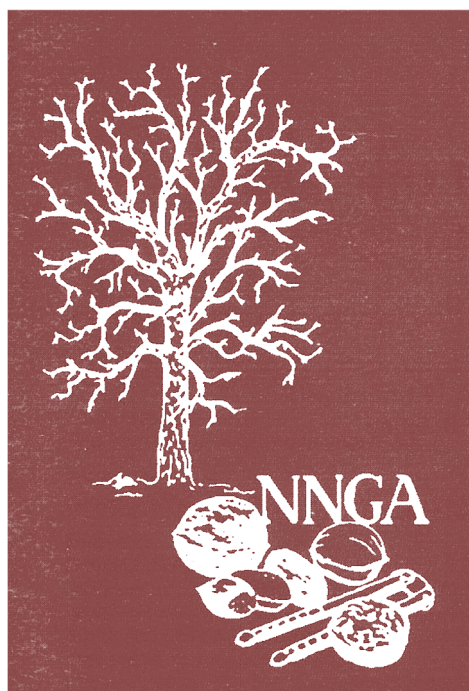


Volume 78, Issue 2
Summer 2024

The Nutshell

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The Quarterly Publication of the Northern Nut Growers Association



IN THIS ISSUE

115TH ANNUAL NNGA CONFERENCE

*To be held jointly with the
Chestnut Growers of America*

**JULY 21-24, 2024
SYRACUSE, NEW YORK**

(See page 6 for details and full schedule.)

**PERSIMMON ZONE 4B
HARDINESS PROJECT**

**NY PROJECT PROMOTING
CHESTNUT & HAZELNUT**

**FRST – NEW TOOL FOR
INTERPRETING SOIL TESTS**

**DIAGNOSING & PREVENTING
HERBICIDE INJURY**

**PRECOCITY IN SWAMP
WHITE OAK**

**FUNDAMENTALS OF TREE
PRUNING**



Ripening chestnuts on a selection made in one of Bob Stehli's orchards in Ashland County, Ohio. Bob Stehli has intentionally overplanted his orchards and aggressively thinned to remove approximately 90% of the trees while retaining only the better trees. Bob and Julie Richards, his daughter, own and manage the Ohio Chestnuts LLC Ashland Sorting Facility [Photo: Julie Richards].

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Our Mission Statement

The Northern Nut Growers Association, Inc. is a non-profit organization of people interested in growing nut and minor native fruit trees such as pawpaw and persimmon. We achieve our purpose by discussions at our annual meetings, through our publications, with our award-winning website, and through interactions with other nut growing organizations throughout North America and the world.

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Conference Site Selection Chair appoints for each conference

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About the NNGA

The **Northern Nut Growers Association, Inc.** (NNGA) is a national non-profit organization founded in 1910 for the promotion of hardy nut bearing trees and select minor fruits, their products, and their culture. It has members throughout the United States and a number of foreign countries. Our members include beginning nut enthusiasts, farmers, amateur and commercial nut growers, research station staff, teachers, nut tree breeders, nursery operators, foresters, and nut processors.

The NNGA members meet at different sites once a year, generally in July or August. We visit amateur and commercial orchards, research sites, nurseries, and nut processing plants. There are lectures on all aspects of growing nut trees for the hobbyist and the commercial nut grower. Both amateurs and professional experts are on hand to share their knowledge and experience. There are demonstrations of grafting, advice on cultivar selection for your climate and soils, nut evaluations, and displays of equipment and new products. Several members usually donate nuts for cracking and snacking on at our conferences.

The NNGA is a tax-deductible 501(c)(3) organization. Donations to the NNGA and its research fund are tax deductible and tax exempt to the extent allowable under the provisions of IRS Code 501 (c) (3). The NNGA website at www.nutgrowing.org houses an open section providing links to resources on the growing of nut trees and a member's portal for material already paid for by our members such as past conference presentations and archived issues of *The Nutshell*.

