Volume 3, Issue 4

COENOSIUM PUBLISHING

November 1, 2023

**Special points of interest:**

- **A cultivariant is an artificial construct.**
- **A 'Horsham' is something special.**
- **Fran Mara is a place.**
- **Meet Laughing Wolf.**
- **Self-esteem is over rated for middle schoolers.**

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# Bob's News & Musings

## THE ORIGINS OF CONIFER CULTIVARS

New garden selections of conifers are being offered for sale on a regular basis by nurseries all over the world. They originate in a few basic ways.

For example, *Picea pungens* 'St. Mary' (below-right)is a most attractive, low-mounding form of Colorado spruce that originated as a witches' broom. *Pinus strobus* 'Horsford' (below-left) is a dense bun that was discovered as a seedling growing in Vermont. *Pinus strobus* 'Sea Urchin' is a dense, bluish bun that came from a witches' broom seedling. *Picea glauca* 'Blue Teardrop' developed as a fast-growing branch, called a sport, on *Picea glauca* 'Echiniformis'.

Obviously all known cultivars had to originate in some manner. The ones just listed are a few examples of the various origins of plants. All these plants are cultivars. They are selected variants of the normal species that have garden merit and can be propagated asexually to produce duplicates of themselves. Plants that are artificially induced to grow in a desired manner by propagating selected material are not to be included in this class and are considered cultivariants. A good example of a cultivariant is *Abies procera* 'Glauca Prostrata' which is described as a flat-growing plant (p.7), but invariably produces an upright leader and eventually becomes a tree. The grafting of a side branch of *Abies* will generally produce a cultivariant exhibiting this kind of behavior (plagiotropism).

*The original witches' broom of Picea pungens 'J.B.'s Broom' is shown above and a plant propagated from the broom is shown below.*

## THE ORIGINS OF CONIFER CULTIVARS

The mechanisms that produce cultivars are not very well understood, but there are some good observations and interesting theories about the various processes at work. Cultivars tend to remain stable, and propagations grow like the parent plant. However, reversions back to species normal do sometimes occur and serve to confuse the issue (p.7). I described *Picea glauca* 'Blue Teardrop' (below-right) as originating from a fast-growing branch on *Picea glauca* 'Echiniformis' (below-lower left), itself a slow-growing cultivar. This type of activity is quite common in many species. Mutations occur in nature and are often induced by the background radiation present all around us. When cell divisions are occurring in growing tissues, they are most susceptible to damage by this radiation. If such damage occurs at the right time and place, a mutation may result. Since a typical plant of *Picea glauca* 'Echiniformis' has a high number of growing tips, it is not very surprising that such mutations occur quite often in this cultivar. In plants with a more open growth habit (fewer growing tips) such sporting is more uncommon but does occur. Sometimes this sporting affects the color of a plant instead of, or as well as, its shape or growth rate.

*Pinus strobus* 'Horsford' and *Pinus strobus* 'Sea Urchin' (below-upper left) both originated from seed. 'Horsford' was found growing in the wilds of Vermont by William Horsford while 'Sea Urchin' was grown in a controlled experiment by Sidney Waxman at the University of Connecticut. Both plants are obviously the products of mutations but as to just when the mutation of each one occurred is not so obvious. 'Horsford' may have resulted from a mutation during the sexual activity that created the seed from which it germinated. That mutation could have occurred in a cone produced by a normal specimen of *Pinus strobus*. However, the mutation may have occurred at an earlier time in a witches' broom. Then that mutation was passed on in a seed produced by the broom.

The work of Dr. Sydney Waxman at the University of Connecticut demonstrated the way that witches' brooms pass their dwarfness onto their seedlings. For over twenty years Waxman collected seed cones from witches' brooms and grew

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seedlings from them. These seedlings had a high percentage of compact and dwarf forms among them. Several exhibited enough merit and individuality to warrant cultivar designation and naming.

Witches' broom seedlings are indicative of genetic aberrations in witches' brooms since a high percentage of them tend to be dwarf and slow-growing. The percentage could easily be much higher except for the fact that almost 100% of witches' brooms that produce strobili have only female ones, and the fertilizing pollen must come from male strobili on normal parts of the tree. Other dwarf plants from seed collected in the wild and grown commercially at seedling nurseries and those found in the wild like 'Horsford' may often be produced from an unnoticed witches' broom in the region of the seed's origin. If not, then the seed was produced by a genetically damaged sperm, egg cell, or zygote.

