Pennsylvania
PENNSYLVANIA NATIVE PLANT SOCIETY
notes
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The Potential Role of Epigenetics in the Origin of Regional Ecotypes

Central Illinois ecotype — mainly A. gerardii, including less S. nutans, July 10.

by Harold W. Gardner

For some time it has been known that seeds from various geographical areas show marked differences after growing into mature plants. For example, **Little Bluestem** (*Schizachyrium scoparium*) grass seeds, collected from Texas north to North Dakota, varied considerably when they grew together in one location (Cornelius 1947). Such differences in "ecotypes" referred to in this article might be more specifically defined as regional variants. Regional variations have compelled restoration organizations, such as the Illinois Nature Preserves Commission, to suggest seed collection in a 100- to 200-mile radius within the same Illinois Natural Division, particularly on an east-west orientation. I have observed striking differences in plantings of mainly **Big Bluestem** grass (*Andropogon gerardii*) mixed with less than 15% of **Indian Grass** (*Sorghastrum nutans*), when growing side by side. The illustrations (*see below*) show grass that grew in adjacent plots in Carlisle, Pennsylvania, from seed collected in central Illinois (Peoria area), compared with seed from Sherburne County, Minnesota (about 25 miles northwest of Minneapolis). What a surprising difference! The view of the non-flowering Illinois ecotype on the left is most definitely mainly *A. gerardii*, including less *S. nutans,* as confirmed by other knowledgeable persons. The regional variant from central Illinois flowers about two weeks later. In fact, tall-grass inflorescences from Minnesota can be seen in the far left background of that illustration. In addition, my Carlisle plantings of **Wild Bergamot** (*Monarda fistulosa*) flowered later if they grew from seed from central Illinois, *versus* northern Pennsylvania.

Interestingly, within about 300 years after **Tall Goldenrod** (*Solidago altissima*) and **Giant Goldenrod** (*Solidago gigantea*) were introduced into Europe, the plants transformed into regional ecotypes (Weber & Schmid 1993). That is, plants from the northern region flowered earlier and were smaller, compared with those from southern regions. Given the rate of spread of these two species of *Solidago*, the actual time would be certainly less than 300 years. It seems impossible for such specific genetic mutations to have occurred in such a short time, especially those specifically favorable to climatic conditions. Enter the new field of **epigenetics**, whereby organisms adjust to new conditions in a relatively rapid fashion without altering the basic DNA sequence.

The first reports regarded human epigenetics, which found resistance from journal publishers (Cloud 2010). Now there is a plethora of reports and mini-review series in influential journals, *e.g.*, the *Journal of Biological Chemistry* (Gottesfeld 2011). Even bacteria possess epigenetic characteristics (Casadesus & Low 2013). Recently, reports of plant epigenetics have excited plant molecular biologists, not without resistance by some plant scientists (Pennisi 2013). Of course, one can argue the point of genetic variation within species, such as hair and eye color in humans, which is a legitimate concern. New scientific discoveries, like epige-

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Southeastern Minnesota ecotype, July 10.

Note: Reprinted from *Solidago, Newsletter of the Finger Lakes Native Plant Society*, Vol. 15, No. 4, December 2014, pp. 12–13, with the author's permission.

Dear Members and Supporters,

It has been a great honor to serve as president of the PA Native Plant Society with such a dedicated and loyal group of volunteers by my side. I have served as President for four years now and I think it is time for some fresh energy and perspective. I look forward to staying active on Board and will take time this winter to review my tenure and organize my files to pass on to a next president. Debra Grim is chairing a Nomination Committee. If you or someone you know would be interested in serving on our Board, please submit the nominee's name and contact information, along with a brief statement of the nominees interest and experience to vicepresident@panativeplantsociety.org

I am thrilled to share that our 2015 Annual Meeting resulted in the formation of a committee to establish a local Chapter of PNPS in Adams County. To connect with this committee or to learn more about forming a chapter in your community please contact me at president@panativeplantsociey.org.

Two years ago we set out to establish a stronger statewide presence by holding Annual Meetings away from our headquarters in Central PA. By all accounts our 2015 meeting was a big step in the right direction. The Adams County Master Gardeners, lead by Martha Young made our Annual Meeting their own. They developed the program, set up the venue, and arranged for lunch. They manned the registration table and were wonderful hosts in every respect. The program they presented included hands on workshops that I hope will become a new tradition for PNPS Annual Meetings — we are a community that is happiest with our hands in the soil.

