New and Special i-hybrids

New i-hybrid R8P06, Bomb-type double form

New and Special i-hybrids

New i-hybrid R8P06, SD-D form

New and Special i-hybrids

New i-hybrid R8P04

New and Special i-hybrids

New i-hybrid R8P03


New Unnamed Pink


Smith Family Jewel

Breeding Intersectional Peonies

Long-term Secondary Goals

- Increased fertility
- More diversity in flower types and color
- More diversity in foliage types

- Changing the (herbaceous/ tree peony) ratio should provide progress on all three goals

The Potential of Other Types of Intersectional Crosses

My assessment of where we are with the intersectional cross

- With well over 1000 i-hybrids having been grow to date
  - I think we have pretty much tapped the potential of the lactiflora x lutea hybrid intersectional cross
  - Other intersectional crosses still need to be more fully explored
  - However, if the primary objective was to achieve a truely herbaceous peony with bright yellow flowers, then I am not convinced that we have reached our intended goal.
  - Advanced Generation and IBC progeny might help get us to the desired goal

Summary of the (12) different types of successful intersectional crosses that have resulted in i-hybrids

Cross	Seed Parent		Pollen Parent			Approx. Herb/Tp mix
	Forward Crosses					
IC	Lactiflora	X	(Lutea	X	Suffruticosa)	33//33/33
IC	Lactiflora	X	Suffruticosa			50/50 ?
IC	Lactiflora	X	(Potanini	X	Suffruticosa)	33//33/33
IC	Lactiflora	X	Delavayii			50/50 ?
IC	Officinalis	X	Suffruticosa			67/33
IC	Mlokosewitschii	X	Suffruticosa			50/50 ?
	Back-crosses					
IBC	Lactiflora	X	i-hybrid			66//16/16
(7)						
	Reciprocal Crosses					
RIC	Lutea Hybrid (lutea x suffruticosa)	X	Lactiflora			33//33/33
RIC	Suffruticosa	X	Lactiflora			50/50 ?
RIC	Delavayii	X	Lactiflora ?			?/?
	Reverse Back-crosses					
RIBC	i-hybrid	X	Lactiflora			66//16/16
RIBC	i-hybrid	X	Herb. Hybrid			?/?
(5)						

Recent Developments in Intersectional Peony Breeding

Three Important New Developments in the Wonderful World of Intersectional Peonies

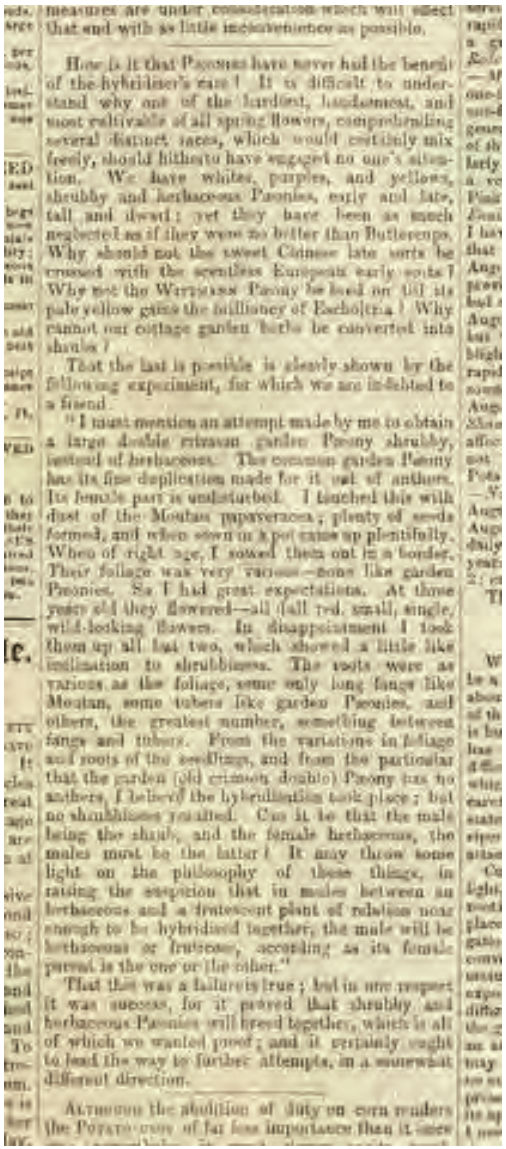
- Discovery of a very old report of a successful intersectional cross
- Discovery of a chance seedling from a new intersectional cross
- Announcement of preliminary results from the first chromosome count of an intersectional hybrid

