

## Witches' Brooms

Have you ever wondered where all those wonderful dwarf conifers for your rock garden come from? Many of them are cultivars derived from seeds from Witches' Brooms that were grown on as seedlings for three to five years by the late Dr. Sidney Waxman at his nursery at the UCONN Horticulture Research center in Storrs, Connecticut. At least 40 Waxman cultivars, mostly conifers, can be found in the nursery trade. For over 30 years Dr. Waxman collected seeds from Witches' Brooms to produce seedlings that were about 50 percent dwarf or semi-dwarf and 50 percent normal or standard. The reason for this split is very simple: Witches' Brooms produce only female flowers; so the cones have to be fertilized by "normal" male cone pollen. At one point, late in his life, it is estimated that Dr. Waxman had over 200,000 seedlings growing in his vast nursery at the University of Connecticut.

Witches' Brooms are dense, brush-like clusters of weak shoots growing from one spot on a tree (or more rarely on a shrub) mostly on pines, hemlocks, larches, and Japanese Umbrella pines. Early in his career, Dr. Waxman shot the Brooms out of trees with his 22 rifle; later he employed tree climbers. From the seeds collected from the Brooms, Dr. Waxman grew seedlings. He wanted to see what the next generation of mutations would look like. He evaluated them for desirability and, frequently, sent superior clippings free to various sites. One such site is our own Mt. Cuba, which has had five white pines derived from seeds from Witches' Brooms growing on the West Slope Path since 1987 according to Jeanne Frett. Waxman did not send seeds "because of the inherent unpredictability" of cultivating something that began as a genetic mutation.

Witches' Brooms can be caused by environmental stresses (where the growing tips of branches are injured), or by the host's response to organisms like insects, mites, viruses, fungi (especially *Taphrina betulina* fungus on Birch trees), parasitic plants (like dwarf mistletoes) or, more rarely, spontaneous genetic mutations.

**Disease causes:** living organisms enter the tree, stimulate extra growth on one shoot, feed on this extra growth, but do not harm the tree. Diseases can cause Witches' Brooms on deciduous trees: e.g., hackberry (*Celtis occidentalis*) is attacked by both an eriophyid mite (*Eriophyes celtis*) and a powdery mildew fungus (*Sphaerotheca phytoptophila*) that causes Witches' Brooms in the Eastern United States, but not in the Northern plains. Honeysuckle (*Lonicera*) species produce high numbers of brooms in response to aphid attack, probably as a result of toxins or growth regulators in the aphid's saliva. Several types of powdery mildew (*Sphaerotheca*) cause Brooms in oaks, hackberry, and ninebark (*Physocarpus* spp). Other species subject to Witches' Brooms include various cherry (*Prunus*) species, apricots, ponderosa pine (*Pinus ponderosa*), Rocky Mountain juniper (*Juniperus scopulorum*) and ash (*Fraxinus*) species. Brooms caused by organisms are usually many in number in one tree or among a stand of trees. If twigs of Witches' Brooms are grafted onto normal rootstock, freak trees will result; hence, the attacking organism has changed the inherited growth pattern of the twigs. For example, auxin keeps the secondary, tertiary and other apexes of trees buds from growing too much; but, if cytokinin, a phytohormone, interferes with an auxin-regulated bud, these apexes will grow into a Witches' Broom.

Witches' Brooms caused by **genetic mutation** of a single bud, which are technically "chimeras," are where a portion of a plant has a genetic makeup different from the rest of the plant. These kinds of Brooms are usually found on conifers. Genetic Brooms produce only female flowers which need fertilizing by "normal" male pollen. Hence the 50%/50% yield rate cited above. But there is a wide variety within the category of "dwarfness." Some seedlings may be so dwarf that they have little aesthetic appeal. The more desirable seedlings have a moderate rate of

growth appearing as though pruned or sheered. The genetic Broom is rare with perhaps one in 10,000 to 100,000 trees having a genetic Broom. If there are many Brooms on a tree, it indicates that they are not genetic. And, for ornamental applications, the genetic Brooms allow gardeners to use woody perennials in small spaces. They require less maintenance than standard plants because their size does not require pruning. They use less water and do not require fertilizing.