A committee was formed during the meeting, with the goal of establishing a local chapter of PNPS in Adams County. We will work this group to help them in their efforts to establish their Chapter and we hope that this will be a model for other local groups.

On behalf of the PNPS Board and membership I would like to thank the Penn State Master Gardeners of Adams County, especially Martha Young for their hard work and gracious hospitality.

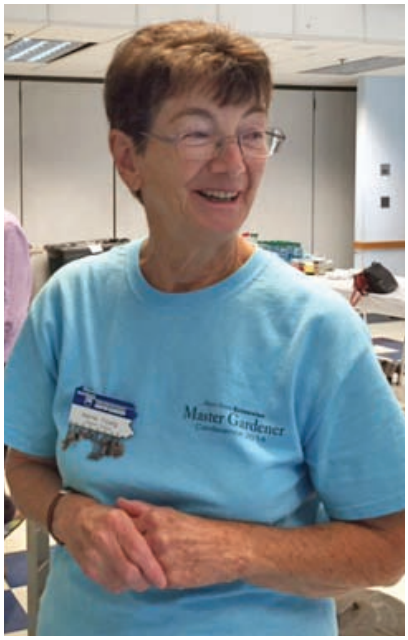
Mark your calendars for our 2016 Annual Meeting on Saturday, September 24th in State College, PA. After two years on the road, the Board has decided to bring the Annual Meeting back to Central PA, in 2016 as we search for another group to host the 2017 meeting.

Sincerely,

Jean Najjar

Jean Najjar, President

ANNUAL MEETING PHOTOS



Left: Laura Jackson and Hal Gardener putting together their bog gardens at the Annual Meeting. Right: Martha Young, Volunteer Coordinator for the 2015 Annual Meeting.

NATIVE PLANT FESTIVAL

The 2015 Central Pa Native Plant Festival at Shaver's Creek Environmental Center was a big success this year. It has been growing each year with over 600 visitors for the past two years. Many thanks to all of our vendors and volunteers who help to make the event so successful. In fact, it has become so successful that, after much discussion, we have decided that it has outgrown the Shaver's Creek venue. So mark your calendars for next year's event — Saturday, May 7, 2016 at our new location — the Boalsburg Military Shrine on Rt 322 Business in Boalsburg. We have enjoyed our collaboration with Shaver's Creek — it has provided the opportunity for us to grow the event.

Boalsburg will provide us with a lot more visibility for "drop in" visitors, as well as more parking and more space for vendors.

Education & Outreach 2015

Volunteer Lilly Najjar plays educational card game with kids at Wings in the Park.

WINGS IN THE PARK

The *Annual Wings in Park* outreach event at the Snetsinger Butterfly Garden in State College flourished in 2015 with 750 estimated attendees. *Wings in the Park*, a celebration of bees, butterflies and blossoms, is a free family friendly opportunity to educate nature enthusiasts of all ages about the importance of pollinators in our ecosystems and everyday lives.

This year PNPS introduced installed a sign **to identify the Pennsylvania Native Plant Society Demonstration garden within the Snetsinger Butterfly Garden.** The PNPS Demo continues to grow and thrive with the help of local volunteers.

Pictured around the sign the Short-toothed Mountain Mint (*Pycnanthemum muticum*) has really taken hold and has proven to be a worthy competitor in this meadow garden. Growing up to 3 feet it attracts a spectacular assortment of butterflies, moths, bees, and many beneficial insects. The profusion of tiny blossoms offered by these plants provides plenty of food throughout the summer months for a diverse array of pollinators. Soft velvety pale blue-green leaves frame the clustered white blossoms, which bloom progressively over many weeks.

New at Wings this year, PNPS introduced a new educational card game to help children learn to identify native and non-native plants. There are plans to refine this game and make it available to the public. Look for details on our website next Spring.

Join us next summer, on July 23, for *Wings in the Park* 2016!

NATIVE PLANT AND SUSTAINABILITY CONFERENCE

This November, PNPS expanded its outreach westward by participating as an information table at the 2015 Native Plant and Sustainability Conference in Pittsburgh. This conference, held annually by the Phipps Conservatory and Botanical Gardens, brings together national experts for a one-day forum on plants, landscapes and our roles as environmental stewards. Over 90 people — including home gardeners, professional landscapers and municipal planners — attended. Co-chair of the PNPS plant sale, Betsy Whitman, spoke to dozens of native plant enthusiasts who visited the PNPS table, making connections with valuable resources in Western Pennsylvania.

