PAEONIA

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OF PIGMENTS AND GENES:

In John C. Wister's book ''The Peonies", on page 172,you will find in the Saunders lutea hybrid (actually delavayi x suffruticosa) group the name Red Cloud which is in the "Black Pirate" division. Red Cloud was pollinated by Saunders F2B. The resulting seedling was numbered 95 by Mr. Gratwick. (Saunders F2B is a second generation lutea hybrid.) This plant, number 95, was pollinated by CHONI – maybe Rock's variety suffruticosa? – and a resulting seedling from this cross was numbered 258. This clone produces purple flowers, a warm color that seems to have a little yellow in it that gives it a new shade of purple.

So – P. delavayi x suffruticosa = Red Cloud
Red Cloud x Saundars F2B = seedling #95
#95 x Choni = seedling with purple flowers

Now someone please tell me how this is possible!!

It is difficult to imagine that paper chromatography would reveal any pigment that makes this possible. Now, if pollen from this seedling applied onto an herbaceous peony to develop a purple Itoh – maybe dozens of them, as our former A.P.S. president suggested as possible for the 1990's, we may have the delightful addition of purple.

Maybe another approach would be using purple T.P. pollen on the herbaceous or herbaceous hybrids in hopes of getting a purple flowered Itoh that way though lactiflora x suffruticosa seems to produce Itohs with incomplete flowers (flowers with almost no petals).

Years ago Roy Pehrson said: "TRY ANYTHING."

- Chris Laning

PEONY BREEDER'S ROBIN 12-7-86 Don Hollingsworth

Dear Friends: I was able to spend a little time today with the article on tree peony pigments from Dr. Takashi Hosoki in APS Bul. 259, Sept. 1986. Went through it hurriedly before and was mostly concerned that he differed from Fred Cooper, Bul. 197, June-Sept. 1970, in saying that he found no carotenoid pigments in the yellow tree peony hybrids. Well, by the year after Cooper's article came out, I had carotene yellow accepted as indisputable fact, so Hosoki rather shook me when he said that the yellow is chalcone pigments, and he found it in all but three of the Lutea Hybrids used in his trials. Cooper found chalcone only in Paeonia potaninii trollioides petals.

What are we to make of these seemingly conflicting reports, and why bother? I am concerned with understanding this information as much as possible, for it gives us some criteria for selecting plants in breeding for color.

After looking through the Hosoki article more thoroughly, I feel more comfortable with the apparent discrepancies. First, what little I understand about the thin-layer chromatography and paper chromatography techniques doesn't help me to eliminate the possibility that the chalcones were present in the Lutea Hybrids Cooper tested and he just didn't get his technique refined to where he could find them. Hosoki gives us considerably more information about what he did and we find that the Lutea Hybrids represented in his Table 1 all got a +++ rating for chalcone quantity, while those in his Table 2 mostly had a + rating except for '**Tria**' which received a ++ while three of the Daphnis hybrids showed none. Of the latter group I would suppose that '**Golden Isles**' and '**Alhambra**' would have at least as much source of yellow color as '**High Noon**' in the other table. It raises the question whether different batches of Hosoki's tests may also have given variable results. Also, Hosoki tells us how he extracted the anthocyanins from the petals, but I suspect that method would not have obtained carotenoid pigments which are fat soluble. Could some of you who are more informed on these techniques comment?

What is greatly interesting to me in Hosoki's conclusions is the observation that the darkest purple tree peonies have all three anthocyanidins and each one in both of its two variations (manoglucoside and diglucoside). Note also that his quantity rating shows the "red" varieties have pelargonidin predominating and peonidin only slight to trace and sometimes present only in one form. These are what we might call "warm" or "high" red colored flowers.

When Cooper discussed the breeding implications of the pigment tests he also commented on the odds of obtaining a mutation toward one of the other pigments (that occur in some genera) from this family of chemicals. He pointed out that it is much better odds that one may get a shift which drops out part of a chemical or the chemical entirely than the odds of obtaining a desired addition. Note that the "high" red colored tree peonies show an absence of cyanidin and little of peonidin, in Hosoki's results. Increased quantity of the pelargonidin would result from gene replication as might happen in chromosome breakage, while the loss of cyanidin or peonidin could result from losing the genes responsible, both events of which might more easily occur than a change in composition of a gene, which would be indicated in order to change one pigment to another such as to delphinidin, also one of that family of chemicals.