Breeding Intersectional Peonies

An Important New Discovery

- It appears that the date of the "first" successful intersectional cross was about 100 years earlier than we previously thought
  - Reiner Jakubowski has discovered an old article dating back to 1852, which discusses a successful intersectional cross
  - Published in an old British Gardening newsletter
  - This report seems to be very credible

First report of a successful intersectional cross?



measures are under consideration which will effect
that end with as little inconvenience as possible.

How is it that Paeonies have never had the benefit
of the hybridiser's care? It is difficult to under-
stand why one of the hardiest, handsomest, and
most cultivable of all spring flowers, comprehending
several distinct races, which would certainly mix
freely, should hitherto have engaged no one's atten-
tion. We have whites, purples, and yellows,
shrubby and herbaceous Paeonies, early and late,
tall and dwarf; yet they have been as much
neglected as if they were no better than Buttercups.
Why should not the sweet Chinese late sorts be
crossed with the scentless European early sorts?
Why not the Wittmannia Paeony be bred on till its
pale yellow gains the brilliancy of Escholtzia? Why
cannot our cottage garden herbs be converted into
shrubs?

That the last is possible is clearly shown by the
following experiment, for which we are indebted to
a friend:

"I must mention an attempt made by me to obtain
a large double crimson garden Paeony shrubby,
instead of herbaceous. The common garden Paeony
has its fine duplication made for it out of anthers.
Its female part is undisturbed. I touched this with
dust of the Moutan papaveracea; plenty of seeds
formed, and when sown in a pot came up plentifully.
When of right age, I sowed them out in a border.
Their foliage was very various—some like garden
Paeonies. So I had great expectations. At three
years old they flowered—all dull red, small, single,
wild-looking flowers. In disappointment I took
them up all but two, which showed a little like
inclination to shrubbiness. The roots were as
various as the foliage, some only long fangs like
Moutan, some tubers like garden Paeonies, and
others, the greatest number, something between
fangs and tubers. From the variations in foliage
and roots of the seedlings, and from the particular
that the garden (old crimson double) Paeony has no
anthers, I believed the hybridisation took place; but
no shrubbiness resulted. Can it be that the male
being the shrub, and the female herbaceous, the
males must be the latter? It may throw some
light on the philosophy of these things, in
raising the suspicion that in males between an
herbaceous and a frutescent plant of relation near
enough to be hybridised together, the male will be
herbaceous or frutescent, according as its female
parent is the one or the other."

That this was a failure is true; but in one respect
it was success, for it proved that shrubby and
herbaceous Paeonies will breed together, which is all
of which we wanted proof; and it certainly ought
to lead the way to further attempts, in a somewhat
different direction.

Although the abolition of duty on corn renders
the Potato-crop of far less importance than it once

1852 article from British gardening newsletter

Breeding Intersectional Peonies

Summary of the 1852 Report

- The cross was: *Officinalis rubra plena* x *suffruticosa*
  - This is, of course, an intersectional cross
  - but it is especially interesting since officinalis is a tetraploid
  - Therefore, the cross was a (4n x 2n) i-cross
  - and thus, the progeny should have been triploids
  - but, with a 2:1 herbaceous/tree peony ratio
  - which is the opposite of modern day i-hybrids

Breeding Intersectional Peonies

A Summary of the results of this 1852 intersectional cross

- First, many seeds were obtained and grew
- These plants flowered as 3 year olds
- The progeny of this Officinalis x suffruticosa cross were:
  - Primarily herbaceous in growth habit with no significant signs of shrubbiness
  - Flowers were all small singles described as dull red in color
  - Foliage and roots were quite variable, but mostly intermediate between the two parents
  - This result seems consistent with the expectation for a 4n x 2n intersectional cross

