

PAEONIA

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REQUIRED READING –

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Notice from - Dr. Mary Tod, Carnethy, Seafield, Roslin, Midlothian, Scotland.

"Thank you for your Peony Communication. I am sorry I must tell you my husband (Dr. Henry Tod) died on May 16th from one of those rare degenerative diseases It has been a great strain but my daughters and I are trying to readjust to our new situation."

* * * * *

1974 REPORT ON THE ITOS

Roy Pehrson

The count of plants from the seed crop of 1972 has improved to not less than 17. This is due partly to better identification of some odd ones. There have been some delayed germinators too. The three fine second year plants of '**Golden Dawn**' x *P. ludlowii* are especially interesting to me. Among the delayed germinators are at least three, and possibly as many as six plants of lacti x delavayii-lutea mix.

The 1973 crop of seeds is giving me a very gratifying crop of seedlings. I have counted as many as 43 several times. Twenty-nine of these are from '**Alice Harding**', 20 of them from just one seed parent plant. This is a 3/4 lactiflora hybrid and I will deal with it some later time, as I believe that there may be something quite special about it. There was one little seedling which looked like a true cross of '**Ama-no-sode**' x potanninni (tall yellow) but some burrowing insect made a hole alongside it and destroyed it.

Germination during last winter was not as good as it usually has been. This may have been the result of colder house temperatures last winter. Quite a lot of un-germinated seeds were planted out in the spring. Very likely there will be a few more hybrids among these. I won't count them in advance! I now seem to have a total of about 109 plants. As there are sure to be some casualties I will just call it 100, for this was the target number I once set for myself.

The prospects for the 1974 crop? Well, I have my fingers crossed! The way I had planned it, this should have been the most successful year ever, but weather conditions during the pollinating period may have circumvented these plans. A high school girl, Mary Jo LeGare did most of the pollinating this year because she turned out to be very good at it. The center lactic buds began to reach the correct stage just a day or two before I left for the meeting in Canada. She almost froze on Saturday, but stayed on the job. Nights remained cold through most of the hybridizing period. If the results are poor this year, I will blame it on all those nights in the 40's and low 50's. I bought 2 bales of 1000 bags each and hoped to get almost that many crosses made, but we ran out of buds. A hard freeze on May 5 had destroyed too many of them. We did get about 1300 well protected crosses made and I'm pleased about that. Now the question is: did that weather do some harm?

Seven of the most advanced plants wanted to make their first try at blooming this year. That freeze — to 27 degrees — stopped that. By the following afternoon the tops were drooping and they looked waterlogged, I thought they would dry up but this didn't happen. The foliage recovered completely but the buds were hurt, not completely destroyed as they were on herbaceous plants. Some of these eventually opened to reveal a set of rather well developed carpels and just a small ribbon of petal, no wider than a paper match. There was only enough petal to show that none of these will be yellows. Two others had a little more petal area and one made an almost complete, but small flower. I'll describe it first. This was a seedling of '**Petite Renée**' x '**Thunderbolt**'. It was deep red. The sheath enclosing the carpels was a lighter red. There were anthers which appeared to contain pollen. I brought it to the show where several other hybridizers got a look at it. If this gets big enough it could be a pretty good peony.

Another one opened a week later. It looked like it might be a sort of "orchid" color, similar to some suffruticosas. It will have darker flares. Another opened three small buds still a week later. Looked like it might be some sort of unattractive medium pink with darker flares. None but the first one described is likely to have pollen.

Most plants have grown very well this year. Next year there could be about 20 capable of blooming. - Roy Pehrson

HAS A BETTER SEED PARENT BEEN FOUND?

July 20, 1974

Not all of the Ito crossings have been counted for inclusion in the below tabulation. There are enough for some meaningful comparisons. It will be noted that L.T.K.A. is more than seven times as effective in making seeds as the average of the other crosses. This is not all of it! Perhaps with no exceptions, the others will produce only a single seed in one of the capsules in a seed head, L.T.K.A. will have a number of seed heads in which there will be several seeds in each of several capsules. I think there will be enough of them to increase the effectiveness of this cross to at least thirty times the average. I should mention here that ALL of the crosses included in this tabulation were made "in bud" and then bagged immediately.