Cultivars originating from seed behave in a stable manner and are relatively dependable. Those produced from cuttings/scions taken from a witches' broom are often another story altogether. Propagating cuttings/scions from a witches' broom is often a hit-or-miss proposition. If the broom is not genetic in origin, the propagules either fail to survive or have a very short lifespan. The cuttings/scions may also fail simply because the broom is in bad condition or very old, producing poor quality cuttings/scions.

The cultivar *Picea pungens* 'St. Mary' maintains the dense, low habit of its originating broom and is a most desirable plant. It develops into a dense cushion about three feet across and 18" high when it is twenty years old. It has a tendency for shoots to develop terminal buds that do not open in the spring, creating an irregular outline.

There are several ideas which attempt to explain the origin of a witches' broom. Most brooms are thought to be viral in origin. A virus upsets the hormonal balance in an elongating bud, causing it to grow little but produce many lateral branches. Such growth continues until the broom chokes itself or is shaded to death, provided the hormonal irregularities themselves are not fatal. If this type of broom is propagated, the progeny will fail

*Greg Williams of Vermont planted a Pinus strobus 'Horsham' under a Pinus strobus 'Torulosa' (right) and collected seed from the 'Horsham' (it is a witches' broom progeny that produces cones and viable seeds). Pinus strobus 'Mini Twists' was a dwarf seedling that resulted (left).*

*The original witches' broom of Picea pungens 'St. Mary' is shown above and a plant propagated from this broom is shown below.*

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*Abies concolor 'Conica' is a fastigiate selection grown from a seedling while the plant below was grown from a witches' broom found on a 'Conica'.*

immediately, or within just a few years. One clue that a discovered broom is of this type would be the observation of several brooms within a small area, indicating that the virus spread through the area like a disease.

Brooms that do propagate successfully are attributed to other causes. These 'other causes' have never really been defined. But some interesting facts or clues are known. Cytokinin is found at a higher than normal level in a witches' broom. Cytokinin is a hormone that does not move very freely around the plant. Its presence stimulates cell divisions. The hormone, gibberellin, which encourages shoot elongation is present at reduced levels, especially in a virally produced broom. Many shoots of reduced length result.

How these unknown agents upset the hormonal balances in a bud and how they can persist into the resulting brooms are questions that still need explanation. Since these agents apparently have a genetic influence as well, the questions are even more complex than when they first appear. Grafting a small piece of a 'nonviral' witches' broom onto a seedling will generally create a plant with the characteristics of the original broom. The hormonal imbalance apparently remains, even though a new stem and root system have been added. (Of course the broom itself was on a species-normal trunk and root system while attached to the parent tree.) Either a causative agent was in the piece of broom that was grafted, or the genetic structure of the cells was imprinted with a new hormonal code equal to that of the whole broom.

Almost all witches' brooms that have been observed to flower have been female. (*Pinus sylvestris* 'Longmore' is a male broom). If the egg cells are fertilized, the resulting seeds produce a high percentage of dwarf plants. Either the eggs have an altered genetic structure, or the causative agent is somehow encapsulated within the seed. The variation of growth rates exhibited by the seedlings, however, indicates genetic changes. A causative agent in the seeds would be expected to product a relatively uniform population of species normal and witches' broom duplicates, with little or nothing in between.

Some seedlings from witches' brooms will die at a young age, develop into weak, sickly plants, or con-

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sistently exhibit dead areas. Other seedlings from the same source will be normal in all observable ways while some will develop into compact or dense plants, and a few will become quite dwarf. Such variation within a population is thought to be due to genetic factors.

Many cultivars originate as abnormal seedlings from apparently normal parent plants or as branch mutations on otherwise normal trees. For example, *Pinus strobus* 'Fastigiata' gets very large and the branches widen as one ages. In Vermont a fastigiate *Pinus strobus* was found ('Stowe Pillar'-below left) that maintains its spire-like growth habit in spite of heavy winter and spring snows. There are several similar plants growing near the specimen pictured below, but the one being cut by Greg Williams in the photo has the best growth habit.

Any seedling population will show variations in growth habit, rate of growth, and coloration. This variation is normal but seldom produces anything that varies very much from the species norm. However, mixing genetic material between two cultivars can actually produce some exciting new garden forms as seen on page 7 where Jim Boyko is shown with some seedlings from his crosses between *Pinus strobus* 'Pendula' (pollen parent) and 'Torulosa' (seed parent).

Color mutations can occur in seedlings or on the branch of an otherwise normal tree as shown below-right with the variegation shown in *Pinus sylvestris* 'Barrie Bergman'.

