USDA National Agroforestry Center

Inside Agroforestry

VOLUME 26 ISSUE 1

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SO MANY TREES

TO CHOOSE FROM

A popular catch-phrase in agroforestry circles is "the right tree in the right place for the right reason." The words are simple enough, but implementation is much more complicated and difficult to achieve.

The process of selecting the right trees and shrubs for an agroforestry system begins with the producer's goals. Are they focused on production, some function such as water quality, habitat, or modifying wind speeds, or a combination of several goals? What species and varieties can meet those goals? "I want to grow chestnuts or elderberries because I think there is a good market for them," is just the beginning. It is also necessary to determine if that species or a variety will not just grow, but thrive on the site you have chosen.

There is more to it than simply comparing plant hardiness zones. Varieties and hybrids vary in production as well as in the soils, slopes and even altitude required for optimal growth.

Once the species and varieties are narrowed down the hunt begins. Are they available as bare root or potted plants? Can you buy them in bulk? Maybe you need to buy scion wood to graft to your root stock. Or maybe you will choose to collect seed and go into production.

The following articles highlight some of these questions as well as potential solutions for establishing a productive agroforestry enterprise.

NAC Director's Corner

A commentary on the status of agroforestry by Susan Stein, NAC Director

This issue of *Inside Agroforestry* highlights a variety of considerations for identifying and acquiring productive plants to achieve producer goals. We hope that this opens the door a bit wider to the types of tools and information resources available. As you take the plant selection journey, please know that there are many resources available at USDA. I have featured a few here:

- The Natural Resources Conservation Service (NRCS) has twenty-five Plant Materials Centers (PMCs), each based in ecologically distinct areas. The role of PMCs is to evaluate plants and vegetative technologies that support USDA conservation programs and practices. https://bit.ly/NRCSPMC
- The USDA Forest Service Reforestation, Nurseries and Genetic Resources (RNGR) program mission is "To supply people who grow forest and conservation seedlings with the very latest technical information". The RNGR website includes publications, a national nursery and seed directory, and a listing of events around the country associated with reforestation, native plant production, restoration, seeds etc. https://rngr.net
- The NRCS PLANTS Database includes standardized information about plants and lichens of the U.S. and its territories. It also provides plant symbols, checklists, distributional data, species abstracts, characteristics, images, crop information, automated tools, and references. https://plants.usda.gov/java/
- Lastly, the USDA Agricultural Marketing Service manages programs that support the production and availability of local and regionally-important plants. These programs include the Federal-State Marketing Improvement Program (FSMIP), Local Food Promotion Program (LFPP), Farmers Market Promotion Program (FMPP), and Specialty Crop Block Grant Program (SCBGP). Some of these programs are managed through State Departments of Agriculture. https://www.ams.usda.gov/services/grants

We hope that these resources, as well as other ones presented in this issue of *Inside Agroforestry*, will help in your efforts to establish agroforestry systems with "the right tree, in the right place, for the right reason". Please enjoy this edition of *Inside Agroforestry*.

Sincerely,
Susan Stein

NAC's Website Has Moved!

You may notice that your old NAC links or bookmarks are not working, NAC's website has moved. The web site itself has not changed. However, if you have created bookmarks or posted NAC links on your website for specific pages or publications, they will not automatically redirect to the corresponding page at the new location. You will have to manually save or post new addresses for future use.

We apologize for the extra work for you and your web managers. Questions or concerns about website changes can be addressed to Joe Banegas at: josephpbanegas@fs.fed.us. Thank you for your continued interest in agroforestry and NAC!

The USDA National Agroforestry Center's website has moved to a new address:

www.fs.usda.gov/nac

Agroforestry: Enhancing Resiliency in U.S. Agricultural Landscapes Under Changing Conditions

The USDA Forest Service recently released a report, *Agroforestry: Enhancing Resiliency in U.S. Agricultural Landscapes Under Changing Conditions.* This technical report presents the first-ever synthesis on agroforestry as a mechanism to provide mitigation and adaptation services in response to a changing climate. With contributions from more than 50 experts from the U.S., Canada, and Mexico, this report draws upon recent science and shows how tree-based management strategies can improve agricultural production and resiliency. The report can be downloaded at: https://www.fs.usda.gov/nac/publications/changing-conditions.shtml. To request printed copies, please contact gbentrup@fs.fed.us.