Other Types of Intersectional Crosses

Exploring the potential of the officinalis x suffruticosa i-cross

- The Officinalis x suffruticosa cross has the potential to produce some interesting and different i-hybrids
  - The reverse cross may also be successful
  - Other similar crosses might also work as well
  - Such as:
  - Officinalis x AGLH (if successful, might give tetraploid progeny)
  - It is also interesting to note that suffruticosa pollen has produced real i-hybrids when used on Mlokosewitschii
  - Thus, (Mloko x suffruticosa) ref. Paeonia newsletter, V30N2

Recent Developments in Intersectional Peony Breeding

Another Important Recent Discovery in the World of Intersectional Peonies

- A grower in Germany recently discovered a chance hybrid seedling growing among a large group of p. delavayii seedlings in his garden.
  - This remarkable new i-hybrid, was discovered by Wolfgang Giessler and recently registered with the APS under the name "Yes We Can"
  - This new hybrid is clearly a new type of i-hybrid
  - And exhibits a few remarkable characteristics

Recent Developments in Intersectional Peony Breeding

What makes "Yes We Can" so Unique and Important

- Appears to be the first known successful cross between (p. delavayii x p. lactiflora) ??
  - It is from a rare reverse intersectional cross
  - Similar to the reverse i-cross which gave my "Impossible Dream" (i.e., suffruticosa x lactiflora)
  - This new i-hybrid exhibits an extraordinary number of sidebuds, producing up to 25 flowers per stem

New Reciprocal Cross i-Hybrid

Yes We Can (Giessler, 2013)

New Reciprocal Cross i-Hybrid

Foliage of "Yes We Can" (Giessler, 2013)

New Reciprocal Cross i-Hybrid

Plant and growth habit of "Yes We Can" (Giessler, 2013)

Important New Data on the Intersectional Hybrids

Chromosome Counts on the i-hybrids and their tp parents, the AGLH, have been lacking for far too many years

- Now, thanks to the extraordinary efforts of Belgium scientist, (and APS member) Geert Vetters, we finally have an extensive database of excellent microscopic images of dividing cells from root-tip squashes of various intersectional and tree peony hybrids, which is summarized below:
  - Database includes 243 files with over 1000 images
  - Data includes 17 different peonies in all
  - Including 10 i-hybrids and 4 AGLH + 1 F_1LH + 2 species

Chromosome counts on the intersectional and tree peony hybrids

Preliminary Chromosome Counts Performed

Recently, I began the process of searching the database and selecting countable images in order to perform preliminary chromosome counts.

- To date, 10 preliminary counts on 7 different peonies have been completed
- These include Garden Treasure, Golden Era, Golden Experience and Alice Harding

