Handling Bareroot Perennials

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Bareroot perennials are a major component of the perennial industry. They can be produced domestically, or imported as washed, soil-free roots or crowns.

Bareroot crowns or divisions have both advantages and disadvantages for the perennial grower, among the following:

Advantages of bareroot:

- Available in wide assortment of major cultivars and varieties
- Available both domestically or as imported items
- Available in a range of sizes or grades
- Larger plants available in a shorter time
- Can be very cost-effective
- Plants are easily stored frozen; planting and bloom times can be staggered; cold requirements are met
- Plants can tolerate cooler temperatures after planting, compared to greenhouse-grown liners

Disadvantages of bareroot:

- Obvious distinguishing characteristics (e.g. foliage color or markings) are absent while bareroot
- Roots and crowns are very susceptible to drying (quality, vigor loss)
- Time frame of availability is somewhat limited. There is a distinct limit in seasonal availability
- Growing practices after planting need to be very carefully monitored

(continued next page)

This is the first of two articles by Dr. Miller. The next PPA Journal will include an article regarding planting depth of bareroot material (planting high).

Disadvantages of bareroot: (continued)

- Optimum/detailed storage and handling procedures per species/cultivar are not known
- Some plants do not thrive bareroot handling
- Washing of plants to remove soil (to comply with USDA-APHIS import regulations) is thought to injure roots (but, see below!)

Import of bareroot perennials and the washing process.
The volume of imported bareroot material is increasing and more sources are being developed. Import of plants from various sources is accompanied by increased monitoring of plant materials entering the United States.

A distinguishing requirement of imported roots, bulbs, and landscape plant material, is that they must be free of soil, per USDA-APHIS regulation. This is to minimize the danger of importing unwanted plant pests (e.g. nematodes) into The United States. Thus, all imported plants must be free of soil. In practice, this means roots and crowns are washed by a series of moderate to high pressure sprays. In Holland, there are a number of different machines to do this, and this activity can be conducted internally by individual export companies, or it can be contracted to one of the major "washing companies". In any case, a given lot of bareroot perennials may be washed from one to several times to fully dislodge and remove adhering soil or sand. Along with washing, high temperature and/or fungicide dips may be applied to control nematodes or diseases.

The physical impact of fairly high pressure water in combination with sand and soil particles has led many to imagine that "washing" can cause physical injury to certain bare root items. This injury would lead to pathogen entry points, perhaps cause more rapid water loss due to the injury to the root or crown epidermis (or "skin"), and generally lead to reduced regrowth potential and quality. *(See table 1 next page)*

Our research on washing.
In 2001, Cornell University initiated a cooperative research project with the Bulb Lab in Lisse, Holland, aimed at sorting out the facts related to bareroot washing. Our colleagues in Holland organized several species of perennials (*Phlox*,

Table 1. Effect of the number of washes (in Holland) on root regrowth and plant survival after 3 weeks of growth at Cornell University. Plants were planted June 26-27, 2002. Root and survival data collected July 16/17. Data are averages of two independent evaluations of root growth and plant survival. There were 40 plants per treatment. Other data are presented in table 2.

Species	Number of washes	Root rating	Percent survival	Fresh weight (g)	Final height (cm)
Epimedium	2	0	98%	5.6	10.0
	8	0	89%	4.3	10.6
Phlox	2	1.2	92%	25.2	38.3
	8	1.1	99%	23.6	39.7
Omphalodes	2	dead	0%	—	—
	8	dead	0%	—	—

Helleborus, Pulmonaria, Anemone, Delphinium, and Epimedium) to be washed 0, 2, 4, or 8 times at Helmus (the major perennial washing company in Holland). After washing, roots were packed per normal procedure, and ultimately shipped to Cornell in Ithaca, New York, where we planted them into 6" pots and evaluated root and plant growth in the greenhouse. The experiment was repeated in two different years. The unwashed controls had to remain in Holland, because of import restrictions!

Root growth was rated on a 0-5 scale where0 = no growth and 5 = many roots circling the pot more than 2 times.

The findings are very simple. There was no effect whatsoever of washing from 0 to 8 times on the rate of re-rooting, growth by season's end, or percentage survival for any plant in any year. This held true for plants exported to Ithaca, or for those that remained in Holland and were planted in fields for growth observation. Since in no one's experience are perennials ever washed 8 times, we can state with confidence that washing *per se* is not an injurious process for bareroot perennials.