Selecting Plants for Adaptability

Richard Straight, National Agroforestry Center

When selecting a tree or shrub for your farm, the most significant and commonly considered factor apart from soils, is local climate. Cold is an important concern. When it comes to plants, cold kills quickly. Choosing well-adapted plants is even more crucial where production and income are concerned. Hence, it is important to consider the trends in changing climate patterns and weather variability.

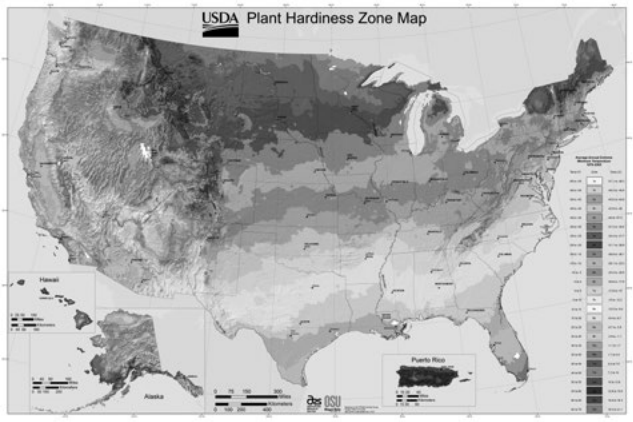
Not surprisingly most people turn to the USDA Plant Hardiness Zone map. The map is based on the average annual minimum winter temperature, divided into 10-degree-Fahrenheit zones. However, there is more to determining plant suitability than cold hardiness (the lowest temperature that the plant can endure).

The American Horticultural Society's Plant Heat Zone Map measures the other extreme: heat tolerance. The zones indicate the average number of days each year that a given region in the United States exceeds 86 degrees. That is the temperature at which many plants begin suffering physiological damage from heat.

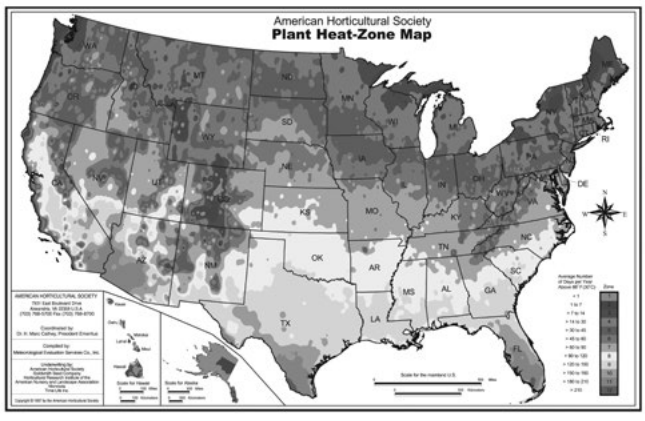
The length of the growing season and number of frost-free days are also important. These factors are key to anticipating both the risk of frost damage when buds begin to break or grow as well as the timing of plant senescence (when it shuts down for the winter). In addition, the length of the growing season impacts plant growth and fruit maturation. For known cultivars and varieties, suppliers often provide information on length of growing season required. However, these details are often not know for plants from unknown sources or native plants.

When moving native plants or plants of unknown seed source across the landscape, such as from one woodland to another, two other factors come into play: latitude and altitude. These affect the length of growing season. Plants adapted to conditions further north and higher in altitude will also be adapted for shorter growing seasons. Rough rules of thumb are "don't move a plant more than 75-100 miles north or south" and "don't move it more than 1,000 feet in elevation."

The tools and guidelines discussed here may be helpful in selecting adaptable species, cultivars and varieties for agroforestry production. Even so, remember the basics of soils, slope and precipitation!



This map is ***NOT*** the official Plant Hardiness Zone Map.
Please go to planthardiness.ars.usda.gov for the official map.



Reproduced with permission of the American Horticultural Society (www.ahsgardening.org)

Chestnut Genetics for Your Farm

Casey Dahl, Folk Tree Farm
Kate MacFarland, USDA National Agroforestry Center

"I want to plant trees!"