On the agenda were three presenters:

- Ian Caton, owner/operator of Enchanters Garden
- Karla Dakin, landscape architect
- Nette Compton, R.L.A., associate director of city part development for the Trust for Public Land

GRASS, SEDGE, RUSH WORKSHOP

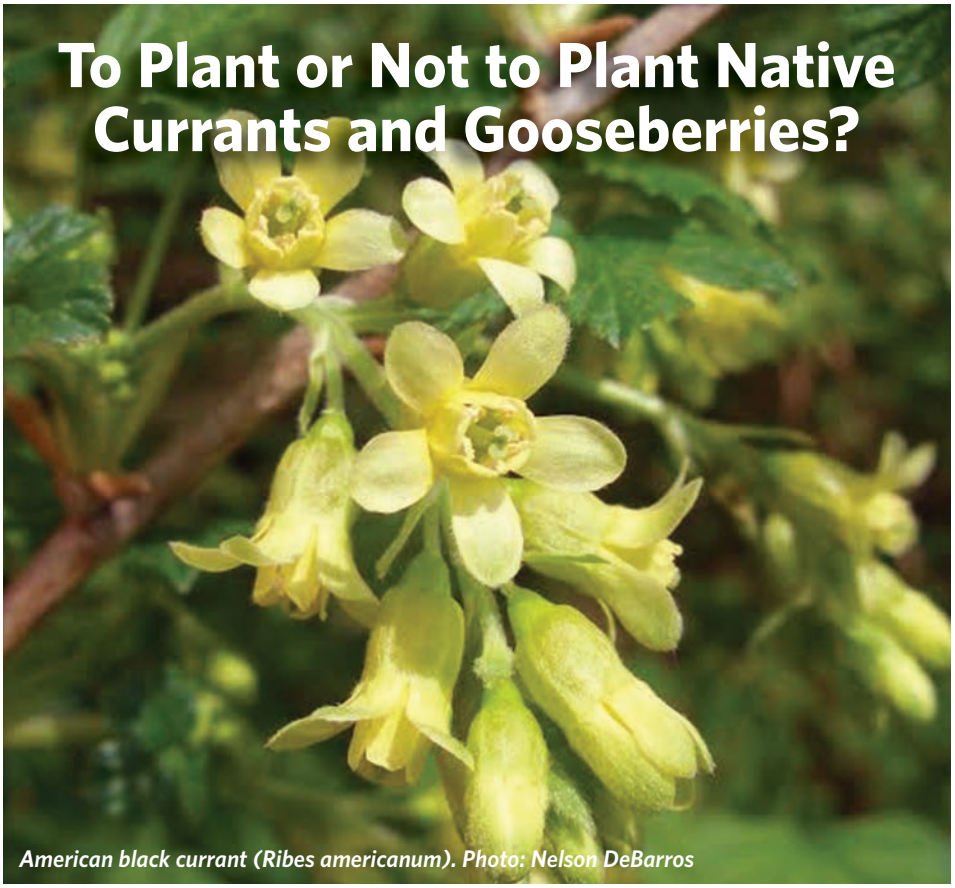
On July 9 & 10th PNPS hosted its first educational workshop on grass, sedge, and rush identification at Canoe Creek State Park. Sarah Chamberlain, botanist and Curator of the Penn State (PAC) Herbarium, instructed the 2-day workshop in which included both classroom time and fieldwork.

Classroom exercises focused on the morphological characteristics of these difficult to identify taxa and attendees were able to practice their keying skills on fresh plant material and herbarium specimens. The wetlands, streams and fields of Canoe Creek State Park provided ample opportunities to practice keying in the field with participants identifying over 30 specimens!

Attendees came from a variety of backgrounds including academia, consulting firms and government agencies. Participation was capped at 12 students, with an additional 12 on the waiting list demonstrating a desire for these types of field-based trainings. PNPS hopes to offer this and other plant identification workshops in the future as part of our new Education Initiative. If there are any workshops or trainings you would like to see in the future, please contact Sarah (sjchamberlain8@gmail.com) or Deb Grim (dsgrim02@gmail.com), co-chairs of the Education Committee.

Colleen Ashbaugh examines a rush (Juncus) specimen on the boardwalk at Canoe Creek State Park.

To Plant or Not to Plant Native Currants and Gooseberries?