Cooper gives us a good deal of general discussion on the breeding implications of pigment studies and Hosoki expands considerably the array of cultivars tested, while giving us reason to feel that the sources of inheritance for the genetic variations found are somewhat wider and therefore more readily obtainable than we had learned from Cooper's work. We are fortunate to have these reports and can only hope that more will follow, helping to shed a little more light on just how these matters work.

A thoughtful re-reading of both these articles might just help dispel any notion that we are limited in the potential in peony breeding. Just look at what has been accomplished in tree peony breeding – within one species – while we have such a wealth of genetic material represented in the early hybrids (herbaceous) which combine the genetics of several species in descendants which have good inter-fertility already established and double the chromosomes?

L.J., about giberellic acid and overcoming dormancy, some research in Japan is the most definitive with respect to conclusions that I have seen. As best I can understand without a complete translation, treatment with GA3 was effective in promoting seedling production of P. lactiflora in two circumstances. In a stage after rooting, shoot elongation was obtained after over a half hour soaking in aqueous solution of 10 ppm GA3. Also, seeds germinated (rooted) and produced shoots after 48 hours soaking in aqueous solution of 1000 ppm of GA3. I'll send copies of these two articles under separate cover.
Also, your question on Daphnis numbered seedlings. I am enclosing a list which was prepared by Peter Hughes, presumably during a visit at Gratwick's. This is rather bulky. However, I would suppose that everyone in the Robin may have an interest in it and may wish to copy it for future reference.

Roger, your photos are great! Believe I saw 'Bartzella' at Minneapolis/St. Paul show last spring. These are exceptionally promising.

Chris, the photo of P. suffruticosa papaveraceae is enlightening with respect to the similarity with Rock's. Botanically, I suppose the two might be called identical, but I'll grant Rock's a little more class for garden use! That transparency of the seedling table is terrific. I have some slides of the same view which I make good use of in my slide show. The flowers depicted are just a sample of variations we already know can be obtained. Aren't you about to name some of these and get them out to the gardening public? (Chris says "NO"!)

Bill Adee, I'm impressed by your listing of cultivars. Could you give me a few comments on each of your species and your officinalis cultivars with respect to how they perform under your conditions and what those conditions are -- soil, shelter, etc, -- for helping get a few statements together to help persons who may be new to species and not know what to expect? I'm putting this sort of thing together in the interest of the species project which the Society has agreed to try out.

Incidentally, I am appealing for some volunteers to help with the species project. Anybody that would like to have the advantage of being at the center of the activity and therefore first in line for the benefits, please speak up!

Bill Seidl, I ran across your show classification coding system today -- want to discuss that with you, another time.

BREEDERS ROBIN, Flight #4; In 12-11-86, Out 1-16-87 January 16, 1987

L. J. Dewey, 2617 Wyndham Drive, Richmond, Virginia 23235

Dear Robin Members,

Tree Peony Crosses - During the spring of 1986, I made 104 hand cross pollinations with tree peony varieties. The crosses involved various combinations of suffruticosa varieties, lutea hybrids and the P. lutea, P. delavayi and P. potaninii species except that no crosses were made among suffruticosa varieties alone. Out of all these crosses only 3 produced one firm seed each. The productive crosses were:

'**Age of Gold**' x #C252-81
'**Roman Gold**' x TP1-82
TP1-66 x #C252-81

Description of breeding stock:

TP1-82 - unknown Japanese tree peony with double white flower and purple flares - like a double Rocks variety - Japanese import.

TP1-66 - unknown lutea hybrid with full double clear yellow flowers - may be 'Alice Harding' - Japanese import.

#C252-81 - a seedling grown from Domoto seed. The epicotyl of the young seedling was treated with colchicine to induce tetraploidy in the spring of 1981. It had its maiden bloom in spring of 1986. The flower with two rows of petals and with flares. Hopefully, the above portion of this plant is tetraploid. I plan to describe the plant in more detail in a letter to Paeonia.

These three seeds are now in the indoor germination process. The '**Age of Gold**' seed has produced a root and has gone into the refrigerator.

To date the tree peony interspecific crosses have been very nonproductive for me. Perhaps this is due to the growing conditions and/or our warm springs here in Richmond since the seed set on P. lutea and P. potanini, Stern's tall yellow, is very poor even when these species are selfed.