I can't remember ever having used tree peony pollens on this plant prior to 1973. In 1973 I used '**Alice Harding**' on it. I have reported having 20 baby seedlings from this cross, but there are more

little ones, and when these are observed again next spring it may be possible that there are as many as 37 altogether.

It may be argued, and with some logic, that since LTKA is not a pure lactiflora that I cannot be sure of my identification based on leaf outline only. I won't clutter up this report with the many counter-arguments which I can muster; arguments which to me are completely decisive. I'm delighted in having to conclude that L.T.K.A. is some sort of a miracle plant with a most amazing affinity for lutea hybrids pollen. It follows that these pollens must be more viable than I had previously thought.

The plant is a product of one of my earliest attempts, using a mixture of '**Golden Glow**' and '**Bright Knight**' pollens on lactifloras. The seeds were planted out in the garden where four of the resulting plants are still growing. The stake was marked "lacti-triploids" so this one has become "lacti-triploid (pink anemone)". It is a nice medium self colored pink of good size. The stems are quite tall and sturdy. The foliage is on the lacti pattern and extremely thick and leathery, fairly dark. There are 27 stems this year. This is really quite a good peony aside from its breeding potential and should perhaps be given a name — and distribution sometime later.

Seed Parent	Pollen Parent	Pollinations	Apparent "Takes"	%
L.T.K.A.	'Themis'	33	19	57.8
'Plainsman'	'Artemis'	34	6	17.7
'Laura Dessert' sdlg.	'Amber Moon'	9	4	44.4
Big Loose Double	'Age of Gold'	24	1	4.2
'Nippon Gold'	'Themis'	38	1	2.6
'Golden Dawn'	'Segovia'	56	4	7.0
'Vesper'	'Happy Days'	56	3	5.4
Mauve Bomb	'Kronos'	92	10?	10.8
'Tokio'	'Silver Plane'	19	0	0.0
'Charm'	'Thunderbolt'	22	2	9.0
L.T.W.J.	'Amber Moon'	25	5	20.0
'Nippon Beauty'	'Renown'	56	0	0.0
'Gertrude Allen'	'Infanta'	32	0	0.0
'Battle Flag'	'Black Pirate'	31	1	3.2
L.T.K.J.	'Amber Moon'	31	4	12.8
Big Pink Jap	'Silver Plane'	12	3	25.0
'Petite Renée'	'Golden Isles'	40	1	2.5
'Largo'	'Demetra'	30	5	16.7
'Moon of Nippon'	'Silver Sails'	54	2	3.7

Weighted average of all but the first on this list 7.8 % - Roy Pehrson

MORE ON SEED PARENTS

August 20, 1974

After writing the above account and sending it on to Chris, I took to wondering if I may not have been too impetuous. I have decided to explain in more detail so that each reader may judge for himself whether or not I may be wrong in my conclusions.

L.T.K.A. is not a pure lactiflora. The pollen parent is either '**Bright Knight**' or '**Golden Glow**'. Could it be conceivable that the lobed outline I see in these seedlings comes, not from their pollen parent, but from L.T.K.A. itself? I should say that it IS very conceivable, even though L.T.K.A. itself has foliage showing no sign of an "officinalis" type influence. It is this officinalis or lobata type of first leaf which so much resembles in outline that of a true lutea cross.

If leaf outline is no sure test in this instance, then how about leaf and stem color in early season? The situation is no better here. L.T.K.A. itself is quite green in color when it emerges in the spring, nowhere near as red as a lactiflora. These seedlings were also almost entirely green, without the pinkish color that most of the true Itos have. I say "almost" since there have been a few true Itos which were like that, if the pollinator happened to be one of the yellow luteas.