American black currant (Ribes americanum). Photo: Nelson DeBarros

By Nancy Ostiguy, Ph.D., M.P.H.

Why is it a good idea to plant natives? Preventing the introduction of invasive species can be an excellent reason to stay away from non-native plants. Many invasive species have been introduced when they have accompanied plants being imported for gardens. Invasive species come in all life forms including plants, insects, molds, and fungi.

What is the connection between invasive species and the decision to plant or not plant native currants and gooseberries? The rather interesting story begins with a North American native — Eastern white pine.

Introducing eastern white pines to Europe

Eastern white pine (*Pinus strobus*) is an extremely timber valuable tree of the Northeast and Great Lakes region. Since before the Revolutionary War *P. strobus* was highly prized as ship mast because of their extremely straight habit. These trees were so desirable that Captain George Weymouth of the British Navy carried white pine seeds to England, where they are called Weymouth Pine, in 1705 to have a 'home grown' source for the ship masts. From England, *P. strobus* was planted throughout Europe.

Introducing white pine blister rust from Asia to Europe

In the meantime, the disease white pine blister rust (WPBR, *Cronartium ribicola*) was accidentally introduced to Europe from infected pine trees, Siberian stone pines (*P. sibirica*), imported from central Eurasia (east of Ural Mountains to the Pacific and south to the Himalayas). By the late 1800's WPBR outbreaks were being reported throughout Europe in various white pines (*Pinus)* species in the subgenus Stobus, sometimes called five-needle pines.

Introducing white pine blister rust from Europe to North America

By the mid-1800's in North America, improvements in logging equipment, allowing for more rapid tree removal, and the high demand for white pine lumber resulted in deforestation of large parts of Eastern Canada and Northeastern (New England) and North Central (Great Lakes) United States. Due to interest in restoring native white pine forests to supply North America with timber, and despite warnings by English and American silviculture experts, white pine seedlings grown in Germany, France and Netherland were imported to North America. Seedlings from Europe were purchased for two reasons: 1) low demand for American grown white pine seedlings resulted in depressed American production and 2) prices for seedling from European sources were significantly lower than American production costs. When tariffs were removed, trees from Europe arrive. By the mid-1890's WPBR had arrived in North America.

White pine blister rust and native currants and gooseberries

Over 100 years ago it was discovered that WPBR required two hosts — five-needle pines, including the Eastern white pine, *Pinus strobus*, and plants in the genus *Ribes* (currants and gooseberries), *Pedicularis* (louseworts) or *Castilleja* (paintbrushes). Because white pine had been such a valuable species in North America, a *Ribes* eradication effort began in 1917 by the USDA in an attempt to control WPBR in the northeastern states and protect native white pine tree stands.

Ribes and the ecology of white pine blister rust

To survive over winter, WPBR needs to infect white pine as the only *Ribes* it can use for overwintering is a coastal California species does not lose it leaves in the winter. Environmental conditions favoring WPBR include cool wet summers, topography (western or northern slopes and the bottom of hills) and frost-pockets, and features in the landscape, e.g., lakes. Generally WPBR is not found in Eastern white pine growing south of Pennsylvania because summers are too warm. It is expected, as our local climate warms, WPBR in Pennsylvania will be reduced due to warmer summers temperatures.

Non-native *Ribes* species are more susceptible to WPBR infection and produce more inoculum than native *Ribes* species. Thus, planting non-native *Ribes* species is not recommended.

Planting *Ribes* and reducing risk of white pint blister rust

The overall best growing conditions for *Ribes* species are full sun and well-drained soils with surface moisture during the growing season. Like white pine, *Ribes* species are early successional species that take advantage of disturbances in forests including recent low to moderate intensity fires or trees killed by insect or disease. Low soil nitrogen levels decrease the susceptibility of *Ribes* to WPBR. Few species of *Ribes* have been eval-

White pine (Pinus strobus)

uated for their susceptibility to WPBR and only one Pennsylvania native has been evaluated, *R. lacustre* (prickly currant); it has low susceptibility.