Itoh Crosses - Again as in 1985, I had much better seed production in spring 1986 with the Itoh crosses than I did with the tree peony crosses. In 1986 I made 94 hand pollinations involving 11 crosses. Of these 94 flowers 9 produced seeds representing 6 crosses. Seed production is shown in the table below.

Seed Production from 1986 Itoh Crosses

Cross	No. Flowers Pollinated	No. Flowers with Seed	No. Seeds Harvested	
			Hollow	Firm
'**Bu Te**' x '**Golden Era**' (A199)	6	2	12	6
HP1-61 x '**Golden Era**' (A199)	3	1	1	3
HP1-61 x '**Golden Isles**'	8	2	1	3
HP1-61 x '**Golden Hind**'	6	1	2	4
HP1-61 x TP1-66	2	2	2	18
HP1-61 x Kinko ('**Alice Harding**')	2	1	0	1

Description of Breeding Stock

HP1-61 - unknown lactiflora variety with full double pale blush flower fading to white.

TP1-66 - see above.

This seed harvest from the Itoh crosses is not quite as good as the 1985 harvest, but it is much better than the harvest from the tree peony crosses. These seeds are now being germinated indoors.

Seedlings from the 1985 Itoh Crosses - Some interesting seedlings have been obtained from the 1985 Itoh crosses. Among these are seedlings from the following crosses:

'**Bu Te**' x '**Golden Era**' (A199)
'**Gertrude Allen**' x '**Golden Era**'
'**Gertrude Allen**' x '**Golden Isles**'
HP1-61 x '**Golden Isles**'

All of these seedlings appear to be true Itoh hybrids since they all have the typical hybrid foliage.

Don Hollingsworth: I have had a fair amount of experience with thin-layer and paper chromatography and am convinced they are both powerful techniques for separating constituents of plant extracts. Although some people use these techniques for quantitative analyses, I prefer other techniques for these purposes. However, for qualitative analyses of plant extracts these techniques are hard to beat. Apparently in the case of Cooper's investigation (APS Bul. 197, Jun-Sep 1970 and reprinted 1n APS 75 Years, 1979, pp 141-143) and that of Hosoki's (APS Bul. 259, Sep. 1986), the chromatograms were evaluated subjectively. For a more accurate picture of the pigment distribution in peony petals, I would prefer to see some quantitative data and hopefully that may come along later.

Cooper does not describe his method for identifying carotenoids in P. lutea petals, but since these pigments are fat soluble, one must assume he used organic solvents to extract these constituents and less polar solvents to develop the chromatograms. Hosoki used the quite polar hydrochloric acid (HCl) in methanol to extract the pigments from the petals. It is unlikely the carotenoids would be extracted with this solvent, and even if they were, I doubt if his polar developing solvents would have separated these pigments on the chromatograms (one needs less polar developing solvents). Perhaps, Hosoki used a different method when looking for carotenoids but does not describe it in his article. For an abbreviated chemical discussion of the carotenoids, Trevor Robinson's "The Organic Constituents of Higher Plants", 5th ed., Cordus Press, North Amherst, MA, 1983, pp. 162-168 may be consulted (this should be available in university libraries).

Unfortunately, neither of these authors gives sufficient experimental detail so that their methods can be evaluated objectively. As an example, it is not clear in Hosoki's Table 2 whether the chalcone is the aglycone or the glycoside. He does say the anthocyanins were chromatographea before and after hydrolysis with HCl. This could be a problem in determining chalcones since these compounds are converted to the less colored flavanones in acid and the chalcone glycosides yield a flavanone aglycone as an artifact on acid hydrolysis. So as not to give the wrong impression, I should admit I am not an expert on flower pigments. For a higher authority on these flavonoid pigments, Robinson's book (pp 191-221) cited above can be consulted.

The analysis of flower pigments must be extremely difficult. Not only do we have the problems discussed above to contend with, but there are a number of complicating factors inherent in the analysis of plant extracts. I have listed a few below.

1. Age of flower - pigment levels may change on ageing.
2. Plant culture - fertilization, climatic conditions and soil type can greatly influence the levels of constituents found in tobacco plants and I can imagine that these factors could alter flower pigment levels also. To evaluate these factors one could analyze flower petals from the same variety grown in

different localities and also compare levels from one year to another. This type of analysis could help to establish a range for a particular pigment from the lowest levels to the highest in a particular variety.