In 1973 the blooming season came on with a rush. There was not time to make only well protected crosses and still get a good number of crosses made. Seeds from crosses made "in bud" and properly bagged were kept separate from those made after the bloom had opened. They were germinated and planted out separately. THERE WAS ONLY ONE EXCEPTION! The protected crosses on L.T.K.A. appeared to have much too many seeds and so they were thrown together with the unprotected ones. It is in this batch of seedlings that I find those 20 or more seedlings which seem to be genuine hybrids.

So you see it is the combination of these different sorts of evidence that makes me all but certain that this plant is a really superior seed parent for this cross. The last two summers I have been very fortunate in having had quite a few different lutea hybrid pollens to try. I am not in a position to say which one — or which ones — are better than others. Every one has produced at least a seed or two if used on a suitable number of blooms. It may be futile to hope that one will be found which will produce seeds in far greater numbers than the others. Possibly these pollens are better than we have thought. If my experience is any guide we should be looking for better seed parents instead. I suppose there is no way to find them except to try everything. L.T.K.A. itself may be only a freak happening.

I have three sister seedlings of it and they are no better than the usual lactiflora. (Chris asks what L.T.K.A. stands for. It means —lact-triploids-pink anemone. When I was breeding glads I used the letter "p" for purple and so the code letter for pink had to be "k". It is just a carry-over from those years.) - Roy

LETTER FROM DR. DAVID REATH, Vulcan, Michigan, 49892. July 11, 1974.

The peony season is coming to an end here with the blooming of '**Lullaby**'. Roy's creation is a very fine fully double variety that should be a very good cut flower. It is about the latest of any of my herbaceous peonies.

This year I concentrated on crosses of F₁ lutea hybrids x pollen of fertile advanced generation lutea hybrids. This is a type of cross that yields a fair number of seeds and the resulting seedlings may be worthy of garden introduction; many of them are fertile and therefore useful to the hybridizer.

We purchased a nearly complete collection of the Daphnis-Gratwick advanced generation hybrids from Gary last fall (as scions). We had extremely good results with the grafting of this material and by using a strong rootstock in making these grafts many of the young plants bloomed here. This gave me an opportunity to use pollen of these valuable new additions to the peony world. Also many of the blooms were pollinated with known fertile pollens. This test will give some indication of which ones are fertile.

As I made my crosses this year, I thought of the idea of having a hybridizers' workshop right out in the gardens of various hybridizers. This would give the other hybridizers an opportunity to observe the projects of other hybridizers and to pick up bits of information that may be of use. Also, we would see the results of other hybridizers.

If you thought there may be enough interest in holding such a meeting we would be willing to host the first here at Vulcan. It should be held the weekend before or after the APS meeting so as not to interfere. We will soon start to make our grafts of tree peonies. We expect to make between five and ten thousand this year. We finally have sufficient scion wood of several varieties; however, several are still in short supply. Some of those Daphnis-Gratwick varieties are out of this world. No. 255 is one of the nicest strawberry reds that I have ever seen. It has the texture of plastic with perfect placement of petals. Then there is No. 240 which is another topnotch variety with similar shape and petal texture but in the dark red class. It faces upright on especially strong stems. Unfortunately, neither of these has pollen and the seed setting ability results won't be known until this fall or next year.

Paeonia potanini var *trollioides*. Three or four years ago I received from Silvia Saunders three plants of this species which she imported from England. One plant grew and has now formed a clump two feet across. It has charming fern like foliage which grows to a height of only six inches here. It would be useful in a rock garden.

There was just one bloom this year which opened before I realized it would and shed its pollen before I had a chance to gather any or to hybridize the carpels. The bloom was of a pure deep yellow color with no flares as is present in many *lutea* forms as well as the Tall Yellow forms of *Potanini*. Like the Tall Yellow form it is very stoloniferous, a trait that would be very useful to propagate its offspring. It is a species that I should think worthy of much hybridizing work.

I will make some grafts this August and will also dig and divide by natural increase the whole clump. I should be able to supply stock within two years if it increases as expected.

Stern's book "A Study of the Genus *Paeonia*" contains a picture that fits my plant well.

