PAEONIA

Volume 11, No. 1 March, 1980

REQUIRED READING –

1. "The Peonies" by John C. Wister, $3.50 from American Peony Society. 250 Interlachen Rd., Hopkins, MN 55343
2. The Bulletins of the American Peony Society.

The PAEONIA is authorized by Miss Silvia Saunders.

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Suggested yearly contribution to cover expenses of printing and mailing is $2.50

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MORE ON COLCHICINE

Don Hollingsworth

Dear Chris: February 4, 1980

For me a logical review of the facts leaves not much but sheer lust for adventure as a justification for adopting a foliage spray treatment method -- for attempting to achieve colchicine-induced polyploidy in peonies! In a more serious vein, however, I must hasten to caution that what you called my method is not a tried method. It is merely a proposal, a logical synthesis based upon published conclusions of colchicine researchers and upon my own conclusions about how a peony grows. My account of the latter is in an article which is in publication now for the March 1980 APS Bulletin.

First, a comment on the differences in the problems of colchicine treatment compared to those of the radiation technique by which Murray pursued and won a verticillium wilt resistance gene mutation in mint. The colchicine procedure does not change (in effect, damage is a more expressive term) individual genes. You either get chromosome doubling or you don't. The only other uncertainty for the desired result is whether the change is in a tissue capable of propagating a whole plant. Radiation damages genes with equal probability throughout the chromatin, the probability of getting the desired change is very small. Most of the changes achieved are inherently negative.

Also, you raise the question of cumulative effect. I have not run across any evidence that cumulative effects have any bearing. The colchicine action is more of a "hit and run" Accumulation of the material over time leads to death, for it destroys cell division, for example. The idea is to get the concentration up in tissues in which cells are dividing, leave it long enough to keep daughter cells from forming, then remove it in hopes the cell cycle will resume.

Here are the relevant facts insofar as I understand them, in relation to the potential usefulness of spraying the foliage as an application method. With the exception of the few kinds which can make adventitious stem buds on blind root pieces, peonies can only be propagated from the meristem lineages which are seen on the perennial stems (underground, in the case of herbaceous peonies). This is true whether they are divided, grafted or grown from stem cuttings. Buds for future growing seasons are originated during the current growing season, when the stems grow in the spring, some of their buds remain small. These (Continued on Page 9)

CORRESPONDENCE BETWEEN ELISABETH GEORGIADOU (England) and Chris Laning

TO: Elisabeth Georgiadou, B.Sc., F.L.S. 15 Oaklands, Bulmershe Road, Reading, Berkshire, RG1 5RW England

FROM: Chris Laning

Dear Mrs. Georgiadous:

Information about yourself would be helpful in my determining what aid we (Paeonians) can furnish. The following can be a guide for your letter of introduction to our readers:

1. How old are you? — in terms of ten years (in the 20's; 30's, 40's, or 50's) This will determine the possible duration of your hybridizing project. Some goals are of such long range as to be impractical for the older hybridists.
2. Where do you work? In this area some things of special interest may be forthcoming such as access to laboratory equipments, library facilities, herbarium establishments, greenhouses (glass building enclosures), etc.
3. HOW much time is to be spent in gardening and hybridizing.
4. Would you get your hands dirty or have the unpopular tasks of weeding, planting, dividing, etc. done by the hired man?
5. What have you accomplished to date — are you a beginner or have you accumulated a bit of experience?

I realize that this letter up to this point is blunt and perhaps appears a bit unfriendly, but your answers could be exceedingly informative and meanings of words and sentences hopefully could be straight-forward and nothing misconstrued.

If your reply is written in such a manner as to be informative and interesting to our readers, I'd like to include it in our newsletter, "Paeonia".

* *

TO: Chris Laning

FROM: Elisabeth Georgiadou

DATE: February 12, 1930

Thank you for your further letter duly received.

First to answer your questions in your numerical order.

1. I am just thirty years of age.
2. I am currently doing my Ph.D. in plant taxonomy here at Reading University. I did my B.Sc. in genetics and will turn back to genetics and plant breeding after I finish my thesis.
3. I do not now spend much time on gardening and hybridizing, as my thesis takes all my time with the house work. But as soon as this is past, later this year, I can spend most of my time on hybridizing and related laboratory work.
4. We have plenty help for the what you call unpopular tasks, also we have plenty greenhouse space. My husband is a commercial vegetable and flower seed producer and breeder.
5. I feel this question is answered by the previous 4.