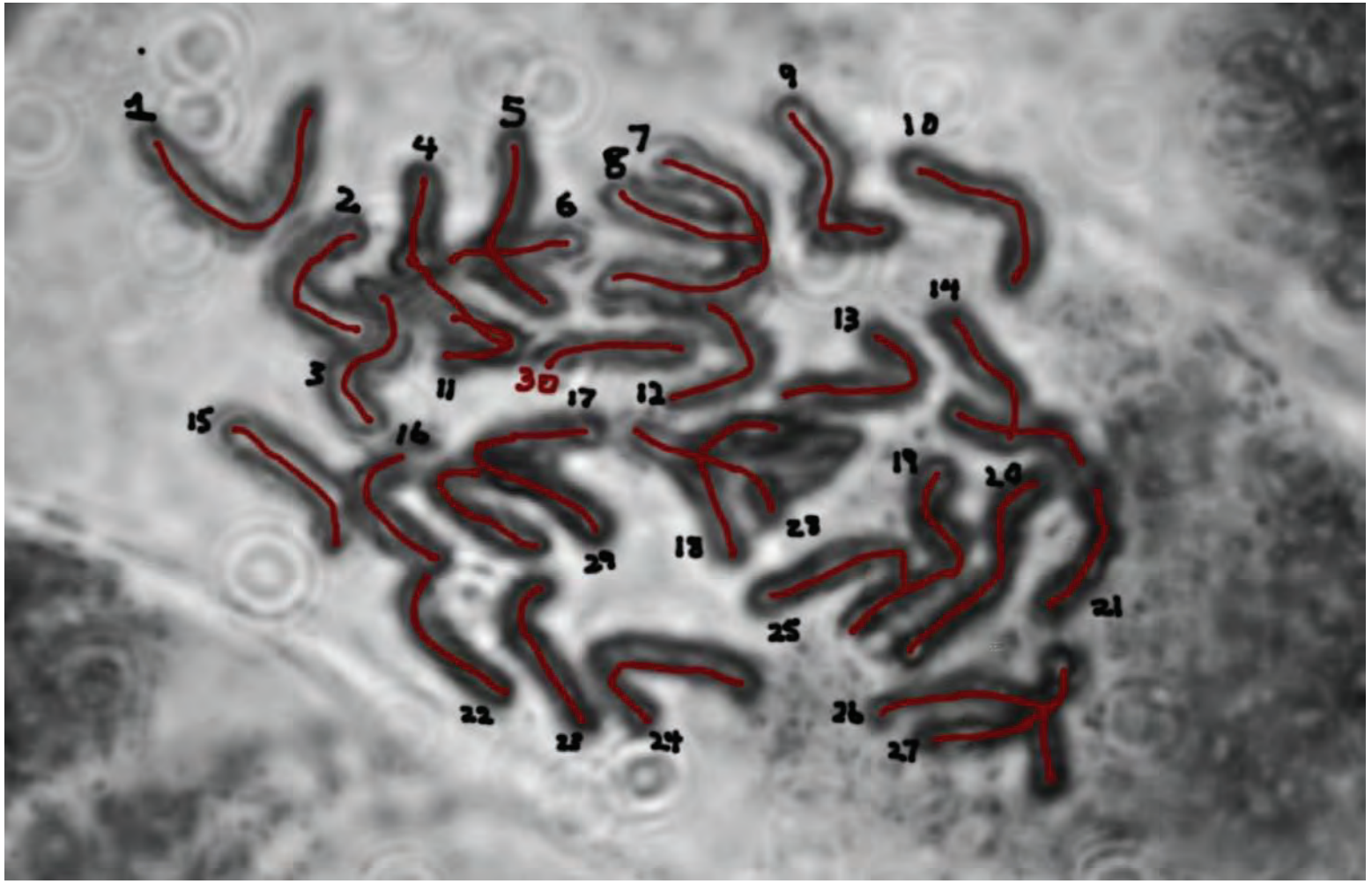
Summary of Preliminary Chromosome Counts

Variety Name	Number of Cells Counted	Preliminary Chromosome Count	Ploidy Level	Polyploid Type
Garden Treasure	2	15	3n	Triploid
Golden Era	3	10	2n	Diploid
Golden Experience	1	10	2n	Diploid
Hesphestos	1	15	3n	Triploid
Leda	1	15	3n	Triploid
Alice Harding	1	10	2n	Diploid
P. Veitchi	1	10	2n	Diploid

Peony chromosomes from root-tip squashes

A composite (stacked) photo of the chromosomes of p. veitchi (2n = 10)

Intersectional Peony Chromosome count from a root-tip squash



A photo of the chromosomes of the intersectional hybrid, Garden Treasure in the metaphase of mitosis with the chromosomes numbered and highlighted in red (N = 30)

Summary of Other Peony Samples Waiting to be Counted

Variety Name	Peony Type	Preliminary Chromosome Count	Ploidy Level	Presumed Polyploid Type
Singing in the Rain	i-hybrid	-	-	Triploid
Yellow Doodle Dandy	i-hybrid	-	-	Triploid
Yankee Doodle Dandy	i-hybrid	-	-	Triploid
Seq. Sunshine	i-hybrid	-	-	Triploid
Smith Family Yellow	i-hybrid	-	-	Triploid
Scrum-didley-umptuous	i-hybrid	-	-	Triploid
Candy Cane	i-hybrid	-	-	Triploid
Visions of Sugar Plums	i-hybrid	-	-	Triploid
Julia Rose	i-hybrid	-	-	Triploid
P. Suffruticosa	species	-	-	Diploid