Sincerely, David Reath

ARTICLE ON Embryo Culture - and letter from—— John E. Simkins
1246 Donlea Crescent,
Oakville, Ontario, Canada

Dear Chris:

9-8-74

Here is a short note on Embryo Culture. I seem to have mislaid the Iris bulletins that give the directions but I'm sure there must be quite a collection of literature on the subject in Agricultural College libraries.

I'm quite willing to toss some money in to help look into Meristem culture and/or Embryo culture if we find someone to carry out the work.

I visited Gary last week but the seeds are not ripe. I'm still trying to get the grafting technique for tree peonies to work so am quite busy planting hybrid seeds and grafting.

- John E. Simkins

The Embryo Seed Culture for Peonies?

Two main characteristics of peony seeds have been sent to try us. The first is the time it takes to germinate the seeds and to obtain the first flowers. The second is the number of hybrid seeds that will not germinate.

I still have seeds of the 1973 crop in their warm phase and many more in the refrigerator in the cool period. While visiting Gary Seaman at Gratwick, I found many beautiful red seeds on Angelette which Gary said would not germinate because they were hollow. Hollow seeds are often found on herbaceous hybrids. These will not germinate by ordinary means.

Similar problems have been overcome by crab apple and iris hybridizers using Embryo Seed Culture. This is described briefly for crab apples in Montague Free's "Plant Propagation in Pictures", page 47. He states that the method will bring roses into bloom the same year the seeds are produced and iris have been bloomed in one year.

The method is said to give quick germination and much more rapid growth than the usual methods. The method consists of cutting the seeds to remove the embryo which is planted in a test tube of nutrient agar. The operation must be performed under aseptic conditions as fungus will grow rapidly in agar and kill off the embryo

A variation of the technique is described for Iris in "Iris for Every Garden", by Sydney B. Mitchell, page 140, It is called the Cluff Method. He refers to Embryo Seed Culture in "Garden Irises" by Dr. L. F. Randolph, American Iris Society, 1959.

I found a description and formula for the agar in a copy of the Iris Bulletin and tried it. The agar set up before the embryo were planted and they just sat on top and dried out. Cluff used Dehydrated Orchid Agar supplied by Dico Laboratories, Inc. of Detroit, Michigan and this might be easier than making up the solution.

I found it difficult to locate the embryo in the peony. It seems to be near the depression but a tail stretches around the outside. I cut open some hollow seeds of Angelette and think the embryo is there. The hollow is in the centre.

This method seems to me to hold promise of working with peonies but I haven't the time to research and try it for a year or two so thought someone else might like to give it a real try. The reward of years saved and difficult seeds germinated seems worth a few months of effort.

In another letter, dated July 9, 1974, John Simkins writes:

I don't know what to think of your Meristem proposal. I also suggested it to Roy in answer to his query. It would seem to be a good thing for the Society in that a new hybrid could be on the market at a reasonable price about five years after the originator decides it is a good plant.

This would reward the hybridizer and attract many more to the Society. I think we will have a selling job to get a positive vote out of the directors. Roy said he will write an article on it so I will ask Greta to follow up on this. Maybe you would like to write an article in the Bulletin on the advantages of the Society sponsoring some research in it. If the members became interested they might sway the directors.

I am still interested in trying embryo culture with peonies as this could reduce the time of the first flowering to three years. This plus meristem would get a new plant on the mass market in eight years from the cross. I will write something on it in the Bulletin this winter and see if anyone is interested.

Keep up the good work on Paeonia. -John Simkins

Reply to John's letter of July 9

The American Peony Society may be reluctant to finance Mericlone culture — too bad. But I'm sure that through PAEONIA, the job could be done. Maybe the same is true with regards to your embryo culture. PAEONIA is interested in embryo culture so I'd appreciate an article from you on this subject. Also, give me additional sources of information, please!

-Chris

P.S. – Yes! Please send a picture of your seedlings of '**Amber Moon**'.