I fully understand your 5 questions and consider them necessary for you to know, in order to evaluate my position.

1 am of Greek-Cypriot descent and because of the excellent climate, we produce a lot of seed in Cyprus. Consequently we visit often to the island. All sorts of climates are available. Cool summers and Cold winters in the high mountain places, with plenty of snow and wild Paeonies, to desert like climates, very arid indeed, with rather cool winters and very, very hot dry summers, though all nights are much cooler.

I am trying to find now places where I can establish the *Paeonia brownii* and *californica*. I got plenty of seed but not one of them germinated so far. So you have any suggestions? Or do you think that the seed was too old? It would be so interesting to include these two species in Paeony breeding.

My other Paeony interests you already know. It is most kind of you to offer me a '**Mikado**' plant, and your fertile pollen single yellow stud-plant. Also thank you so much for helping me in locating a plant for sale of '**Good Cheer**'. I wonder what I can do for you.

Did you know that my good friend Mrs. Niki Goulandris is preparing a very fancy book with splendid watercolours in 13-colour litho printing on all the Paeonies of Greece, with a text by Professor William Stearn (before retirement British Museum, Natural History)? The book will be privately published by their Goulandris Natural History Museum. This book is going to put Sir Frederick Stern's book into the shade. One or two sample plates have already been printed for determination of the way perfection in the printing can be achieved. I may be able to obtain a copy for you of such a plate if you want. And of course the book itself when published.

I would like to prepare from now, the importation of interesting and valuable plants from the U.S.A. that I would need for breeding work on Paeonies, late summer. Also very excellent hybrid or other tree and herbaceous clones, that can be considered standards in quality, but not necessarily good parents, I would like to bring together too, as an example to judge seedlings by.

Tree Paeony clones that are known to hybridize with herbaceous and herbaceous clones that are known to cross with tree types, are also of much interest to me.

I would much appreciate your assistance in making a want-list of names to start with. A number of good plant sources and their lists would be interesting also.

I wonder whether there are hexaploid hybrid Paeonies reported, and if so, what do they behave like?

I hope to hear from you again soon.

Yours sincerely,

Elisabeth Georgiadou

p.s. B.Sc, is as you guessed "Bachelor of Science", which I did in Horticultural Botany.

F.L.S. means Fellow Linnaean Society, a very prestigious body, of which I am one of the youngest members, because of my friendship with Professor William Stearn, V.H.H. — as mentioned earlier in my letter — who is the President. V.H.K. you will now wonder, means recipient of the Victoria Medal of Honour, which is about the highest possible honour in the U.K. in horticulture or botany.

MAKING CROSSES FOR DOUBLE FLOWERS HAVING NEW COLORS

Don Hollingsworth

Lactiflora peonies have the finest expression of doubled flower forms, while the early hybrids peonies have the new colors. Although it isn't easily done, these two groups can be interbred. If you will accept this as basic fact, then how to bring together the best features of the two is merely a matter of accomplishing details. The prospect of what might be available from such efforts is suggested in seedlings which already exist. One of these is a full double flowered offspring of '**Lady Alexandra Duff**' x '**Claire de Lune**' which I displayed at the Champaign peony show last June. It has a form and season like many other midseason double Chinese peonies, but the color is pale yellow with a pink suffusion. It is a novelty which clearly shows that the chief ornamental qualities of the two parents can be combined genetically.

Many of the most novel colors and color patterns seen in the early hybrids are in plants which have lactiflora (Chinese) peonies as one parent. Thus, when crossed back to lactifloras, doubling genes can come from both sides. At the same time, most of these plants are highly infertile, as is often the case in interspecies F_1 hybrids. Some of them are triploids, an additional cause of reduced fertility. Consequently it takes a little more than ordinary faith in technique and in certain genetic facts to keep one from giving up in discouragement when the seed yield is found to be quite low.

This is not a cross on which to take the easy way out by crossing only on bomb doubles, Japanese flowered and single flowered forms. The strongest doubling effects are contained in the plants which make semi-double and full double flowers. It is their genes that you hope to carry forward in your breeding program. This doesn't mean that one can't get these genes from plants which are showing the other flower types, just that we don't have the information established as to just how that might happen nor which ones may be capable. Conversely, in the full double types you can see something of what you want in the plants which you are using.

