cross '**Petite Renée**' x '**Thunderbolt**'. Roy allowed me to take whatever pollen I could find. (It was taken across the Canadian-US border in a home-made dessicator: open film cans of pollen set in a fish bowl with silica gel on the bottom, the whole wrapped in polyethelene . This must've looked pretty suspicious to the border inspectors as they wanted to hear the whole story behind it.) There was enough pollen to pollinate three or four blossoms and, although no seedset resulted, the fact that the pollen existed supports hope that we may yet get some F2's from Ito hybrids. I have never noticed any pollen on any of the Ito-Smirnow hybrids.

Readers will notice I still spell "Ito" without a final, and silent, "h" that is now espoused by Mr. Smirnow and the Bulletin. This is for two reasons: (1) It is the way it had been initially spelled and followed for many years in gardening literature, and (2) it is more sensible. Native Japanese do not write their words with Roman letters; they use ideograms. Westerners, finding it impractical to learn the thousands of ideograms necessary to communicate, have "Romanized" the Japanese written word according to either of two accepted systems. In the more popular system, you will find "Ito". In the less popular (less popular because of its many needless and silent letters), "Itoh." Let's stick to the original, more sensible system.

Paeonia readers nay wish to obtain the latest handbook (#75) of the Brooklyn Botanic Garden (1000 Washington Avenue, Brooklyn, New York, 11225) for $1.50, entitled "Breeding Plants for Home and Garden." Topics that night especially interest readers are those on pollen storage and the use of colchicine. Specific plants covered include African violets, begonias, cacti, camellias, daffodils, dogwoods, gladiolus and acidanthera, hemerocallis, hollies, irises lilacs, lilies, magnolias, nut trees, orchids, roses, rhododendrons and azaleas.... but not peonies. We wuz missed.

MY GOAL — A PROGRESS REPORT

Let me bring to your remembrance my goal in hybridizing; a plant with fifteen blooms per stem. To date the progress is mostly in the collecting of material (plants that can be used in working toward this goal). And I might say the progress in this regard is satisfactory.

Here is the list:

1. '**Sparkling Windflower**' — an F2 (sets seeds).
2. Roy's Windflower, which is an F2 (sets seeds).
1. * Roy's "Cluster-flowered Plant."
2. '**Daystar**' — small plant with small yellow flowers.
4. '**Multiflora**' — from Ben Gilbertson (For description see January issue).
3. ** '**Tiny Tim**' — by Smirnow.
7. '**White Innocence**' (Saunders' Albi. x Emodi).
8. *P. veitchi* — a species — several buds per stem.
9. *P. anomala* — a species — several buds per stem.
10. **P. californica** — several brown, red, yellow blooms per stem.
11. **P. emodi** — several small white flowers per stem.
12. '**Early Windflower**' and '**Late Windflower**'.

* Roy sent the root of this plant, also enclosed one of its stems. This stem had seven seed pods with seeds still in them. Surely the stem with seed pods when dried makes a candelabrum of beauty. Roy says the flower is Pink Jap.

** See the picture of '**Tiny Tim**' in Mr. Smirnow's new catalog — a, little gem!

- Chris Laning

THE TESTING OF POLLENS
by Professor Saunders
from "Manual of the American Peony Society," ed. Boyd, 1928.

The procedure in making such artificial tests is to prepare solutions of cane-sugar of different concentrations, all containing a small percentage of agar jelly; place drops of these on microscope slides, put a small quantity of the pollen to be tested in each drop, leave for six to twelve hours, and then examine under a low power of the microscope. If the pollen is strong the whole field will be an intertwined network of pollen-tubes, whereas the sterile pollens remain unchanged.

In the case of weak pollens it is often possible to forecast the result from the beginning, for they usually have a dry, shriveled look, in sharp contrast to the plump appearance of healthy pollen. Among the hundreds of pollens of species crosses among peonies which I have examined there has been no case where a bad-looking pollen has given abundant pollen-tube formation. The usual appearance of such poor-looking pollens is a field of small more or less shriveled grains with here and there some normal grains; and a few of these will almost invariably show pollen-tubes. The cases are very exceptional in which there is really complete sterility. But where the number of good grains is less than 10 to 20 percent there is not much hope of success in any crosses in which they are used.

My practice is to make up a solution of agar jelly of 1% concentration or a little less, then divide this into three portions and add to these 5, 10 and 15% of cane sugar respectively. Solutions of approximately these concentrations may be made up as follows: Place half a teaspoonful of powdered agar jelly (weighing about 1 gram) and a teaspoonful of table sugar (weighing about 4 grams) in 20 tea-spoonfuls of water (weighing about 100 grams). Heat to gentle boiling until agar and sugar are dissolved, make up two other solutions by the same formula except that in one of them two teaspoonfuls of sugar are used, and in the other four, the quantities of agar and water remaining the same.

If the solutions so obtained are to be preserved for any length of time, they may be divided among a number of test-tubes, each plugged with cotton batting, and then sterilized by boiling. To set up a row of slides, one tube of each concentration is heated, and one drop taken from it and placed on each microscope slide. Every slide will thus have three drops of different concentrations on it. The pollens are immediately placed in very small quantity on the three drops of half-gelatinized liquid, and the slides placed without delay in a desiccator provided with water in the bottom to keep the atmosphere moist and prevent the test drops from drying. This is a most vital point, for if the drops are allowed to evaporate they will soon be so much increased in concentration that pollen-tube formation will be prevented.

A simpler arrangement will be to lay the slide across the top of a small dish containing water, and then over the dish and slide, place a glass cover, such as the cover of a cheese-dish. Microscope cover-glasses must not be used on the drops, for the exclusion of air prevents the production of pollen-tubes.

Furthermore, for some unknown reason, the sugar solutions gradually deteriorate and must be made up fresh every week or two. If this is not done, negative results are likely to be obtained with even very good pollens.

It will be evident that making pollen-tests involves both time and trouble; but it is an unavoidable necessity except where one can be sure without them that the pollens he uses have a high vitality. Perhaps some day we shall have a testing laboratory like the U. S. Bureau of Standards to which we can send our samples for test. But in the meantime we must attend to the matter ourselves; and, after all, the time spent in making pollen-tests is not much in comparison with the time that may easily be lost in attempting to make crosses with dead pollens.