* * * * *

BRAGGING

Being editor of the PAEONIA has fringe benefits like you wouldn't believe! Some plants that have come to my garden are so rare that I wonder if anyone of you has any of the following:

1. '**Halcyon**' F2 - from Miss Silvia Saunders is a beautiful plant, having small leathery pointed leaves with very prominent veins. The plant was very small but grew well this year and "just might" bloom next year. I'm expecting that it will set seed! Maybe Ozieri has something even greater to offer than we see in the '**Halcyon**' F1 strain.
2. '**Angelica**'! Flowers which look like cup shaped white calla lilies. For me this is probably the most beautiful of all peony flowers. It doesn't like me, I guess, and so has been getting smaller with each passing year. It is a close relative of '**Silver Dawn**' so that should give you the reason for its poor showing. Last year it was moved out of the low garden frost pocket onto higher ground and seems happy in its present location; at least it grew very well this season. Oh, I forgot to tell you how I know '**Angelica**' has pretty flowers. Well, the first year after

receiving it from Our Miss Saunders, it bloomed in spite of a frost that damaged the whole plant — but never again did it bloom. Next year this prize plant will have all the protection necessary — then we shall see!

3. Windflower F2. Two plants from different clones are growing well and should bloom next year. One of these F2 plants came from Roy Pehrson and the other - '**Sparkling Windflower**' - from Miss Silvia. Surely we can expect great things from these seed producing plants! Everyone should have at least one '**Early Windflower**' and one '**Late Windflower**' plant in his garden. You can't have my F2's but should be pleased with the F1's that are readily available. Say! I just happened to think that great big five foot '**White Innocence**' produces similar flowers and more abundantly, larger and of much better presentation (they don't hang down). Get that one!!
4. '**Picotee**' (I bought this one). '**Picotee**' is a plant that looks quite similar to P. mloko, that is, dwarf, red or pink stems and shaped like the mloko plant. The white flowers are of good size, single, with bright pink edges and a reasonable number of buds (or blooms). Really, though, it's a lady's flower — so fragile looking and fair! I like '**Picotee**'! No, I'm not a lady — but I like it and ladies too. The seeds from this plant supposedly produce similar picoteeing. We shall see, for I have several seeds from this year's growth. Next year I should pollinate '**M. Jules Elie**' and '**Carolina Moon**' with '**Picotee**' pollen. Wouldn't a double or semi-double white flower with bright pink edges be great! Let's try it!
5. '**Roy Pehrson's Best Yellow**'. This is a seedling of a '**Moonrise**' F2 X Quad F2. The color is a good yellow (you received a picture of it in a previous issue of PAEONIA). Roy also gave me a piece of his "Second Best" yellow — but we won't talk about that one just now. Best Yellow is a good size plant with a generous amount of blooms with good yellow color. Just think, though, it sets seed! You can almost hear it say, "Ito Hybrids, move over, here I come!"
6. And what more should I say? Roy Pehrson even parted with one of his Ito seedlings! Yup! he gave it to me. This seedling is now three years old — could it be large enough next year to bloom? I doubt that but hope so!
7. Bill Seidl made me a present of three of the Smirnow Itoh hybrids along with '**Fan Tan**'. With the increase in price of the Smirnow Itoh hybrids, the value of this gift is such that it would make a "three hundred dollar bill" look sick.
8. Seeds and seedlings from "Roy" are ever expanding my garden. His gift plants of named varieties too, have expanded my hybridizing capabilities enormously! So some day — and maybe that will be soon — all readers of PAEQNIA will profit from these bounties. I plan to share with others.

- Chris

LETTERS RE. MERISTEM PROPAGATION

From: Dara E. Emery, Santa Barbara Botanic Garden, California
To: Chris Laning
Date: August 7, 1974

Thanks very much for the newsy letter. It's good to hear the peony show was a success and I certainly agree with you that the high point was the discussion on hybridizing.

I'm so glad to hear the Mloko flowered. I tried hard with it, but it just would not bloom.