The problem with doubles is how to get them to produce suitable carpels on any kind of a predictable basis. The one positive approach that has been identified is decapitation, cutting off the first shoots (beheading) in a manner which forces secondary shoots to grow. These secondary stems are known to sometimes produce flowers of reduced doubleness, sometimes completely single and having nice, full blown, carpels. The question is, how to make the result more dependable.

I've made observations on this procedure for several seasons, both on accidentally produced reduced flowers and on planned decapitations. I can offer some perhaps useful speculations, which may encourage others to try.

The stimulus to flower is formed in peonies during the previous growing season. When the stimulus is not formed the plant remains vegetative. Thus, first year growth from a division often makes flowers, even though much of the food storage has been cut away in making the planting piece. Also, some of the hybrids that form eyes on blind root pieces will flower on the shoot which grows from such a bud in the first year. Afterwards both of these kinds seem to require the attainment of a substantial new system of storage roots before flowering will resume. Thus, the secondary stems

which arise from decapitated primary stems that were going to flower can be expected to form flowers also. Experience shows that this is generally true.

The phenomenon of flower reduction (from more double habit to less double in the current flowers) is quite variable, at least from one cultivar to another. I get extremely undependable results from planned decapitation. The best reduction I've seen was from a double similar to '**Richard Carvel**', to completely single. It was on a stem accidentally broken only partway through, after it was a foot or more high. Thus the secondary buds broke into growth rather late. Was it the lateness or the fact that soil temperatures were higher, perhaps making the bud develop too rapidly for the doubling forms to be generated. I don't like the cultivar so didn't try a planned decapitation. The ones that I have done on purpose involved established plants, the stems usually cut when less than two inches high, maybe later is better.

Perhaps there is a quantity (or shortage) of stored food factor which is responsible for the degree of reduction. There was a reference, which I cannot locate just now, telling how the decapitation procedure was used by the Klehm Nursery. It seems to me now that this or some other quote said the procedure was used on plants grown from division, in effect, root pruned.

This is the extent of the speculations which I can offer at the present. I think the only really good results I've had on purpose was on '**Karl Rosenfield**'. '**Lady Alexandra Duff**' and '**Miss America**' are semi doubles that make some good carpels without help, but the proportion will be improved by the decapitation process.

The merits of improving the seed production potential of double flowered peonies is obviously high, if one has reason to use these types in breeding. The potential of being able to improve the prospects of producing introduceable cultivars in one generation makes it worthwhile to invest a few plants for experimentation. Serious breeders will not mind sacrificing a few show flowers for the chance of better discoveries in the future.

ADDENDUM: February 22, 1980
Regarding the discussion of what may be the keys to successful decapitation technique for inducing carpel production in peonies that are normally too double, I can add a couple of references.

One is the comment of Ben Gilbert son about how tall to let the primary shoots grow before removing them. This was in his article which you published in December, 1979 "Paeonia", page 6.

The second is from Harold Wolfe in The Peonies (Wister, ed.), chapter on hybridizing in the section on herbaceous peonies. Harold speculates that the bloom primordia remains in a less advanced level of differentiation in the underdeveloped secondary (axillary, is my preference of terms) buds, that the forced growth brought on by decapitation may help to preclude full differentiation of the extra petals. This implies some things about morphogenesis of the flower which I find very interesting. However, it is also consistent with the idea of waiting until the primary stem is more advanced in growth to do the decapitation.

I did not re-locate the reference which I attributed by memory to Klehms. I think it was a back issue of the Bulletin, which I had borrowed, probably about the middle 1950's.

Letter from: L.J. Dewey, 2617 Wyndham Drive, Richmond, Virginia 23235 Date: Feb. 21, 1980

Dear Chris,

Thank you for your letter of January 23. My interest in peonies has not waned. I have had no breakthroughs in my experiments so there has been little of value to report. This partly explains the silence from this end.

The seedlings from my crosses are still too young to bloom, and I doubt if I will have any maiden blooms this year either. Therefore, in the hybridizing area I've been mostly observing the plant habits of the seedlings, but have found nothing startling yet.

I have about run out of ideas for experiments on decreasing the germination period for peony seeds. Nothing I have tried has improved the method described by Don Hollingsworth. I try to keep up with the literature in this area and as new techniques are reported I will try them with peony seeds.

Yes, I can use a supply of Mr. Domoto's tree peony seeds. Although I don't have any current plans for germination studies, I can use the seed to produce seedlings for colchicine treatments.