3. Variety identification - in comparing pigment levels, it is obviously important to make sure we are comparing data from the same variety. We are all familiar with mislabeled varieties especially with regards to the Japanese suffruticosa varieties.

I agree with you that Cooper and Hosoki have made valuable contributions to the understanding of the basis for color formation in peony flowers and I trust Hosoki will be able to keep up the good work.

Many thanks for the copies of the two papers by Yoneda et al. on peony seed germination and treatment with gibberellin A3. I do not read Japanese either so your margin notes are most helpful. I am inclined to think this treatment is too much trouble to use routinely, but it might be worthwhile on valuable seedlings which break dormancy with difficulty.

I really appreciate having a copy of Peter Hughes' Summary of the Daphnis Seedlings. By the time the list got to me the copy was a bit faint. That in combination with Peter's writing style made deciphering a bit difficult but I think I have made most of it out. Again your margin notes are helpful. I would still like to have descriptions flowers of all the seedlings but that may no longer be possible. I thank you.

I would like to volunteer for your species project if I can limit my involvement to the tree peony species (I am cramped for space). If you need such a volunteer, count me in. I might point out that I seem to have more disease problems (particularly "stem die back" - fungus?) here in Richmond with P. lutea, P. delavayi and P. potamni than I do with the suffruticosa vatieties or the lutea hybrids. Also the tree peony species do not set seed very well for me even when selfed. Do any other Robin members have these problems? As for the herbaceous species, P. tenuifolia is extremely difficult to grow here because of the disease problem while mloko survives albeit not vigorously.

Bill Seidl: I quite often harvest seeds with ruptured seed coats from the Itoh cross. It is as if the endosperm gets, too large for the coat. I run the seeds through my indoor germination procedure anyway and sometimes they germinate before spoiling.

Chris Laning: With regard to your desire for a P. delavayi plant with no pollen, maybe male sterility would be one answer. Male sterility occurs in tobacco and other crops and is genetically controlled. How would you find such a plant? My guess is that you would have to grow a large population of seedlings and examine the anthers on individual plants for aborted pollen or check the pollen for germination on agar. It sounds like a formidable undertaking. Once you found such a plant you would not have to worry about self pollination. I should think spraying the flowers with something to inactivate the pollen would be iffy since you risk damaging the stigmas.

Steve Varner: I cannot answer your question about cold injury to Itoh cross seeds planted in the open garden since all of mine are germinated by the indoor process. The new seedlings once up do seem to withstand light frosts here. Unfortunately, I have found no control for slugs although I almost killed the dog one year by spreading snail bait around some plants. She thought it was dog food.

I hope 1987 will be a banner breeding year in the peony patch for all of you.

Best regards,
L. J. Dewey

L. J.: Named varieties of suffruticosa produce very few seeds for me, too, but seedlings raised from seed I received from Mr. Domoto, California, are fertile and generous in seed production. I suppose the older named clones have lost their vitality and youthful vigor. And I suppose a number of varieties of herbaceous species are in the same category. - Chris

THE TAXONOMY OF THE MLOKOSEWITSCHII, MACROPHYLLA, AND DAURICA FAMILY SERIES

Nancy Ann Halas

The last flowering season was a very interesting one in terms of the study of this series. I believe that they really do form a group of their own. First I noted that I have misspelled Wittmanniana again, since it is something like Mississippi in the double "I's" and "N's" similar of the "S's" and "P's" in the name of the American River.

We always look for similarities to tie the relationships of the Peonies together, sort of like cousins, aunts and uncles. The easiest relationship to observe is that the unripened seed pods are bright red, they turn bluish on ripening and finally look to be a black. The other similarity is that they are hard to pronounce, some of which are real tongue twisters.

There are misconceptions as well. For example Wittmanniana is supposed to be difficult to grow, actually it isn't. Rather it is hard to identify. Macrophylla is supposed to be dwarf with huge leaves. This isn't true either since there are both tall and short plants in the four members of this series. I have seen a Macrophylla plant that was thirty inches tall and for some time I didn't think that it was Macrophylla except the flowers were white and the leaves were characteristic. However the largest leaves that I have personally witnessed have been on a Wittmanniana plant.