Planting white pine *(P. strobus)* to reduce risk of white pine blister rust

The overall best growing conditions for *P. strobus*, taking into consideration wildlife, herbivorous insects, woody and herbaceous plants, including *Ribes* species, and WPBR, are dry to moderately moist fine sands or sandy loam soils and warm, dry summers. [Nutrient-rich mesic soils provide the best growing conditions for eastern white pine but competition from other vegetation is intense in these locations resulting in a low overall plant success rate.] Seeds germinate on moist mineral soils, moss-clumps and moderate grass or deciduous leaf litter. As long as the seedlings are protected from direct sunlight, they will develop; seedlings need as little as 20% full sunlight but small trees will die without greater levels of full sun. Disturbed areas including abandoned agricultural fields, recent burned areas, eroded locations where mineral soils have been exposed, and shelterwood silviculture sites are good natural and artificial regeneration sites. Locations where WPBR is most likely to find hospitable conditions for germination on *P. strobus* include soils with high nitrogen levels, western and northern slopes, the base of slopes, frost pockets and or where clearcut and seed-tree silviculture methods have been used. Hilltops, steep slopes, western or southern aspects, low soil nitrogen, and under the forest canopy are locations with a low infection risk.

General recommendations

While WPBR can kill white pine trees, by the mid-1950s experts had concluded that it was not the primary reason for the lack of success in the establishment of white pine plantations or in the regeneration of white pine forests. Many state forestry programs and the United States Forest Service halted their *Ribes* eradication campaigns.

Even so, if you wish to plant native *Ribes* it is a good idea to not plant *P. strobus*, louseworts or scarlet paintbrush nearby. Resistant *P. strobus* and *Ribes* individuals occur naturally but the susceptibility of individual plants is not known until after a WPBR outbreak has occurred in an area. Breeding from these naturally resistant individuals has resulted in resistant plant varieties available from nurseries but genetic mutations in WPBR may reduce their efficacy. Seedlings and younger white pine trees typically are more susceptible to infection than older trees.

WPBR requires eastern white pine and one other remaining species to complete its lifecycle. In Pennsylvania the host species for WPBR include: eastern white pine (*P. strobus*), gooseberries and currants (*R. amiercanum, R. aureum, R. cynosbati, R. glandulosum, R. hirtellum, R. lacustre, R. missouriense, R. rotundifolium,* and *R. triste)*, louseworts (*P. canadensis and P. lanceolata*), and scarlet paintbrush *(C. coccinea*).

Penn State Recommendation: Destroy currants and gooseberries in and around white pine nurseries. Purchase and plant only rust-free plants. Inspect white pines frequently and prune out any infected branches, cutting 12 inches below the canker.

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Demonstration Gardens

Girl Scouts working on their demonstration garden at Millbrook Marsh.

MILLBROOK MARSH NATURE CENTER

MMNC is a 62-acre site consisting of a 12-acre farmstead area with an adjacent 50-acre wetland area. A field in the farmstead area was an abandoned nursery overgrown with invasive plants. The marsh staff decided to turn the area into a pollinator garden using all natives. Partnering with a local Girl Scout troop they transformed it into a beautiful garden.

The garden was an instant success and not just with visitors to the marsh. Hummingbirds and monarchs became frequent guests, with a constant stream of bees (so many bees!). The garden will be used for educational field trips and programs offered at MMNC. Landscaping with native plants has been implemented at other areas now, including plans to install a garden for birds with similar educational purposes. Many thanks to PNPS for the grant money to help purchase the plants!

PNPS STEWARDSHIP GARDEN

This year PNPS installed a sign to identify our demonstration plot within the Snetsinger Butterfly Garden. Pictured around the sign the Short-toothed Mountain Mint *(Pycnanthemum muticum)* has really taken hold and has proven to be a worthy competitor in this meadow garden. Growing up to 3 feet it attracts a spectacular assortment of butterflies, moths, bees, and many beneficial insects. The profusion of tiny blossoms offered by these plants provides plenty of food throughout the summer months for a diverse array of pollinators. Soft velvety pale blue-green leaves frame the clustered white blossoms, which bloom progressively over many weeks.

BELLWOOD-ANTIS MIDDLE SCHOOL

The Bellwood-Antis Middle School Environmental Education Center (EEC) was first conceived in the summer of 2010. Principal Donald Wagner saw an opportunity to create something instructive and beautiful, in some unused space on the school grounds. One grant, from Natural Biodiversity in Johnstown, paid for the design of the classroom, while additional grants from Lowes, WREN, Albemarle Chemical Company, Northern Blair Kiwanis, Operation Our Town, DeGol Brothers, and the Pennsylvania Native Plant Society funded the purchase of materials.