My new '**Alice Harding**' (T.P.) flowered last spring and promptly died, which was very disappointing. Also our small part shade growing ground had to be abandoned last summer and the clones moved, and divided last winter. The divisions have not fared too well in their new plot — full sun and hot. I'll let them go one more season and see what happens. It is good to hear that you folk are at least going to check into the possibilities of meristem propagation. If this technique can be developed for herbaceous peonies it would be the biggest advance in peony propagation in many years it seems to me. A real break-through as the saying goes and what a break it would be for the peony lovers. Less time lag will be wonderful.

Dr. Murashigo gave the meristem class again this last spring and much as I would like to have taken it, at the moment, it could not be justified. His address is: Dr. Toskio Murashigo, Assoc. Prof. Hort. Science, 3211 Batchelor Hall, U. C. Riverside, Riverside, CA. 92507.

Good luck and do keep us posted through the breeders newsletter on -what transpires.

From: Chris Laning
To: Dr. Toskio Murashigo, Riverside, California
Date: August 17,

At our annual American Peony Society meeting in June, a group of hybridizers of peonies expressed much interest in Meristem Propagation. Knowing of your research success in this field with other plants, it has been suggested to ask that you take on this project.

One thousand dollars has been suggested as the probable cost of the research development. I suppose there is no way of knowing in advance the final actual cost, but such enthusiasm on this subject was shown that cost is secondary — the development is urgent.

If you and your post-graduate students should be successful in peony mericlone culture development, and with your permission, the information would be published by the American Peony Society Bulletin, or *Paeonia*, which is a small hybridizers' publication, thus to be made available to any interested person.

From: Dr. Toshio Murashige
To: Chris Laning
Date: August 22,

I am very pleased and proud to be asked by the American Peony Society to initiate an investigation, the ultimate object of which is to develop a realistic procedure of rapid propagation of peonies through tissue cultures. As you suggested, the amount of funds the Society proposed may be inadequate to cover actual costs of the investigation. However, I am happy to accept the \$1000. This

would pay for part-time wages of an undergraduate student assistant for 9 months, or the school year. I shall need to ask for supplemental support during the summer months.

In addition to financial assistance, I shall need the Society's cooperation in obtaining plant material that can be used in our experiments. Before initiating the investigation, I would like to have arrangements made for a convenient source of experimental material.

If available, I would also appreciate any publication that your Society might have or could refer me to on the botany and horticultural characteristics of peonies. Such information would be very helpful and desirable prior to any experimentation.

It would be my privilege to have the results of our research published by the American Peony Society.

Hoping to hear from you soon.

To: Paeonia Readers

From: Chris

The American Peony Society did not ask for the investigation of meristem culture; the Board tabled the matter. I'm sorry that my letter was ambiguous! Probably the American Peony Society feels that this project should be supported — but is feeling the need at present for a consensus of opinion by its members.

Some members, or rather, readers of Paeonia urge hybridizers to help finance the initiation of this project. I am asking that pledges be sent to me early to expedite matters.

We of the American Peony Society won't let the readers of Paeonia down, this I believe.

THE PROBLEM OF SEEDS THAT DO NOT GERMINATE

Don Hollingsworth

From the beginning of my experience with germinating peony seeds, I have wondered why some seeds never germinate, sometimes staying alive for three years or more before deteriorating. When working with a hybrid cross that produces all too few seeds in the first place, the practical cost of germination failure is especially acute. Some of my experiences suggest that there may be a way to overcome such loss, provided we can improve our understanding of what goes on in germination.

The basic knowledge base from which we derive our present day germination methods comes almost entirely from two sources. First, we have it from the ancients that germination will be much better if the ripening seeds are not permitted to become entirely dry. As far as I know no attempt has ever been made to determine why this is true, but almost anyone who has heard it and tried germinating seeds by the early germination methods believes that the ancients were basically correct.