Intersectionals in Bloom

Pink Passion

Candy Cane

Yankee Doodle Dandy

Strawberry Blonde

Smith Family Jewel

Magical Mystery Tour

Intersectionals in Bloom

Pink Passion

Impossible Dream

Singing in the Rain

Candy Cane

Smith Family Jewel

Pink Double Dandy

Intersectionals in Bloom

My garden in bloom during mid-June

Full Bomb-type Doubles

One example of an intersectional hybrid with bomb-type full double flowers

Under Appreciated and/or Little Known Characteristic of the Intersectional Hybrid Group

Multiple flowers per stem are characteristic of the intersectional hybrid group

Unique characteristics of intersectional sidebud flowers

- Majority of i-hybrids have many excellent quality sidebuds
  - ~ 80% of my i-hybrids produce sidebuds
  - – Generally 1-3 sidebuds per stem, but sometimes as many as 5
- Sidebud flowers often as large as main bud flowers
- Sidebud flowers extend out beyond main bud flowers
- Sidebud flowers often more double than main bud flowers
- Result: Floriferous blooming with extended period of bloom

Intersectional Sidebuds

Many excellent sidebuds (1-4 per stem) give extended period of bloom (example R4P16)

Main Bud vs Sidebud Flower Comparison

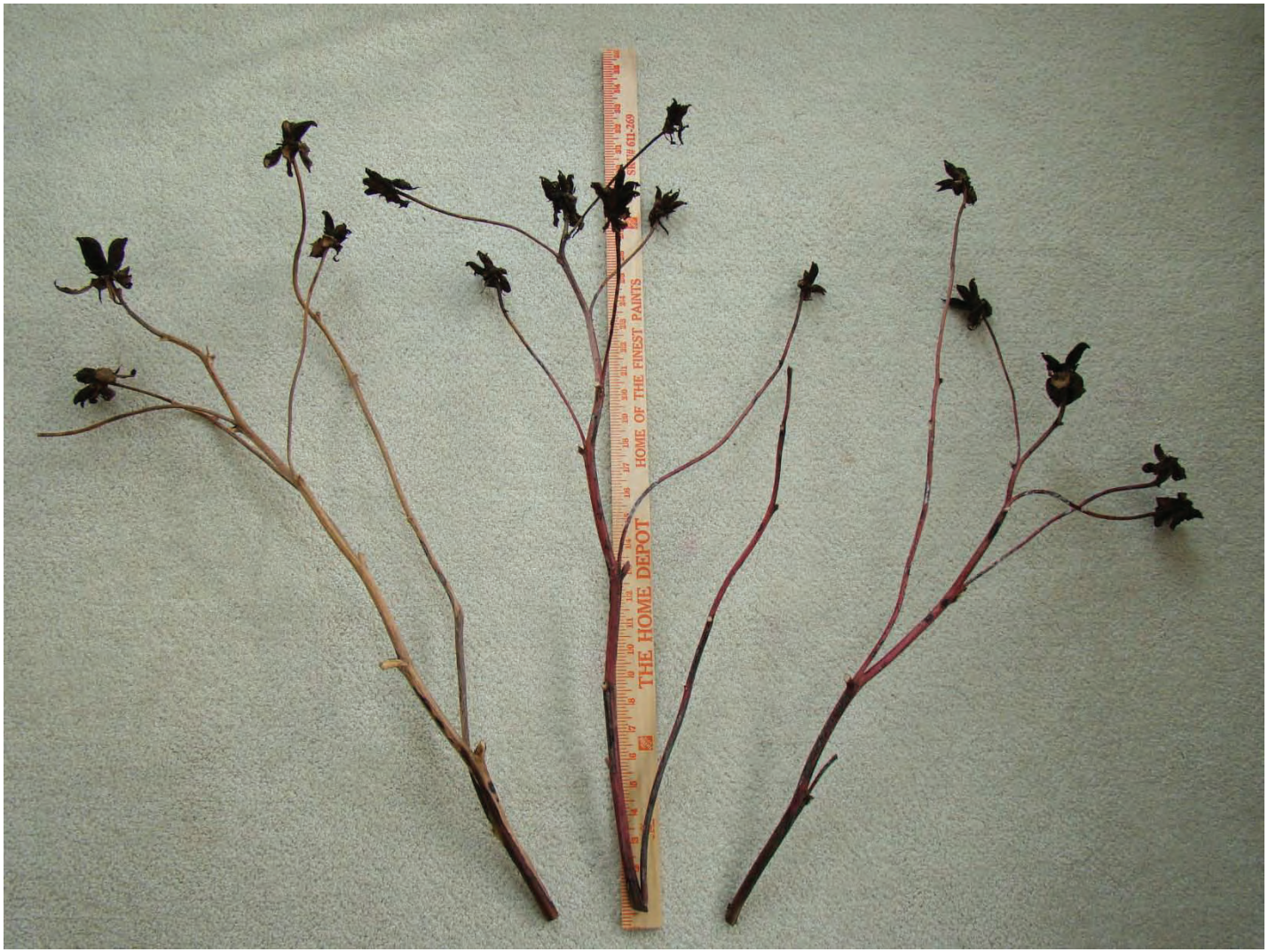
Strawberry Blonde from terminal buds

Strawberry Blonde from sidebuds

Dried Stems of Intersectional Hybrids

Stems with 5-6 sidebuds

Dried Stems of Intersectional Hybrids



Multi-sidebud stems with yardstick

Intersectional Sidebud Stems

- *Main stems exhibit deep branching with long secondary stems*
- *Sidebud stems are 6-12 and sometimes 15 inches in length*

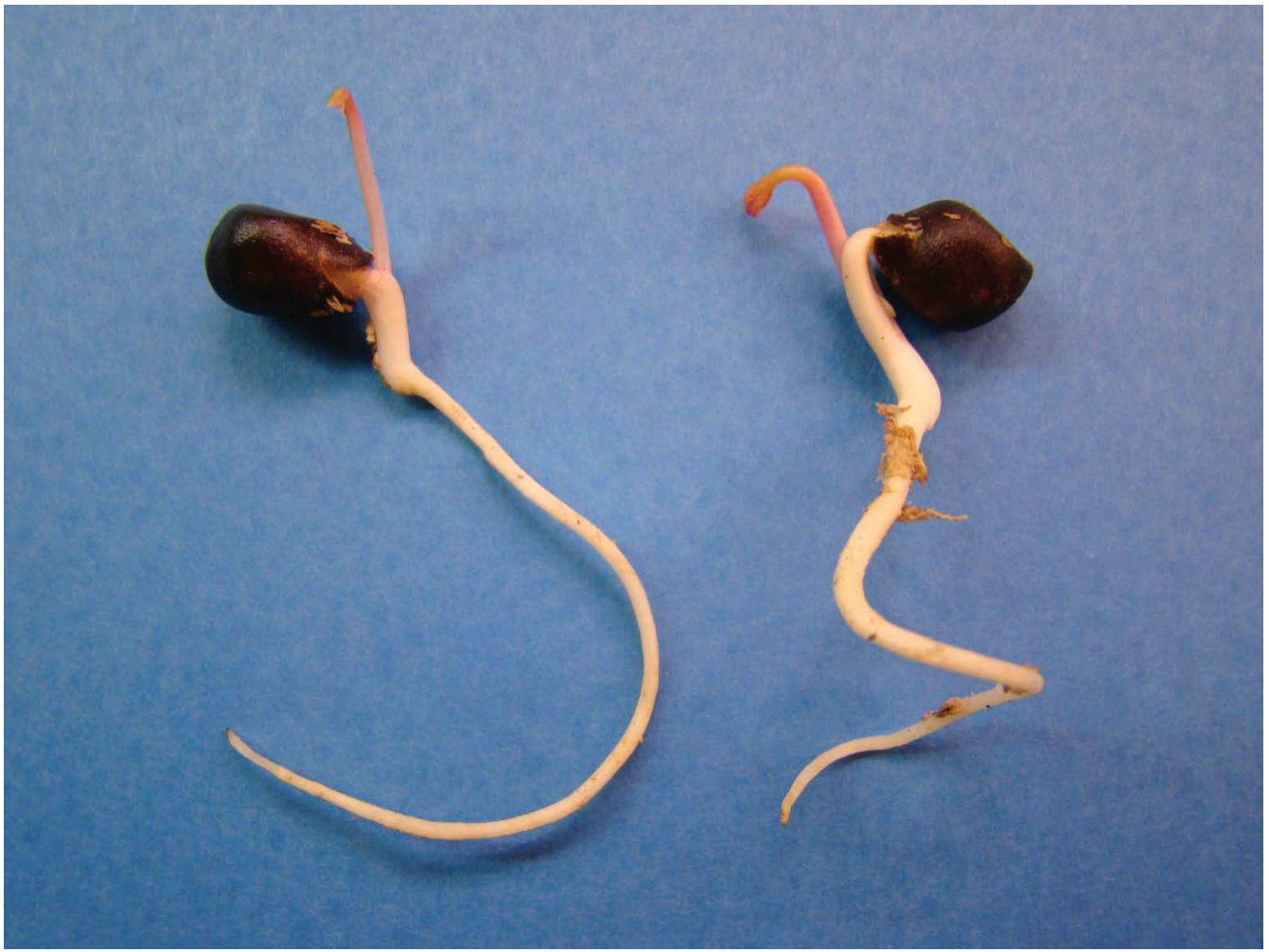
Germinating intersectional seeds using the indoor method

