



## Natural Products

HIGH VALUE PERSONAL CARE PRODUCTS AND ENVIRONMENTAL BENEFITS FROM NATIVE MINNESOTA PLANTS

### Overview

Strategic placement of native perennial plants on Minnesota's landscape has been identified as a way to improve our environment. Native perennials grown in mixed plantings or polycultures can sequester carbon and nitrate, prevent soil erosion, increase water filtration, and provide wildlife and pollinator habitat. They have great potential for inclusion in well head protection and water buffering areas. The cultivation of native plant polycultures has garnered attention throughout the Midwest as a source of revenue in the form of bioenergy while providing ecosystem services in agricultural areas.

However, revenues from the bioenergy market alone have been insufficient to sustain cultivation of this system. High-value end uses of native plant products are being investigated to further incentivize restoration of native polycultures across the Minnesota landscape.

Plants produce a wide variety of specialized metabolites, many of which have been identified as containing properties useful for human products like pharmaceutical drugs, pigments, and fragrances. Consumer demand for natural products in personal care items has contributed to rapidly increasing demand for organic personal care products that contain plant-based ingredients. University researchers are working to identify high-value antimicrobial compounds that have cosmetic applications from several dozen native Minnesotan plants in wild areas. The strategic inclusion of these plants into polycultures could increase the value of restoring native perennial plant systems for Minnesota growers, resulting in benefits for the environment and creating a local economy around natural compound production for the Minnesota cosmetics industry.

# Current Status and Goals

Investments made in faculty, graduate and undergraduate students, and community collaborators support conducting plant collection, field research, and identification of plant metabolites.

## Activities:

Previous work at the University under the Forever Green Initiative evaluated the antimicrobial and antioxidant activity of compounds from 336 native and naturalized plants of interest, and identified several dozen plant species as promising candidates for large-scale production and commercialization of the natural compounds they produce.

For example, two antimicrobial compounds of commercial interest that showed significant antimicrobial activity against *Staphylococcus aureus* and *Pseudomonas aeruginosa* were identified in the native forbs sweet fern (*Comptonia peregrina*) and wild licorice (*Glycyrrhiza lepidota*). In addition, the common native prairie forbs purple coneflower (*Echinacea purpurea*), showy tick trefoil (*Desmodium canadense*), and Canada milk vetch (*Astragalus canadensis*) were identified as promising candidates for production of natural compounds for the cosmetics industry.

## Outcomes:

- Continue large-scale screening of native and naturalized plants for potentially important compounds, and optimize chemical methods for extraction and isolation of natural plant compounds of interest.
- Identify particular ecotypes within species that produce the greatest quantity of the plant compounds of interest, as well as identifying agronomic management methods to optimize production of natural plant compounds in the herbage, roots, and flowers of native forbs.
- Quantify and compare ecosystem services for native pollinators between agroecosystem types (monoculture, low-diversity polyculture, and high-diversity polyculture plantings).
- Promote integration of native perennial plants onto existing agricultural lands, marginal lands, and riparian buffer areas.
- Connect Minnesota farmers with existing industries and support the creation of a new industry around natural plant products and native plant polycultures in Minnesota agroecosystems.

# Pilot Studies

The native perennials and natural products team at the University is currently cultivating purple coneflower, showy tick trefoil, and Canada milk vetch at the University of Minnesota Research and Outreach Centers in Becker and Rosemount.

Herbage, roots, and flowers have been harvested from these native forbs, and the effects of the plant community structure on production of the active chemicals are being evaluated between monoculture and polyculture plantings of these three forbs. Monocultures of each forb species and two polycultures were established. Ecosystem services, including habitat provision, are being evaluated by measuring pollinator visitations, floral density, pollen availability, and nectar quantity and quality in all planting types. Untargeted metabolomics analyses and comprehensive informatics approaches will be conducted to investigate the effects of planting density and community composition on the production of chemical compounds of interest within the three forb species.

## COMMERCIALIZATION PLAN

The organic and natural personal care market has shown continual growth and demand is expected to increase in the future, thus we will continue to pursue agricultural production of natural plant products for this industry. We will continue to develop and optimize methods for the isolation, characterization, and utilization of natural products from native plants. We will seek out opportunities where we can use the research and development model to collaborate with local companies involved in the production of personal care products, and form partnerships between these companies and Minnesota growers.

## TIMELINE

Ongoing research will continue until we have been able to test all potential native plants with potential to yield natural products. We are designing high-throughput methods for rapid analysis of biologically-active natural products of commercial interest.



Additionally, germplasm of eight native plants of commercial interest was collected from three dozen ecoregions across the state of Minnesota and established in a common garden on the St. Paul campus for evaluation of compound production among plant ecotypes. As some ecotypes within plant species produce greater quantities of certain compounds than others, evaluation of different ecotypes will contribute to maximization of yield of the plant compounds of interest.