In connection with the induction of tetraploids using colchicine, a paper I ran across recently points up the magnitude of the problem faced by a peony breeder who attempts to induce tetraploidy in peonies. The study involved the production of tetraploids in tobacco. The first thing to bear in mind is that tobacco seed is extremely easy to germinate. In the study 1,800 germinating tobacco seeds were treated with aqueous colchicine solutions at 0.1, 0.2 or 0.4 percent levels for either 12 or 24 hours. 669 seedlings (39%) survived treatment. Survival rates were much lower at the 0.2 and 0.4 colchicine levels and for all levels as time increased. Of the 699 survivors only 12 (0.7% based on the number of starting seeds, and 1.7% based on survivors) were identified as tetraploids by cytological examination (chromosome count). One advantage we might have is that peonies are perennials, and treated plants might eventually send up a tetraploid shoot. It sounds like a real challenge, doesn't it?

In the December PAEONIA you asked for opinions about your proposed method for treating peonies with colchicine dissolved in dimethyl-sulfoxide. First of all I would recommend being extra cautious when using this solvent. It is reported that dimethyl-sulfoxide penetrates the skin easily and will carry any substance dissolved in it into the tissues beneath the skin. With that precaution, I think your idea is well worth a try.

What level of colchicine should you use? The only successful attempt at inducing polyploidy in peonies of which I am aware was reported by David Reath (APS Bulletin, March 1972, pp 13-15). Using his results as a guideline, one could start with colchicine solutions having concentrations between one and two percent for herbaceous peonies. You almost need a gram balance for this work. A 1% solution is prepared by dissolving 1 gram of colchicine in 100 milliliters of solvent. It is difficult to translate this into English measures, but one would come close by dissolving ½ teaspoon of colchicine in 20 teaspoons (3-1/3 fl. oz. or slightly under 1/2 cup) of solvent. With these small volumes you would probably want to spray your plants with an atomizer. This would also give you better control in directing the spray

When should the plants be sprayed? I would favor spraying the foliage in the spring after the leaves have expanded somewhat. You can get good coverage and will have all season for translocation.

Considering the cost of colchicine these days you might want to think about two alternative methods which have been successful with tobacco. They are both much less wasteful of material. Both procedures involve application of colchicine preparations to the growing tips of the plants.

How to adapt these methods to peonies. My thought would be to dig the peonies in the fall at transplanting time. Standard divisions could than be prepared and each immature bud (eye) could be treated with the colchicine preparation of choice.

COLCHICINE PREPARATIONS

1. Colchicine in a Solvent: A 1% solution of colchicine is prepared as described earlier. One could use either dimethyl-sulfoxide or water as the solvent. The growing points of the plants (eyes for peonies) are treated with this solution three times a day for three days. An artist's brush might work for this. The treated divisions could be held for a few days to allow the drug to penetrate the tissues and then planted as usual.
2. Colchicine in Lanolin: In this method a lanolin paste is made in the following way. For a 1% colchicine in lanolin paste, one gram of colchicine is dissolved in the very minimum of dimethvl-sulfoxide (DMSO). (Add the DMSO drop-wise to the colchicine with stirring, so that the least amount of solvent possible is added to dissolve the drug.) Carefully melt 100 grams of lanolin by heating, perhaps in a boiling water bath to be safe. After the lanolin is melted, add it to the colchicine-DMSO solution and mix thoroughly. Upon cooling, the mixture will form a paste which can be applied to the eyes of a division. In this case one application will probably be enough. Again, one could hold the treated divisions several days to allow for drug penetration of the tissues, and then the divisions could be planted out in beds. The level of colchicine in the paste can be varied to suit your needs by varying the weight of the drug you start with. This recipe should provide enough paste to treat a fair number of divisions.

With the cost of colchicine being what it is, you will probably want to save leftovers. I have found that unused colchicine preparations keep well if stored in the deep freeze. Before reusing they can be warmed to room temperature.

I have not tried either of these methods personaly but will try treating a few TP buds this fall. I will also continue my treatment of TP seedlings with colchicine this spring. I'm nowhere near 1,800 seedlings yet!

I trust this is not more than you wanted to hear about colchicine. Good luck with your experiments.