Bottom of seed bag after ~12 weeks

Germinating intersectional seeds using the indoor method

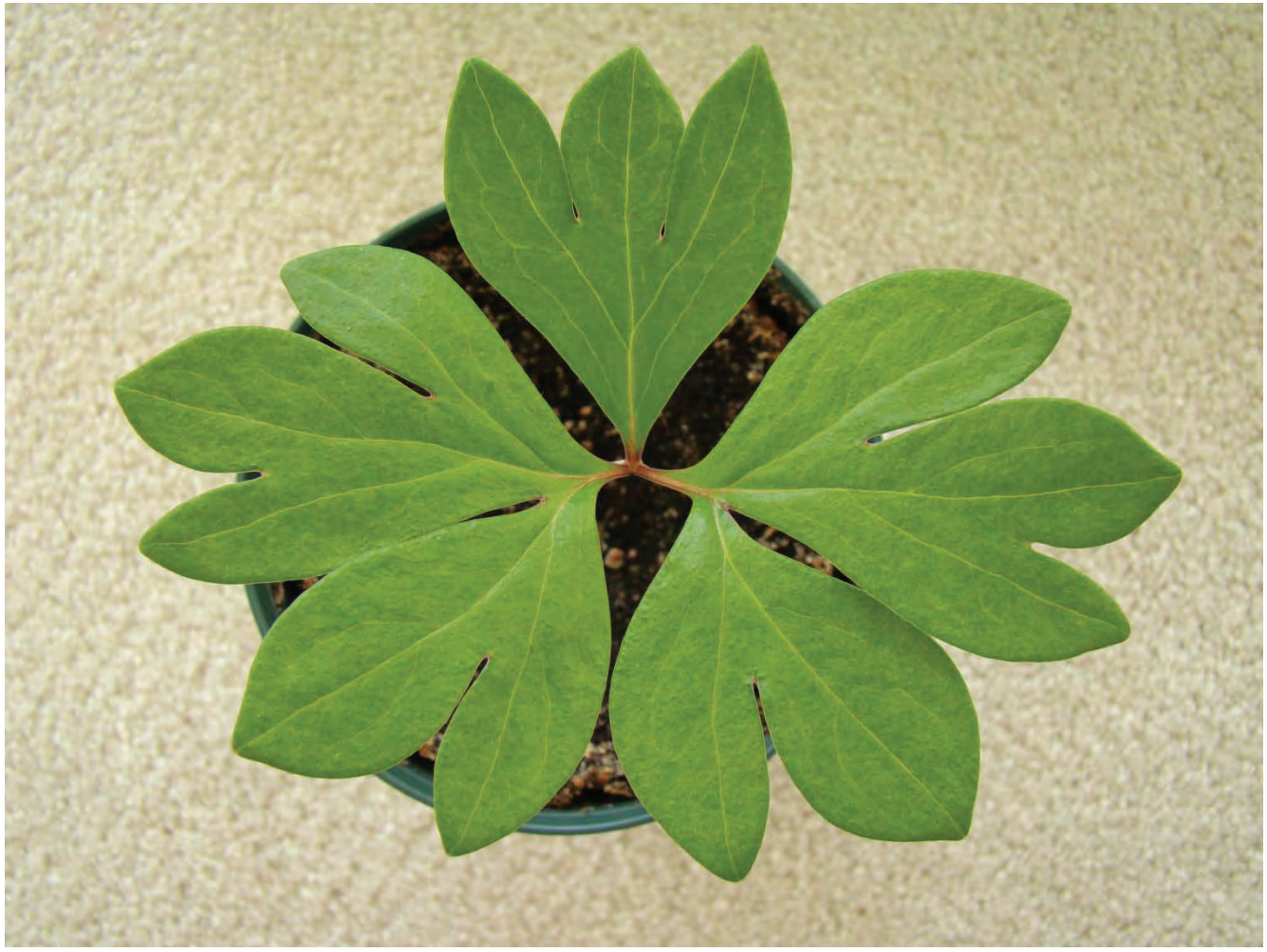
Bottom of 1 gal. size seed bags after ~12 weeks