The second source is perhaps the most important in that it enables us to be successful with early germination methods. This is the experiment report published in 1933 by Lela V. Barton of the Boyce Thompson Institute of Plant Research (new York City). Over a period of several years working with tree peony seeds (*Paeonia suffruticosa*), she showed that root germination was stimulated by different environmental conditions than is subsequent top growth. Roots emerged best from seeds planted in moist medium and held at either 68 °F constantly, or cycled daily between 59° and 86 °F. Emergence of new roots commenced after about two months and was observed to continue for at least four months. With these rooted seeds, she then conducted an elaborate array of trials to determine the best conditions for overcoming dormancy of the top (epicotyl) which process she called after-ripening.

She determined that unless a satisfactory period of cool temperatures was given the epicotyls of rooted seeds either never emerged or died after emergence when placed under normal growing conditions in a greenhouse. She showed that most successful after-ripening was achieved when rooted seeds were held at 41 and 50 °F for two and one-half and three months. Rooted seeds held at 34° also proved to be adequately after-ripened though they were slower to emerge above ground when the pots were moved to the greenhouse. A further finding of these trials was that when pots of seeds otherwise ready to grow were moved to a warm greenhouse (70°) the epicotyls died. Subsequently a cool greenhouse was used for the experimental plants (55°) and the seedlings performed more satisfactorily. My own experience shows that some germinating seeds will after-ripen at 55° and that outdoors-germinating seedlings will commence growth in the spring when average daily temperatures are considerably below that level. Dr. Barton showed us what had to be done to meet the overwintering requirements of peony seeds when out-of-doors conditions prove too harsh for seedling survival or otherwise do not provide the requisites of time/temperature necessary for the completion of germination. However, she worked only with those seeds that rooted in the conditions she gave them and during the calendar period within which she wished to commence the after-ripening trials. She further reported that root germination was as low as 4% and never more than 53% in the seed samples used.

Subsequent to the Barton research descriptions of numerous seed germination plans have appeared in the peony literature, some with innovative embellishments and some very simple, but very satisfactory. However, it was not until five years ago that there appeared in print anything further that is significantly new about requirements for germination. This pertained to conditions for root emergence in certain hybrid seeds.

In 1969 Roy Pehrson reported that during the previous season he had held several large seed lots of *P. lactiflora* x Probable 'Ladybird' (Little Red Strain) and K6 Lobata at the temperatures he had grown accustomed to using. No roots had emerged even after 13 weeks beyond the expected time. Upon moving the seeds to a colder location roots appeared in large numbers within two weeks. This was reported in APS Bulletin 193. June 1969, pp. 34-5. Roy suggested that it may be the drop in temperature which is effective. Coincidentally, Roy had favored me with a quantity of the same seeds. Having benefit of Roy's report, I purposely held these at temperatures above 75 °F beginning in early July and for three months thereafter. When outdoor temperatures had declined sufficiently to get a fairly uniform 55 to 60° in the garage, I moved them to it. No root action was evident at the time, yet within one week root development could be seen. Subsequently in the same season, all of my other seed lots were given from four to eight weeks of high temperature and then moved to the colder level. In every seed lot some root action could be seen within a week whereas none could be detected prior to giving the cooler temperature. These seed lots included *P. lactiflora*, Itoh Cross, Tree Peony and a *P. delavayi-lutea* strain. I have these results plotted on a graph which was circulated in a peony robin and to other individuals. If anyone is interested, I'll be glad to loan a copy for examination.

My conclusion at the time was that although moisture plus time at warm temperature is a basic requirement for root germination of peony seeds, the roots will still not emerge until certain cooler temperature levels obtain. In other words, keeping them on a shelf in the living room will probably not work unless the room is also a bit uncomfortably cool for human habitation.

In the seasons since 1969 I have continued to set up tests of this phenomenon during every germination period. From 1971 on I have used the technique each year as a means of controlling the date when I first have to start the laborious task of moving rooted seeds to the refrigerator. In small seed lots, all seeds will frequently be ready to move at the same time. There have been remarkably few departures from my general experience of no roots at 75 °F, perhaps half a dozen in five years, except among *P. delavayi*, *P. lutea*, and *P. lutea ludlowii* which frequently root at 70-75°, one of which even after-ripened the epicotyl at those temperatures this summer and is now growing.