* *

(continued from page 10 - First Aid for Plants

6. enzymes obtained by squeezing the juice out of sprouting beans, peas, wheat, and barley, aid in rooting and. maintaining haploid peony seedlings. These haploids are discovered and are plants usually resulting from twins and triplets — and quadruplets (easily located when using Roy Pehrson's method of seed germination).
7. Symbiotic association — such as the fungus mycelium which thrives in presence of oak roots, beech trees, heath family, and orchids, and is an aid to their growth, Mycorrhiza fungus makes the raising of rhododendrons easy!
8. I would like to know if mesquite and chaparral are a requirement in growing *P. californica* and *P. brownii*.
9. Etc. - Chris Laning

POLYGENE CONCEPT

Chris Laning

One concept that has drawn little attention which hybridizers should find extremely useful is the Multiple Gene Inheritance Effect. We see its effects as a continuous gradation of observable traits which show up in the mating of two dissimilar parents. Gradation is apparent in terms of single traits showing up in the F2's of the cross and conforms to Mendel's principle of segregation.

Did you get lost? Maybe an illustration will put you back on the track. Here is an example: Cross a white flowered. peony with a dark red one, the expected result would be F1 pink flowered children -- about midway between red and white. Seeds taken from these pink flowered plants will produce F2 plants that should give continuous gradation; in other words, the resulting collection of plants produce colors which range from dark red all the way down to white, thus all shades of pink should register in the plants of the F2's. But parent plants must be homozygous for the trait demonstrated (this means the red flowered plant must breed true for color and the same must be true for the white one).

The December issue of PAEONIA discussed in breeding (dehybridizing) in developing homozygous plants.

The mechanics of the Poly Gene concept: A polygene is understood to be a gene that individually exerts a slight effect on the phenotype (outward appearance) but, in conjunction with other genes (be they many or few) controls a quantitative trait such as color, height, blooming date, etc. This concept in itself is of little use at the beginning of a project or goal. What I mean is that you end up with all shades of pink — from almost white to nearly red. And you can do the same at the chromosome level as we generally understand it. But, can you see the implications where a third color is added to the project? Imagine pollinating all these pink F2 plants with Laning's Best Yellow. Various shades of peach color should result and with inbreeding, a color of your choice can be developed which comes true from seed. This whole process involves many years of hybridizing and learning but we will start the project and each step forward advances our techniques and understanding of the peony. Also all along the way individual clones will result that are just what we had hoped for and we will feel we have finally succeeded in attaining our goal. Not So! Individual clones that happen to meet our hopes and expectations are only fringe benefits. We are interested in the mechanics of inheritance, the end result of which is to raise a specific plant with specific specifications from seed. Or, is it that we want mainly to increase our knowledge?

Roy Pehrson reported several years ago that he raised one group of about 500 seedlings of lactiflora x lobata cross, all of which he destroyed because, said he, "they were all singles and no improvement over existing clones of this type of cross." Had he envisioned Multiple Gene Inheritance (polygene concept), he might have realized that this was only the first step of a planned cross and that the next generation from these plants probably held the hoped-for results. Actually, the F2's, F3's, F4's, etc., hold out more promise of success than do the F1's. While not fully understanding the genetic implications of this concept, I have unknowingly been following the procedures it sets forth. When a person reasons out a program procedure such as this and later finds he is right — (the idea being supported by genetic research) — this is great!

For further information and amplification on this subject, read Chapter 12 in the book "Principles of Genetics" by Eldon J. Gardner, Utah State University, 5th Edition.

- Chris

may remain latent for many seasons and, over time, their relationship to a particular growth cycle is lost in the seemingly shapeless enlargement of the crown. A few of the buds enlarge each year and become the principal source of next year's stems. These enlarged buds occur in a very limited portion of the plant, occur in relatively small numbers and are easily located. Thus they are readily accessible for targeted treatments. The one previously successful treatment of peonies was deliberately focused on this region of the plant where the apical meristem lineages are concentrated.

Colchicine is toxic, poisonous. Reports of successful treatments in other plant species seem to agree that the best results are achieved when the treatment concentration is relatively high. High enough that a substantial proportion of the subjects are severely damaged or destroyed. By this guideline we must try to tread a relatively narrow range between too much (destruction) and too little (not enough to give a good chance of success). This is strictly in terms of the concentration achieved at a site at which cells are dividing and forming new growth points — apical meristems. How much we must put on the outside and for how long depends on how the active material is translocated through the intervening tissues and the extent to which the activity of the chemical remains intact. The farther away from the target that we apply the treatment the less certain we must be about where it gets to in the plant.

