Mutations, disease, bugs, and chemicals can all amplify fireweed flowering

by Ed Berg

Diane Owen and her husband Charlie operate the Russian River ferry in the summer and return to their home in Mississippi in the winter. Diane loves flowers and gardening, and was curious about an unusual fireweed plant she spotted growing near the Russian River this summer. She sent pictures of the flowers, and later the dried plant, to Refuge headquarters after it had gone to seed.

The profusion of flowers and leaves strikes the eye in the photos, but when you see the plant in the flesh, you immediately notice the greatly flattened stem. The stem was round coming out of the ground, but higher up it broadens to about an inch wide and an eighth of an inch thick, like a fat ribbon.

I sent Dianne's photos and a description of the plant to Pat Holloway, who is a professor of horticulture at the University of Alaska-Fairbanks. Pat said that this kind of flattened stem growth is called "fasciation." She instructed me to do an internet Google image search on "fasciation," which immediately provided dozens of pictures of this phenomenon in plant species such as delphiniums, euphorbias, forsythia, foxgloves, lilies, and primulas. Pat has observed this flattened growth once in fireweed, and more frequently in delphiniums, lilacs, and in her son's cactus collection.

The term "fasciation" comes from the Latin word for band or bandage. In anatomy, a "fascia" is a flat, fibrous band of connective tissue that holds muscles and internal organs in place.

To see how this growth form gets started, it is important to know that plants grow upward from the tip (or apex) of the stem, unlike animals, which grow in all directions. The growing zone is called the apical meristem, and it is typically housed in a bud at the top of the stem or the end of a branch. The meristem itself is dome-shaped nub of rapidly dividing cells. The cells at the bottom of the nub soon specialize and form the various tissues of the young stem, such as xylem and phloem for conducting water and food, or fibrous tissues for support. The cells the top of the nub continue dividing, making new cells and replenishing the unspecialized, dividing cells. Thus the stem grows upward and taller.

Occasionally, however, normal cell division in the meristem gets derailed, and several competing zones of cell division occur within the meristem, as if the plant was trying to create several stems simultaneously side-by-side. This produces a widening of the stem, since the stem is now composed of several substems, each with it own would-be meristem at the top.

The apical meristem in a plant controls the number of leaves and flowers on the stem. It normally does this by releasing an anti-branching hormone which severely limits the number of lateral shoots that a stem can produce. This is why gardeners prune off the apical meristems (i.e., the tips) of shrubs when they want shrubs to produce a lot of lateral branches and have a "bushy" look. All gardeners understand this phenomenon of "apical dominance," even if they are unfamiliar its scientific name.

When fasciation compounds a simple meristem into multiple growing centers, each center looses some of its dominance and the stem produces many more leaves and flowers than it would with a single strongly dominant apical meristem. Hence the bushy look of this Russian River fireweed.

When I first saw Dianne's fireweed photos, I immediately thought of genetic mutation. Most of our common domestic flowers are mutations from usually smaller or less showy wild flowers. For centuries gardeners and horticulturists have been propagating the mutations that they like, and in time the favored mutations appear in our nurseries and seed catalogues. Nature of course works in similar fashion, but selects only the mutants that have traits that make them more competitive in the struggle for survival.

In some cases fasciation is caused by a genetic mutation in a cell of the meristem, and this mutation may or may not be reproduced in the offspring. More commonly, however, fasciation is caused by a disease or an insect or mite that partially destroys the meristem. The bacterium *Rhodococcus fascians*, for example, causes fasciated growth in a variety of ornamental and land-

scape plants such as chrysanthemums, impatiens, and daisies, and is a commercially important plant disease. Many plant viruses also are known to cause fasciation.

Fasciation can also be caused by chemicals, such as pesticides or plant growth hormones like cytokinin, as well as by mechanical damage such frost. It can occur anywhere the plant is growing through cell division, such as in a flower head, root, or fruit, as well as a stem.

The Russian River fireweed grew from a well-developed underground stem (rhizome), so it was probably one member of a patch of genetically identical clones. The fact that only one plant showed fasciation argues somewhat against a disease explanation in this case, as bacteria or a virus would probably have infected more than one plant. If it is a mutation, the seedling offspring may or may not show the trait. If for example the mutated gene is recessive, and the plant did not self-pollinate, then the seeds would be fertilized by nearby normal plants with dominant genes, and the offspring would all be normal, even though they carried the mutant recessive gene. If the plant did fertilize some of its own seeds, then some of these seeds could have two recessive genes and produce fasciated plants. If the mutation was a dominant gene, which is unlikely, then all the offspring would be fasciated.

We are going to plant some seeds, and also a piece of the rhizome, to see if we can recreate this growth form anew next spring. It is somewhat of a long shot, because most of the time fasciation is not caused by genetic mutation and it disappears after the present generation. But who knows, maybe in a few years, you will open up your seed catalogue, and here will be the Russian River Giant fireweed awaiting your green thumb!

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