According to Stern, the sure fire way to determine if it is Wittmanniana is that the filaments will be red and those of Mlokosewitschii will be yellow on the flowers. Then again the Wittmannian series are supposed to be hairy or "Villous". In the old time movies the bad person was the Villian, as reference to the fact that he had a beard and was hairy. In fact Japanese relate barbarians with hairy faced persons, in their language. I had to get a fifty power magnifying microscope to determine the hairs on the back of the leaves of the series. Wittmannians and Macrophylla had the most, but Mlokosewitschii had the very least, even to the point of being smooth.

What does all of this mean? It means that nobody ever had enough plants of any species to really qualitatively determine what the true characteristics of the particular series was. I'm still not certain about the definitiveness, except that the concept of color, tallness, shortness, leaf size, among other features is still to be accurately established. I feel that as the facts develop that we will be more convinced that this is one natural family.
However it takes a long time to grow all of the plants and then to discover differences between members of the same species in color, leaf size, etc.

I begin to feel that we have been like the four blind men in India trying to describe an elephant from different sensations unique to our experience. The unique sensation is perhaps a very small sample to not get a true reading of the species, but rather only the characteristics of one form.

FRUITING HABITS OF PEONY BROWNII IN THE WILD

Nancy Ann Halas

Peony Brownii grows in on the dry sides of gentle mountain slopes. It is not in flower very long and few people have ever seen it flower. The foliage is very pretty however. A curious habit is that the foliage dries up as soon as the seeds set. The seed drops while still green. The seed germinates, either in the fall or spring as soon as there is some cold rain to stimulate it.

There have been rumors that the peony Brownii blooms twice a year, in the spring and in the fall. However this has never been verified. What is more likely is that Peony Brownii blooms at the first opportunity that it gets, either spring or fall, depending upon whether there is enough moisture to arouse it from dormancy.

Since it is geared to grow in very difficult dry conditions, and very cold as well, this is a hardy plant that most likely could survive in the mid-west and parts of the north.

I would forecast that this is a likely prospect for the serious collector that wishes something a little unusual and appreciates something that is both old and new; certainly it has been around for a long time and it is well known, but it would be new in cold gardens as an invited domesticated wildflower, which is really that it is. It is native to Idaho and does well there.

It would appear to be an easier likely plant to cultivate than its cousin Peony Californica, except that both will in time be more cultivated as their habits are better known.

REPLY TO BILL SEIDL'S QUERY ON SUCKERING IN TREE PEONY GRAFTING

Mr. Seidel did not describe exactly how he grafted Tree Peonies except to say that he grafted them on Herbaceous roots.

In reference the "Book of The Peony" by Mrs. Edward Harding describes the method of grafting that Mr. Seidel probably uses or at least some variation of its on page 215. Essentially Mrs. Harding states that this method of grafting has been known in China since 1000 A.D. and is also used in France to some extent. Seeds of Peony Albiflora are sown in quantity to furnish roots. A good piece of root is selected about the size of one's middle finger and slit down from the crown about 2 inches. The scion from the tree peony should have about two eyes. It is cut in the shape of a wedge after being fitted with exactness into the slit, and bound in the usual way. The grafted root is placed in a deep pot of soil, with one eye of the moutan scion below the surface. The pot is then placed in frame. The grafting should be done in August or September so that the stock will develop roots before winter. After a seasons growth in the cold frame the peony may be planted out and cultivated in the same way as an established plant. In this way the tree peony in time develops its own roots and does not cause annoyance by suckering. At least according to Mrs. Harding.

I remember that Toicho Domoto was at one time intrigued into the possibility of using Peony Brownii as root stock, possibly because P. Brownii does not show eyes in the dormant state but develops them very rapidly once it is encouraged to grow. Whether that was the reason Mr. Domoto stated this technique not to work because of extreme suckering, I don't know; he didn't say.

SEEDLING PROPAGATION

Don Hollingsworth

Chris: 12-1-86

Just finished going through some bags of 1984 seeds left over from previous germination -- 1984 was the most recent year in which I was able to stay with the pollination chores through much of the season.

Looking at those tags astounded me again. It is so easy to forget how great the wealth of breeding materials available to us and how they are still largely untested. We have to grow many seedlings from the present generation of choice prospects before the potential is even partly tested.

There are so many of the good breeder prospects which have been around for years. In the yellows -- '**Roy Pehrson's Best Yellow**', '**Sunny Boy**', '**Cream Delight**', '**Roselette's Child**', '**Moonrise**', and their seedlings. Numerous warm pinks and patterns -- the Quad Hybrids, 'Roselette', many Saunders earlies and their descendants, '**Dawn Glow**' (Silver Dawn F3) and its descendants. The worth of these plants as parents is already demonstrated yet very few of their progeny have shown up on the show table. The opportunity is endless, and so little has been done.