Further, it is clearly established that there is a period-of-treatment dimension. It is known that the colchicine mode of action is to prevent the formation of the spindle fibers, strands by which it appears the divided sets of chromosomes are moved to the separate poles of the dividing cell. In the absence of the spindle fibers, the two sets remain together, no separation, no new cell wall, no daughter cells. When the chemical level subsides and if the nucleus reforms (which it must in order for the cell cycle to continue), there is a single cell with double the original number of chromosomes. If the cell cycle successfully resumes, the cell will grow for a while, then go into a chromosome replication stage, then go into cell division again, this time making daughter cells just like itself, double the chromosome number of the parent cell lineage. When this changed cell is in an apical meristem, there is the potential that a whole plant may eventually arise from it. Thus the time over which the concentration of colchicine is held at an effective level is of critical importance. The timeliness and rapidity of removing the dosage may be just as important as the amount put on.

While I haven't read on any specific use of foliage sprays as a mode of treatment with colchicine, it has almost certainly been reported. If you can find something along this line it may help in estimating treatment levels. Also reread Reath's discussion of how high the concentration had to be for his immersion treatments to be effective. In my own trials I had colchicine tumors on the hypocotyls and roots, but nothing on the plumules. (The treatment was made while roots were short on the germinating seeds.)

I can see that in plants where there is a bud in the leaf axial that might respond, foliage treatment could be an appealing choice. This might be the case with tree peonies, although the changed tissue would have to be successfully grafted in order to perpetuate the meristem lineage. However, in herbaceous peonies, the relatively long distance between leaf and the underground axillary buds would seem to put an unnecessary burden of uncertainty on the mission. Perhaps the choice of the lowest leaf or two as the site for sprayed treatment on herbaceous peonies would the best bet.

The serious concern that I have about spray treatment of colchicine has to do with its toxicity, which is much greater to animal tissues than plant tissues. Spraying characteristically generates turbulence and a certain amount of uncontrolled over-spray. I believe the handler is taking considerably greater risk when spraying the substance than when using immersion treatments. Further, it is obviously appealing to add an agent to enhance penetration, in attempt to overcome the problems of treating at a remote site. However, this would make the hazards of accidental self treatment a much more worrisome concern.

Then, there is the cost of the chemical. According to the quote which I sent you earlier, 5 grams is $95. One gram in 50cc. of water makes a 2% solution. Reath used 1½ to 5% on seedlings (in evaluating this, remember that he had a lot of seedlings in a small amount of the solution, thus the net amount available was substantially diluted by that portion being taken into the tissues). Five grams makes 250 cc. of 2% solution — a quarter of a liter, a little more than a cup.

Colchicine treatments can be both costly and risky. They should be carried out with an appropriate amount of study and care. The potential benefits are great. However, earlier experimenters became entirely frustrated in their attempts to change the ploidy of peonies. I believe this happened because they did not first consider how a peony grows, then decide how to make the best of their colchicine treatments.

Thanks very much for the Murray articles on radiation of mint. I note that they focused the treatment onto propagatable material — the stolons. I find support in this for my appeal to you and others that you focus colchicine treatments onto the propagatable tissue of the peony.

* *

FIRST AID FOR PLANTS ———

Chris — I am enclosing a page from a book which mentions something like your scheme of using cereals seeds in treating weak peony seedlings — how did you ever discover that technique? — Don

> "A practice of some European gardeners in early days was to embed grain seeds into the split ends of cuttings to promote rooting. This seemingly odd procedure had a sound physiological basis, for it is now known that germinating seeds are good producers of auxin, which, of course, would materially aid in root formation in the cuttings".

* * * * * * * * * * *

In one of the issues of PAEONIA last year I mentioned sowing bird seed at the base of peony seedlings that needed "help". The idea of this type of "first aid" ,. developed as a result of compiling statements about plants and their environments-such as these:

1. Ethylene gas (gas given off by apples) encourages, or rather, stimulates the flowering of many types of plants. Also, it inhibits the sprouting of potatoes.
2. Certain grasses and weeds give off a substance that inhibits competitive u plants and grasses.
3. Walnut tree roots secrete a toxic substance that discourages plant growth and competition. This substance is so effective that black walnut trees kill each other. Don't try to raise an acre of these trees for lumber — it won't work.
4. Marigolds give nematodes indigestion.
5. Garden peas furnish more than just nitrogen when grown in pots that contain prized house plants. (Continued on Page 7) - Chris