For many people this is the beginning of their journey into agroforestry. For other people it is the end, and not always a good place to end up.

Why we plant trees is as important as what we plant. The two are linked because our motivations, goals, and expectations will help to determine the species and specific genetics needed. If we have goals that only specific species or genetics can accomplish, we will never fulfill those goals if we don't choose our plant materials correctly.

Many people are excited to incorporate chestnuts into a wide range of agroforestry systems. Chestnuts can serve as a good example for thinking about this plant material selection process. Which chestnuts should you plant? Which species and cultivars fit your needs? How do you decide?

The lack of information about nut tree cultivars in eastern North America makes gathering information even more important. Rather than consider "what variety is best?", consider "what is best for me?" Some information on chestnuts is available through university publications, non-profit organizations, government offices, and other sources. Learning from other growers about their experiences is also very helpful in answering the question "what is best for me?"

What to consider before planting

- Cold hardiness
- Blight resistance
- Tree size
- Nut size
- How easily nuts peel
- Graft compatibility

The following species may be options:

- *Castanea dentata* (American chestnut)
- *Castanea sativa* (European chestnut)
- *Castanea crenata* (Japanese chestnut)
- *Castanea mollissima* (Chinese chestnut)

There are also a wide variety of crosses and cultivars among these species. So, how do you choose? Characteristics to consider include cold hardiness, blight resistance, tree size, nut size, ease of peeling nuts, and graft compatibility. Other factors are similar to what growers examine for all fruit and nut trees: pest and disease issues, fruit or nut yield, and market preferences or requirements.

Personal goals are important as well. For example, while many producers choose not to plant American chestnuts because of their blight susceptibility and small nut size, others may want to preserve their genetics, to trial trees from breeding programs aimed at adding blight resistance to American chestnuts, or because they live in an area of the country where there is not blight. Producers are making a wide range of choices based on individual situations – there is no one-size-fits-all solution.

Producers have several options on planting chestnuts, as seedlings or as grafted plants. Each has its advantages and disadvantages. With grafted cultivars, you are more likely to get uniform yield, performance, disease resistance, and ripening time as well as shorter timeline to production. But, grafted trees cost more (in either money or time, if you choose to grow seedlings and graft your own), can be affected by graft incompatibility, and sometimes result in lower vigor, especially in the north. Seedlings are cheaper, more vigorous, and face no danger of graft failure. However they may have poor production (size or quality of nut) and different ripening times. In addition, disease resistance and cold hardiness is uncertain. Seedlings from cultivars have an advantage over generic seedlings - because you know that at least one parent has good characteristics. In addition, grafting a cultivar to its seedling may increase the success of grafts. Some orchards are relying entirely on seedling chestnuts and doing quite well.

In the end, consider what you want to achieve with each particular component of an agroforestry system as you assess plant materials for inclusion. Reach out to producers, universities, technical assistance providers, and others in the agroforestry community to share and learn. If you do your homework first, you can find nurseries that grow what you need. This will lead to a much better outcome than relying only on what a particular nursery may have in stock.

For more information on selecting chestnut genetics for your agroforestry system, watch the "Nutshell" presentation, hosted by the Savanna Institute: https://youtu.be/_9xnZL2myMI

Seedlings vs. Grafting

- ✔ Cheaper
- ✔ More vigorous
- ✔ No danger of graft failure
- ✖ Possible lower quality
- ✖ Possible smaller nut
- ✖ Unknown disease resistance & cold resistance

- ✔ Uniform yield
- ✔ Performance
- ✔ Disease resistance
- ✔ Quicker timeline to production
- ✖ Potential graft incompatibility
- ✖ Increased cost
- ✖ Possible lower vigor

New Treat or New Threat? Deciding if a New Crop is a Risk

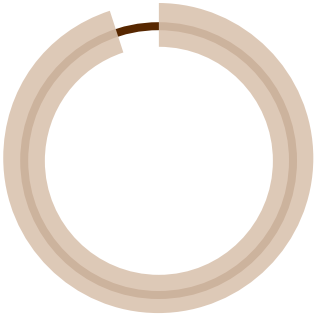
Richard Straight, USDA National Agroforestry Center

Diversifying crops to take advantage of a broader market and to hedge against risk is a proven strategy. One time-proven way to diversify crops is to find non-native plants that bear edible fruits, nuts, roots or leaves or even unique flowers and stems for crafts or decorative uses. Some introduced fruits have become so common that it is easy to forget their origins; apples, pears, cherries, citrus, plums, figs, strawberries and grapes are just a few non-native species that have become commonplace.