Thus, regrowth or problems with uneven growth in imported bareroot perennials from the Netherlands should not be blamed on "washing". Where there are growth problems, *other factors, including the quality of the initial product as well as the attention and care given by the receiver, must be considered.*

Other Cornell-Holland research. As part of the project above, we also examined 4 other factors that might influence quality and regrowth of bareroot perennials imported into the U.S. These included: 1) drying and handling methods (after washing), 2) packaging method, 3) moisture level of the peat-moss material, 4) time of digging.

Drying method. In our work, we looked at a range of techniques in use in the Dutch industry, including temperature of post-wash drying (33 or 45F), exposure (thin or thick layer of roots), or protection (with or without some enclosure by poly film). The basic results were that there was very little difference between the treatments in rooting speed for a range of plants. In other words, the

treatments were not extreme enough to cause excessive drying of the roots. . .a condition that *is* known to reduce root growth and plant vigor.

Packaging method. We looked at several packaging methods, ranging from "wettest" to "driest": 1) Poly film with microholes, 2) poly film with larger holes, 3) poly film with double the number of holes in #2, 4) as #3, but with additional holes, and also holes in the cardboard box. Washed divisions were packed by normal procedure, held for some time in Holland, then shipped to Ithaca for regrowth. In both Ithaca and Holland, there were no differences in regrowth as a result of these treatments.

Peat moss moisture level. Roots were packed in peat moss with moisture levels ranging from 31-64%, held for some time, then shipped to Ithaca for planting and growth evaluation. These experiments were done with *Pulmonaria, Anemone, Phlox, Helleborus, Delphinium* and *Epimedium.*

The findings were that the highest moisture levels usually caused excessive sprout growth, and sometimes rooting. This was a problem as the young, etiolated growth was easily damaged, and could easily have provided entry points for pathogens. In some cases (*Delphinium* and *Phlox*), plants with the lowest and highest moisture levels showed noticeably reduced root growth 3-5 weeks after planting. There were no differences in above-ground growth at flowering, some months later. *(See two years' data in next two tables 2 &3)*

Table 2. Effect of peatmoss moisture content (based on wet weight percentage) on root growth rating taken on 21 May 2001. Dormant roots were planted at Cornell University, Ithaca, NY on 1 May 2001 in 15 cm pots with Metro Mix 360.

Species	Peat moisture content (%)	Root growth rating
Anemone 'Honorine Jobert'	38%	0.30
	42%	0.44
	50%	0.25
	60%	0.24
Delphinium elatum	38%	0.90
	42%	1.98
	50%	1.80
	60%	0.88
Helleborus orientalis	38%	0
	42%	0
	50%	0
	60%	0
Phlox paniculata 'Windsor'	38%	1.80
	42%	2.90
	50%	2.80
	60%	1.80
Pulmonaria saccharata 'Mrs. Moon'	38%	4.23
	42%	4.45
	50%	4.10
	60%	3.63

Table 3. Effect of peatmoss moisture level used to package and ship bare root perennials on root growth 3 weeks after planting at Cornell University. Plants were planted June 26-27, 2002. Root and survival data collected July 16/17. Data are averages of two independent evaluations of root growth and plant survival. n=40.

Species	Peat moisture content (%)	Root rating	% live plants	Fresh weight at flowering (g)	Height at flowering (cm)
Delphinium	31%	0.4	31%	—	—
	42%	0.1	30%	—	—
	53%	0	26%	—	—
	64%	0.4	33%	—	—
Epimedium	31%	0	93%	5.0	9.2
	42%	0	96%	4.7	9.1
	53%	0	100%	5.4	10.1
	64%	0	100%	5.6	8.0
Omphalodes	31%	0	3%	—	—
	42%	0	0%	—	—
	53%	0	0%	—	—
	64%	0	0%	—	—
Phlox	31%	1.5	89%	20.3	32.8
	42%	1.0	90%	18.9	33.4
	53%	1.7	91%	20.4	29.9
	64%	2.1	85%	22.7	33.9

Peat moss moisture level is mainly an issue for exporters and shippers of bareroot perennials, and not one for the finisher. The main conclusion to be drawn is that there is probably a greater danger from shipping plants too wet than too dry. Personal observation indicates that bareroot perennials might be shipped under very wet conditions, and this is expected to cause rooting and sprouting, and possibly real problems for the finisher.

Digging time. In the second year of the trials, we looked at digging time as a factor influencing storage potential and regrowth. Work by Art Cameron some years ago in Michigan indicated that digging time is a critical factor for storability of bare root perennials. We re-examined digging time using Dutch-grown *Delphinium, Helenium, Phlox,* and *Solidago* plants that were lifted from weeks 40 to 51. After lifting, roots were washed, packed, held frozen in Holland till late May, then shipped to Ithaca to arrive in mid-June. We planted them in 6" pots, and evaluated growth.