Some cultivars of trees, such as *Picea orientalis* 'Tom Thumb Gold' were discovered as Witches' Brooms. Many of the well-known dwarf conifers we know began as Dr. Waxman's Witches' Broom's seedlings. The Benenson Ornamental Conifers collection at the New York Botanical Garden in 2002 received a generous number of Dr. Waxman's dwarf conifers for their Collection. Pictures of several of these Waxman conifers are included here taken by the Editor on an Academy trip to NYBG in 2010. His *Pinus strobus* 'Sea Urchin' grown from Witches' Broom seed gathered from an eastern white pine (*Pinus strobus*) is "a soft, tight mound of blue-green needles that grows to less than a foot tall and two feet across in 20 years. It is perfect for a rock garden or small backyard" (The Benenson Ornamental Conifers, NYBG, [n.d.], p. 12). Garden horticulturalists also transplanted a selection of unnamed plants from Waxman's research nursery in 2002 at the same time the Benenson conifer arboretum received Waxman's conifers, most of which are Waxman's selections of eastern white pine, Japanese red pine, and Japanese Umbrella pine. Included are such Waxman cultivars for full sun as:

*Pinus strobus* 'Sea Urchin'

*P.s.* 'Connecticut Slate'      *Pinus densiflora* 'Low Glow'

*P.s.* 'Coney Island'      *Pinus densiflora* 'Vibrant'

*P.s.* 'Green Shadow'

*P.s.* 'Golden Candles'      *Sciadopitys verticillata* 'Cynthia Waxman'

*P.s.* 'Shaggy Dog'      *S.v.* 'Joe Kozey'

*P.s.* Sonya'      *S.v.* 'Wintergreen'

*P.s.* 'U Conn Gold'

*P.s.* 'Witches' Brew'

Note: the New York Botanical Garden also has a section of the Benenson Ornamental Conifer garden devoted to **dwarf conifers for shade**: Russian arborvitae (*Microbiota decussata*), Western red cedar (*Thuja plicata* 'Cupree'), Golden eastern hemlock (*Tsuga canadensis* 'New Gold'), Weeping western hemlock (*Tsuga heterophylla* 'Thorson's Weeping'), variegated American arborvitae (*Thuja occidentalis* 'Snow Tip'), three Hinoki cypresses (*Chamaecyparis obtusa* 'Pygmaea Aurescens' and *C.o.* 'Ivan's Column' and *C.o.* 'Jean Isele'), dwarf mountain Hemlock (*Tsuga mertensiana*)

Sources: Jeanne Frett at Mt. Cuba; Ed Stevenson; Joe Scianna. "HortNote No. 4," Material Plants Program, USDA, Montana, October 2002 [<http://ftp-fc.sc.egov.usda.gov/MT/www/technical/plants/pmpubs/hortnote4.>; New York Times Sidney Waxman obituary: <http://www.cag.uconn.edu/plsc/documents/obitSidneyWaxman.pdf>; "Witches' Brooms on Trees." <http://www.ipm.iastate.edu/ipm/hortnews/2005/2-23-2005/witchesbroom.html>. "Witches' Brooms on Hackberry." <http://ipm.illinois.edu/diseases/series600/rpd662>; "The Origin of Conifer Cultivars." <http://www.coenosium.com/text399/conifero.htm>.

Sidney Waxman Conifers at New York Botanic Garden



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*Pinus strobus* 'Sea Urchin'

*Sciadopitys verticillata* 'Wintergreen'

*Pinus densiflora* 'Low Glow'



*Pinus strobus* 'Connecticut Slate'

*Sciadopitys verticillata* 'Joe Kezey'

*Pinus strobus* 'Coney Island'



*Larix laricina* 'Deborah Waxman'

*Pinus densiflora* 'Vibrant'

*Pinus strobus* unamed