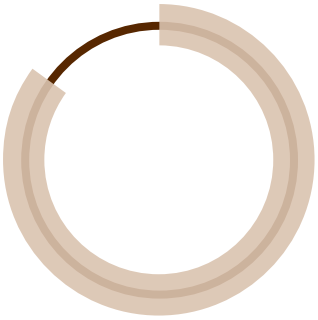
However, there is a risk associated with planting an unfamiliar non-native plant. Will it become invasive and a future management problem? Predicting the future is always difficult, especially when it comes to living systems. A safe and conservative approach is to cultivate only native plants.

Can we take advantage of what have we learned about invasive plants? Can we make an educated evaluation of the potential for an introduced plant to be invasive or become a weed? One useful tool developed for Hawaii and other Pacific Islands is the Hawai'i Pacific Weed Risk Assessment, HPWRA, https://sites.google.com/site/weedriskassessment/home. This is a screening tool to ask "background questions" about a plant before it is imported or widely planted in Hawai'i.

During the testing process of the **HPWRA tool** it was **found to be:**



95% accurate in ***catching*** the would-be **invasive plants** and



85% accurate at ***identifying*** **non-pests**.

The HPWRA is a Free Service.

More than 1900 plants have been screened to date. The updated list of completed assessments is available as a spreadsheet or pdf. If the plant in question is not on the list it can be submitted for screening via email to the HPWRA screener at hpwra@yahoo.com.

How does the HPWRA Work?

No one is required to use the HPWRA. When requested, botanists review available information to answer 49 questions about a plant's biology, ecology and invasive tendencies in other settings. The answers result in a score that predicts whether a plant is likely to be invasive in Hawai'i or other tropical Pacific islands sharing a similar climate.

Is the HPWRA a Good Predictor?

During the testing process the tool was found to be 95% accurate in catching the would-be invasive plants and 85% accurate at identifying non-pests.

What Other Tools are Available?

Other tools have been developed to help identify potentially invasive plants and other organisms. Some of these tools are regionally-focused. The Invasive Species Assessment Protocol was developed in 2004 through a partnership of the NatureServe, The Nature Conservancy and the U.S. National Park Service. This tool assesses, categorizes, and lists non-native invasive plants according to their impact on native species and natural biodiversity in a large geographical area such as a nation, state, province, or ecological region.

The protocol is offered in generalized form for others who might wish to use it to conduct similar assessments and create lists of invasive plants for other nations, states, provinces, ecological regions, or comparable areas, http://www.natureserve.org/biodiversity-science/publications/invasive-species-assessment-protocol-evaluating-non-native-plants. NatureServe is now using this protocol outside of the United States to assess the biodiversity impact of the approximately 3,500 non-native vascular plant species.

Southwest Plant Selection Tool

Adapted from NRCS - Plant Selection Tools for Revegetation Efforts in the Southwest

In California, the eVeg Guide is a tool developed by NRCS in partnership with Calflora. The search function for eVeg allows users to select plnat species for NRCS conservation practices and purposes based on the constaraints of elevation, climate, soil, and evapotranspiration zones. Plant choice may be made with either EPA Ecoregion or Calflora incidence data to ensure that only adapted plants will be chosen. Ther are also options to link to the NRCS PLANTS Database and Plant Guides to provide more information on each species. An instructional guide for eVeg is available on YouTube. (Adapted from NRCS - Plant Selection Tools for Revegetation Efforts in the Southwest.)

In Brief...