The time is ripe for spectacular results in all lines of breeding potential -- and, there are many potential lines already in sight.

Of course, as soon as the next generation is established the potential lines of breeding branch off some more.

Just one problem with peony breeding – first thing you know, you're up against a space management problem. All you can do is bring the seedlings on as rapidly as possible – grow them well – then cull. In this respect I am coming more and more to appreciate the need for first class soil and the value of shading young plants in our Kansas-Missouri border climate. With respect to shading, burned leaves no longer produce food at the rate a whole leaf would; and root development is reduced. This then delays flowering maturity.

Some years ago I saw a photo slide believed taken at the Saunders Nursery. There was a slatted cover (like snow fencing) supported on posts over some plants. The implication is, of course, that they were shading some beds. If Saunders found shading beneficial in cooler Upstate New York, I probably need windbreak as well in Kansas City to approach the protection shading would provide there.

I would like to hear the comments of other seedling growers concerning their crosses, opinion of particular parents, and how to get good growth and timely flowering of seedlings.

Don:

It is true that shading is highly beneficial for growing seedlings. With use of my "Intensive Care" unit some seedlings will bloom in three years. Shading is only part of the routine -- watering and feeding, protection from weather; insects and animals all enter into the pampering. Probably all this monkey business is necessary when raising tree peony seedlings.

Herbaceous sorts need not any of this extra attention here in Michigan. They (the peony seeds) do very well out in the open but then; we don't have your burning sun to reckon with.

- Chris

TIPS FROM AN OLD GARDENER

COMPACTION:

Cultivating, especially rototilling, as a means of weed control leads to compaction 0f soil because of the frequency

During wet spells weeds thrive, thus when tilling wet soil, damage results. Pulverizing to powder eliminates air space. Also, walking down the rows, inspecting the peony plants and flowers during the growing and blooming seasons worsens a bad situation. Even weeds grumble when having to grow on a garden path!

Rain that soaks the finely pulverized soil drives out the air which roots require. Puddles standing on cultivated soil for days at a time is bad news.

Whether the freezing and thawing that our winter weather provides is or is not adequate, I don't know, but if not, then hand spading during the fall season is the only alternative. That is a most difficult chore where the garden is large!! Even a retired man looks askance at the chore of spading an acre garden of peonies.

So, stay off when the soil is soggy and wet. But what about the weeds? In 1985 the weeds took over so in 1986, in desperation, the lawn mower was used. This is a wonderful discovery even though it didn't take care of the weeds in the peony rows. Pulling these weeds by hand was a man-size job in that acre of plants -- but results were satisfactory. Mulching with a heavy layer of straw in between rows may be a partial solution to compaction, but I haven't tried it yet. You can be sure it would at least improve soil texture!

Dr. David Reath mentioned a method he uses that helps control weeds. In early September the peony plants are cut down; later in the fall, Roundup is sprayed killing all existing weeds; then again in spring before peony growth another spraying takes care of the early germinating weeds.

HAVE SEEDS – WILL TRAVEL!

Early Spring:

Peony seeds planted one to two inches deep were properly labeled but heavy rains caused them to surface and soon they inter-mixed so now they will be mutts (of uncertain parentage). While identifying them as to parentage when they bloom is still possible, it is disconcerting to find well laid plans going awry.

Mid-Summer:

July and August were months that finished the seed planting chore. Several pounds of leftover hybrid seeds were planted in rows along with old bean seed which was intended to mark the rows and hold the peony seeds in their position. This procedure is a complete success -- the peony seeds are sending out their roots and the bean bushes supplied us with fresh green beans at the late date of September 30. Now, as you readers probably know, rains rained on us all summer and performed a record drenching of 10 to 12 inches this September. The bean bushes kept everything under control; a complete success

MEDIUM TILLAGE:

Rain, rain, rain, from August through October, saturated soil and presented some very real problems, the solving of which offered a number of good ideas! The soil was too wet to cultivate or rototill and the weeds were too tall to ignore so mowing was the only option that came to mind. Cutting them down to the height of 4 inches did the job. Also it presented the thought of minimum tillage. Maybe plant residue left on the peony patch will assure better growing conditions and help to retain moisture during dry seasons.