Delphinium had a strong reaction to digging time, with early and very late lifting being detrimental to both survival and growth. Roots dug weeks 40 or 43 had 0 or 13% survival. Roots dug in week 46 (mid-November) has 76% survival, with less survival to 35% at week 51. Growth data followed this same optimum. The other three species were much less affected by lifting time, but *Phlox* growth was reduced by about 1/3 at the earliest digging time. *(Table 4)*

In general, perennials should not be dug too early. From a range of research findings, we know that lifting before the full onset of dormancy yields roots that are not able to handle long term storage, that might be more sensitive to freezing storage, or that are more susceptible to disease or rot problems. The problem is further compounded by the often mild nature of the Dutch climate in the fall; hard freezes might not occur until late December, if at all.

Other factors . . Planting depth. The standard advice when planting perennials is to "plant them at the same depth as they were before lifting". With washed, bareroot divisions, it is impossible to determine the depth the plants were before lifting. We have conducted several trials in the last year looking at planting depth as a

Table 4. Root rating and survival of perennials dug and washed in Holland between weeks 40-51, processed, and planted in Ithaca, NY June 26-27. Root and survival data collected 15 July 2002. Data are averages of two independent evaluations of root growth and plant survival. n=40.

Species	Dig week	Root rating	Percent survive	Fresh weight (g)	Height(cm) flowering
Delphinium	40	dead	0%	0	—
	43	0.0	13%	0	—
	46	1.2	76%	45.3	—
	49	1.1	55%	35.3	—
	51	0.7	35%	19.1	—
Helenium	40	2.9	94%	84.1	102.2
	43	2.4	95%	89.9	100.1
	46	2.9	100%	82.5	96.9
	49	3.0	100%	87.6	103.0
	51	3.1	100%	85.0	105.8
Phlox	40	1.3	100%	44.5	36.9
	43	2.3	100%	46.7	49.1
	46	2.9	100%	66.6	47.9
	49	2.4	100%	68.8	44.4
	51	2.7	100%	66.7	46.5
Solidago	40	1.8	82%	39.3	66.8
	43	3.3	100%	41.0	61.4
	46	3.5	100%	43.0	64.7
	49	3.6	100%	39.4	62.6
	51	3.8	100%	47.7	60.3

factor in bareroot regrowth. We used a range of bareroot perennials kindly supplied by Eric Olson and Jack de Vroomen of Jac. Th. de Vroomen (Holland).

We used 1 gallon containers, MetroMix 360, and planted crowns so the dormant buds were at or slightly above the media surface (planted "high"), or 1.5 in. below the surface (planted "deep"). Plants were grown in late spring or summer, in a greenhouse, and evaluated after 6-8 weeks of growth.

With some plants (*Geranium cinereum* 'Ballerina'), there was a nearly absolute aversion to deep planting. Nearly 100% of the plants failed to grow. High planting, on the other hand, resulted in nearly 100% growth. While this is an extreme example, nearly every plant evaluated showed better growth 6-8 weeks after planting if planted "high".

The following list shows species that responded favorably to "high" planting with a minimum of 15% better growth (measured by height), to as much as 4 times better growth due to high planting (*Geum*). Note also, that your experience might indicate than some plants in fact do better with "deep" planting. We have not examined all plants, nor do we intend to. It is, however, striking how many plants responded favorably to "high" planting.

The conclusion is that you should pay close attention to your planting practices, and what happens to your material before it gets set on the ground or bench. Sloppy planting on a planting machine and a bumpy trailer ride to the bed could cause roots to find themselves too deep, with marked consequences for growth. This is an example where even the highest quality product can fail due to the negligence of the grower.

Species showing markedly better growth from "high" planting, as opposed to planting with dormant buds 2-3 cm below the surface.

Aconitum
Astilbe
Athyrium
Campanula
Echinops
Epimedium
Euphorbia amygdal
Filipendula
Geranium
Geum
Helenium
Hemerocallis
Heuchera
Hosta
Iris sibirica
Liatris
Ligularia
Lysimachia
Salvia nemorosa
Sidalcea
Tradescantia
Trollius
Verbascum
Veronica

A full report of this work can be found on the web at:
http://www.hort.cornell.edu/department/faculty/wmiller/bulb/bareroot.pdf

Similar information was presented at the New York symposium, July 2004. Dr. Miller's research presented here was sponsored by the Royal Dutch Wholesalers' Association for Flowerbulbs and Nursery Stock.