Since its conception, the EEC has been a great success. Over 100 students and several teachers have participated in its construction and maintenance. The next step will be to add technological support through the development of QR codes that will be placed on interpretive signs throughout the EEC. QR codes will allow students to embed videos, web sites, and other informative topics like native plants and pollinators, that visitors can view using Smartphones or other QR reading devices. Although its footprint is small, the EEC has already had a big impact on the students and has the potential to influence the larger Bellwood community as well.

WALNUT SPRINGS NATIVE PLANT GARDEN

The Penn State student chapter of the Society for Ecological Restoration (SER) joined with the town of State College, PA to restore native flora to the entrance of Walnut Springs Park on University Drive. In late Fall of 2014 students removed the invasive exotic shrub layer, predominantly European Privet and honeysuckle species. The emerging garlic mustard was removed in early Spring of 2015 to make way for native tree saplings and forest understory herbs. The plants were purchased at the Central Pennsylvania Native Plant Festival at Shaver's Creek Environmental Center with a generous donation from the Pennsylvania Native Plant Society. Several residents of the Walnut Springs neighborhood joined the Penn State SER students for the big planting day on May 3, 2015, and some donated native forest understory herbs from their own gardens. Tree saplings included in the restoration were *Quercus macrocarpa* (Bur Oak), *Celtis occidentalis* (Hackberry), *Carya cordiformis* (Bitternut Hickory), *Carpinus caroliniana* (Hornbeam), *Asimina triloba* (Paw Paw), *Viburnum lentago* (Nannyberry), *Sambucus canadensis* (Black Elderberry), and *Magnolia acuminate* (Cucumber-Tree Magnolia). The student group posted an informational sign on the ecological benefits of restoring with native plants in the Fall of 2015, and will continue to monitor the health of the restored site. Contact chapter member Katy Barlow (kmb513@psu.edu) for more information and if you would like to be a part of future work.

Penn State SER students plant native trees at Walnut Springs Park in State College.

PNPS partners with other groups to support a variety of educational projects. To learn more email president@panativeplantsociety.org

The Potential Role of Epigenetics

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netics, are not without detractors, such as Darwin's Theory of Evolution, and Watson and Crick's structure of DNA. Epigenetics effects its "magic" by methylating or demethylating specific cytosines in DNA, causing changes in expression (Chen & Riggs 2011).

Additionally, chromatin histone proteins are involved in changing DNA expression through biochemical modification, such as acetylation, methylation, phosphorylation, or small peptide changes (Zaidi *et al.* 2011; Wang & Patel 2011). Also implicated are small noncoding RNAs (Zhang & Rossi 2011), as well as histone chaperones (Winkler & Luger 2011). In the 2013 *Science* (*News*) article cited above, Pennisi reported results of research with the cultivated crucifer ***Arabidopsis,*** stating that "heritable changes in plant flowering time and other traits were the result of epigenetics alone, unaided by any (DNA) sequence changes." It is noted that plant flowering time is exactly the issue I have seen with tall-grass Big Bluestem and Indian Grass, as well as *Monarda fistulosa*. Others reported the same regional effect with *Solidago* species (Weber and Schmid 1993).

A good start has been made with *Arabidopsis* epigenetic research in explaining the origin of plant changes. If further research should conclusively demonstrate epigenetic control of regional variants, then collection of seeds from specific locales would become less important. Thus, some future seed from a misplaced plant may adapt to the new geographical conditions causing a stable epigenetic line. With one caveat, the use of local seed would be advantageous in obtaining relatively quick results from plants that already possess regional adaptation. In conclusion, plants may have far more "smarts," in a brainless epigenetic sense, than we give them credit for.

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We are a closed group in order to minimize spam, but we welcome everyone who is interested in sharing and learning about native plants.

2016 EVENTS

MAY 7 • SATURDAY
Central Pennsylvania Native Plant Festival
Boalsburg Military Museum
Boalsburg, PA

JULY 7 & 8 • THURS & FRI
Grass, Sedge and Rush ID with Sarah Chamberlain
Canoe Creek State Park
Hollidaysburg, PA

JULY 23 • SATURDAY
Wings In the Park
www.snetsingerbutterflygarden.org
Snetsinger Butterfly Garden in Tudek
Park, State College, PA

SEPTEMBER 24 • SATURDAY
PNPS Annual Meeting
State College, PA

NOVEMBER 18 & 19 • FRI & SAT
Pennsylvania Botany Symposium
www.pabotany.org
Penn Stater Hotel and Conference Center
State College, PA

For more information on these and other events please visit our website: ***www.panativeplantsociety.org***