Germinating intersectional seeds using the indoor method



Sprouted seeds after ~12 weeks of cold storage, ready for planting

Intersectional seedlings grown indoors under artificial lights



1st-year seedling ~3-4 weeks after planting

Intersectional seedlings grown indoors under artificial lights

1st-year back-cross seedling (lactiflora x i-hybrid)

Intersectional seedlings grown indoors under artificial lights

1st-year seedlings still growing on Dec. 26, 2012 after ~9 months under lights

Comments on the Propagation of Intersectional Hybrids

Intersectional Hybrids are Easily Propagated by Several Standard Methods

▶ All methods used with other peonies (herbaceous or tree peonies) have been successful with the Intersectional Hybrids

- Division
- Grafting onto herbaceous or intersectional roots
- Grafting onto delavayii roots has proved very successful
- Micro-propagation (i.e., Bud culture)

Propagation of Intersectional Peonies

In-vitro plantlets of intersectional peonies from tissue culture

In-vitro plantlets do not require sunlight until they are transferred to soil for the acclamation phase

Propagation of Intersectional Peonies

Plantlets of intersectional peonies from tissue culture

Propagation of Intersectional Peonies

Jars of in-vitro plantlets of intersectional peonies from tissue culture

TC Propagation of Intersectional Peonies

A jar of in-vitro plantlets of intersectional peonies from tissue culture in the rooting stage

TC Propagation of Intersectional Peonies

Bare-rooted Stage 3 intersectional peony plants from tissue culture

TC Propagation of Intersectional Peonies

1-year field-grown plug of an intersectional peony plant from tissue culture

Tissue Culture Plants

Display of tissue culture plants at the APS Meeting in Portland, ME

June 2005

Intersectional peony plants propagated from Tissue Culture

4 year, 3 year, and 2 year old plants along with two first year plants .
The 3 and 4 year old plants are budded up and ready to bloom.

Comments on the Propagation of Intersectional Hybrids

Propagation of intersectional peonies by "tissue culture" (TC) has been perfected over the last decade and is now a proven and preferred method of propagation

- Various TC labs in the US, Canada and abroad have now developed successful protocols for propagating the i-hybrids

- **Micro-propagation (i.e., bud culture) has become very successful and effectively replaced all other methods of propagation**
- **High quality potted plants from TC are now widely available at garden centers through-out the US at reasonable prices**

Intersectional Peony Websites

For those who may want to learn more about intersectional peonies

you can check out my websites on-line at

www.yellowpeoniesandmore.com

www.intersectionalpeonies.com