Genetics appears to be a crucial factor affecting the origins of new cultivars. Although the agents affecting the needed changes in the genetics of a normal tree to produce aberrant growth or seed are not completely understood, background radiation appears to be a major causative factor. Jerry Morris found hundreds of witches' brooms throughout the Rocky Mountains and he could predict where brooms could be found based upon exposure to incoming radiation.

However nature works to produce these mutations, the process has produced a treasure trove of attractive plants for the modern homeowner.

*Witches' brooms often die due to weakness or by being shaded (above in a Pinus strobus 'Torulosa'. Below is a plant propagated from a Picea pungens 'Glauca Pendula' witches broom found in the Gotelli Collection that is nearly impossible to keep alive.*

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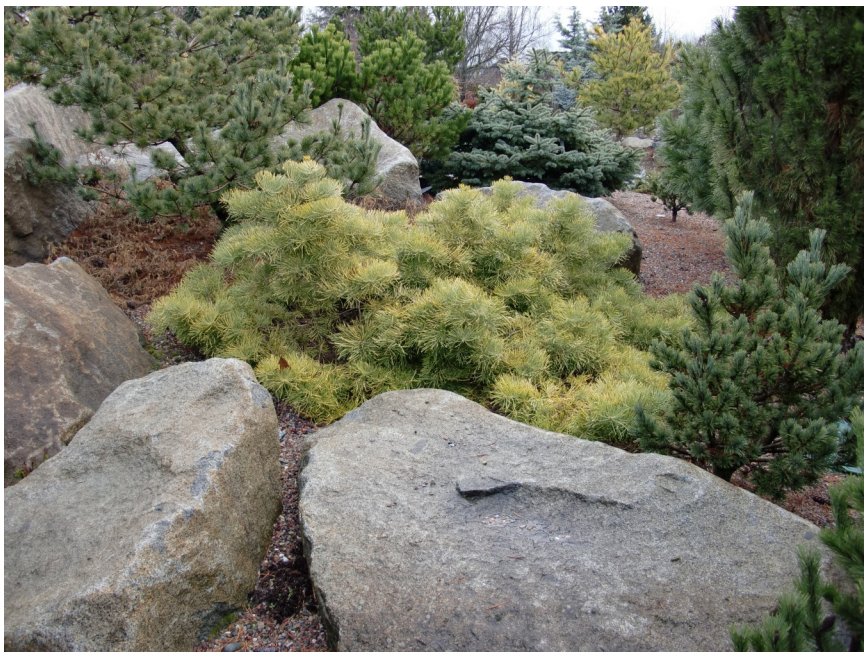
*The original sport that produced Juniperus horizontalis 'Motherlode' is shown top left while a garden specimen is shown top right.*

*Below is a golden plant that was found as a seedling and could easily be maintained as a horizontal spreader with regular removal of any terminal shoots. It is Abies concolor 'Wintergold'.*



# THE ORIGIN OF CONIFER CULTIVARS

*The Abies procera 'Glauca Prostrata', above, is an unstable selection made by grafting a side branch and always reverts to an upright tree unless new leaders are removed. It is a cultivariant (produced artificially). The two Picea pungens to the left ('Glauca Prostrata' top and 'Glauca Procumbens' bottom fit the same criteria.*

*The picture to the right shows a reversion on a Picea glauca 'Conica' that was never removed and now dominates the plant.*

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*Picea abies 'Humilis' has very "loose genes" and produces areas of variation as shown in these two pictures (left and right). The cultivar called Picea abies 'Wichtel' (below) was selected from a Picea abies 'Humilis' growing in the Hillier Arboretum by Gunter Horstmann (bottom right shows the original broom). A normal 'Humilis' can be seen in the botoom left picture on this page.*

## THE ORIGIN OF CONIFER CULTIVARS

*The Pinus strobus 'Pendula' (top left) and Pinus strobus 'Torulosa' (top right) provided hundreds of seedlings for Jim Boyko (right with Pinus strobus 'Slim Jim') in his search for a pendulous form with twisted needles and contorted branches. He made several selections from his seedlings (collected from the 'Torulosa') that have been named. To the left is Pinus strobus 'Blue Tresses' and below left is Pinus strobus 'Octopus'. Pinus strobus 'Blue Petticoats' is similar to 'Blue Tresses'. I also selected and named 'Dianne's Soft Shoulders' (prostrate) and 'Bob's Whiskers' (pendulous with clumping needles).*

*The bottom right picture shows some older seedlings offered for sale. Sold to brokers, they are probably circulating as Pinus strobus 'Pendula', an incorrect name.*