A periodic summary of agroforestry-related journal articles

John S. Weedon, Stark (OH) Soil & Water Conservation District

Different species, different results

Researchers recently compared seven hardwood species in an alley cropping system in southwest Quebec province over a five-year period. The species were *Carya ovata* (shagbark hickory), *Juglans nigra* (black walnut), *Quercus bicolor* (swamp white oak), *Quercus macrocarpa* (bur oak), *Quercus rubra* (red oak), *Acer Saccharum* (sugar maple), and four clones of hybrid poplars.

The mean survival rate for the six hardwoods planted as 3-year-old bareroots was 70%, and the rate for hybrids 82% with no differences among the clones. Sugar maple (33%) and shagbark hickory (57%) had the lowest survival rates. The investigators also planted red oaks and sugar maples as 6-year-old root balled transplants. They had a 100% survival rate, which is consistent with other studies that indicate large-sized seedlings effectively improve tree survival.

Tree growth among the 3-year-old transplants ranged from 268 to 379 cm. Tree height of swamp white oak and bur oak was greater than shagbark hickory, black walnut, and red oak. Sugar maple height was intermediate. The 6-year-old transplants red oak and sugar maple grew higher than 3-year-old transplants of the same species and the cost per dm3 of stem volume was lower. Height and DBH for the hybrids ranged widely.

Tree external defects were observed on 63% of the hardwood individuals. Black walnut, swamp white oak, and bur oak had more defects than shagbark hickory, red oak, and sugar maple. Defects were observed on 55% of the hybrid poplars with variations among the clones.

Take Home Message: Because survival, growth, and defects vary widely among hardwood species, hybrid poplars, and planting stock, substituting one species or stock for another in an alley cropping system may yield different outcomes. Producers need to choose wisely.

Rivest D, Cogliastro A. 2018. Establishment success of seven hardwoods in a tree-based intercropping system in southern Quebec, Canada. Agroforest Syst. https://doi.org/10.1007/s10457-018-0211-0.

Alley Cropping's Favorite Playlist

In the past 35 years, agroforestry researchers have written 1,244 publications from 77 countries on alley cropping. On the one hand, 192 tree and 181 crop genera were studied across three climate zones. On the other hand, most research was limited to a few genera and functionalities. In the temperate zone, the majority of the studies were on *Populus* and *Juglans* for trees and *Zea, Glycine,* and *Triticum* for crops. In the subtropics, it was *Eucalyptus* and *Populous* for trees and *Zea* and *Triticum* for crops. And in the tropics, most were devoted to *Leucaena* and *Gliricidia* for trees and *Zea* and *Coffea* for crops. Moreover, agricultural function was focused as well with 82% of the studies in the temperate zone studying trees only as biomass. Going forward, the paper's authors recommend that researchers explore four rarely travelled topics: within system tree diversity; tree crops for food and fodder production; perennial alley crops; and trees for crop facilitation (via shade, nitrogen fixation, and mulch production).

Take Home Message: Most research on alley cropping has been limited to a handful of tree and crop genera and agricultural functions. Opportunities exist to broaden our knowledge of potential alley cropping systems.

Wolz KJ, DeLucia EH. 2018. Alley Cropping: Global patterns of species composition and function. Agr Ecosyst Environ. 252:61-68.

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Upcoming Events

June 24-27, 2019
North American
Agroforestry Conference
Corvallis, OR

September 22, 2018
Growing American Ginseng
Binghamton, NY
bit.ly/2Lsypaq

December 7-8 2018
Savanna Institute Perennial Farm Gathering
Madison, WI
http://www.savannainstitute.org/perennial-farm-gathering.html

For more upcoming events, visit our website calendar: *www.fs.usda.gov/nac/events*

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USDA National Agroforestry Center

NAC Mission

The USDA National Agroforestry Center (NAC) is a partnership of the Forest Service (Research & Development and State & Private Forestry) and the Natural Resources Conservation Service. NAC's staff is located at the University of Nebraska, Lincoln, NE. NAC's purpose is to accelerate the development and application of agroforestry technologies to attain more economically, environmentally, and socially sustainable land use systems by working with a national network of partners and cooperators to conduct research, develop technologies and tools, establish demonstrations, and provide useful information to natural resource professionals.

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To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at https://www.ascr.usda.gov/complaint_filing_cust.html and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by: (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410; (2) fax: (202) 690-7442; or (3) email: program.intake@usda.gov.

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