In order to provide a specific comparison, the following example has been selected. In 1973 several large batches of *P. lactiflora* seeds were put into germination in order to supply seeds for colchicine trials. I wanted to try some treatments, then observe the short term results before running out of seeds so that adjusted treatments might be tried. Seeds of the preferred parents were scheduled for earliest emergence and an unfamiliar single variety, '**Opha**', was left to the last. Some of the results are set forth below.

On August 19 seeds were collected at Sarcoxie, Mo., courtesy of the Gilbert H. Wild and Son Nursery. These were put immediately to soak and after several days washed and picked over to remove faulty seeds and any with speckled seed coats which I believe are more prone to rot. The remainder were sorted into lots of 200 or so each, placed in moist vermiculite and held near the furnace. A thermometer was kept in the seed box and read regularly to be sure the temperature was holding above 75°. Reduced temperature was given by moving the seeds either outdoors or to various locations in the garage. Early they received daily cycling out of doors, then moved indoors by early October. After my hybrid seeds were moved to cool on October 28, seed box temperatures were recorded in early morning. Temperatures around 55 to 60° were obtained until early December, then they declined to the low 50's and by early January the high 40's.

MOON OF NIPPON

Total number of seeds started - 860; lost to rot during the trial - 105; base number used for computing germination percentage- 755. High temperature of 75 °F and above was given until September 18, or 30 days. Results:

Observation date:	No. days of cool temp.	Accumulated No. of roots	Percentage of total
Oct. 6	18	57	7.5
Oct. 17	29	119	15.8
Oct. 30	52	213	28.2
Nov. 14	67	415	55
Nov. 21	74	434	57.5
Dec. 10	93	444	58.8

After Dec. 10 the unsprouted seeds of this group were moved to the refrigerator still in moist medium. After Jan, 26, I changed my mind and returned all seeds left from all lots to 75° to be held moist through the entire summer. Some additional seeds germinated among the '**Moon of Nippon**' remainder, as happened in the others, too.

'OPHA'

These seeds were also started August 19, but were kept at the high temperature for a much longer time. November 23, three bags had no root action evident and were moved to the cool seed box, by this date about 55 °F daily minimum. The fourth bag was left at high temperature until Dec. 18, when it was moved to an inside location where the temperature remained about 65° constant. There was a single long root in this bag at the time moved. The results in both batches are in sharp contrast to those of '**Moon of Nippon**' seeds reported above. The fourth bag of '**Opha**' performed dramatically differently and it is these results we need to learn how to replicate with all seeds.

Results:

'OPHA'	GROUP A	GROUP B
Date started at 75° plus	Aug. 19	Aug. 19
No. of seeds started	517	197
No. of days at high temp.	96	121
Date of temp. reduction	Nov. 23	Dec. 18
Level of reduced temp. given	cycled (see above)	constant
Days to first count of roots	17	18
Percentage rooted first count	44.1	95.5
Percentage by Jan. 26 (end of test)	54	95.5

The foregoing cannot be considered rigorous research. However, the results do suggest a line of approach for a more rigorous test. Obviously, the conditions given Group B of '**Opha**' were optimal for the variety. The reduced temperature given Group A averaged about 10° lower during the period prior to the first observation and Group B received high temperature incubation for an additional month. Either or both of these differences may enter into the results. It is worth further testing. I would like to have the comments and questions which may arise from this sent to PAEONIA so that all of its readers may participate in the exchange.

Suggestion: Be cautious of assuming that constant 65° F. is the optimum root emergence temperature for a particular species or hybrid group. Roy's experience showed that 55° worked for a hybrid cross using one of the Little Reds. However, it is my impression now that seedlings by pollen of '**Good Cheer**', another of the Little Reds, germinate easily under the same conditions as do straight *P. lactiflora* seeds. It may prove that there are differences among varieties on this character as well as differences among species. By giving cycling temperatures daily we may be able to have the best of all. This could be accomplished during cold weather by moving a seed box back and forth between a warm and a cool area.