About our Publications

The NNGA publishes the quarterly *The Nutshell* and the annual Stakeholder Report. The Stakeholder Report is our administrative report to fulfill 501(c)(3) requirements. *The Nutshell* (ISSN 1093-376X) is the our quarterly journal. A subscription to *The Nutshell* and the Stakeholder Report are included in the annual dues paid by members. Members are notified by email when a new *The Nutshell* is posted in the members section. For an additional fee, a printed *The Nutshell* is mailed (include old address when sending change-of-address notice). Research and technical articles formerly part of the *Annual Report of the Northern Nut Growers Association* discontinued in 2017 are now part of *The Nutshell*. Mention of commercial enterprises or brand names does not constitute endorsement or imply preference by the Northern Nut Growers Association, Inc. nor does the Northern Nut Growers Association, Inc., its officers, or its directors assume any liability or responsibility for claims made by advertisers.

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Regional Nut Growers Meetings & Related Events

CHESTNUT BLOSSOM OPEN HOUSE AND PICNIC

June 29, 2024 | Johnsonville, NY

The Breadtree Team will host an open house and picnic at their oldest chestnut planting. Come and enjoy viewing chestnuts in bloom. For more information follow @breadtreefarms.

AGROFORESTRY DEMONSTRATION FARM TOUR

July 17, 2024, 10am—noon | Spring Green, WI

Savanna Institute. Tour the North Farm, a large-scale commercial farming and agroforestry operations. For more information go to www.savannainstitute.org/event.

NNGA/CGA JOINT ANNUAL CONFERENCE

July 21-24, 2024 | SUNY College of Environmental Sciences and Forestry, Syracuse, NY

Overview of conference, schedule of events, and list of presentations are included in this issue of *The Nutshell*. To volunteer to help at the conference or for more information contact Jerry Henkin at sproutnut@aol.com, Andy Newhouse at aenewhou@esf.edu, or nngacga2024@gmail.com. Registration is online at bit.ly/nngacga2024.

WALNUT COUNCIL ANNUAL MEETING

July 28-31, 2024 | Youngstown, OH

To volunteer to help plan or for more information contact Bill Hammit (hammitw@clemson.edu) or Liz Jackson (jackson@purdue.edu).

AGROFORESTRY DEMONSTRATION FARM TOUR

September 18, 2024, 10am—noon | Spring Green, WI

Savanna Institute. Tour the North Farm, a large-scale commercial farming and agroforestry operations. For more information go to www.savannainstitute.org/event.

INFGA FALL HARVEST MEETING

September 22, 2024 | Trafalgar, IN

Indiana Nut and Fruit Growers will hold their fall harvesting meeting at Harrell's Country Market and Orchard in Trafalgar, IN. For more information, contact Jim McKenna at mckenna3216@gmail.com.

4TH ANNUAL BIG RIVER CHESTNUT FESTIVAL

October 2, 2024, 11am—5pm | Big River Chestnut Farm, 195 River Rd, Sunderland, MA 01373

For more information go to breadtreefarms.com/events.

PERENNIAL FARM GATHERING

October 5-8, 2024 | Spring Green Campus and Monona Terrace, Madison, WI

Savanna Institute's signature event bringing together more than 600 folks to advance perennial agriculture practices. For more information see www.savannainstitute.org/pfg.

WC-MO FALL FORESTRY FIELD DAY

October 11-12, 2024 | Boone County, MO

Social gathering on Friday night and field day at the Butler Family Tree Farm, LLC in northern Boone County. Topics and speakers still TBD. For more information, contact Dennis Evans, Walnut Council – Missouri Chapter President, at dennisevans0361@gmail.com.

LOWER MIDWEST ALLEY-CROPPING FIELD WORKSHOP

Oct 18, 2024 | Horticulture and Agroforestry Research Farm, New Franklin, MO

For more information, visit the UM Center for Agroforestry website at centerforagroforestry.org/event or contact toddsc@missouri.edu.

MISSOURI CHESTNUT ROAST FESTIVAL

October 19, 2024, 10am—3pm | Horticulture and Agroforestry Research Farm, New Franklin, MO

The festival returns as a celebration of perennial agriculture in the lower Midwest. For more information, visit the UM Center for Agroforestry website at centerforagroforestry.org/event or contact toddsc@missouri.edu.

4TH ANNUAL HUDSON VALLEY NUT FESTIVAL

November 2, 2024 | Rose Hill Farm, 19 Rose Hill, Red Hook, NY 12571

Details still TBD. For more information, go to breadtreefarms.com/events.

19TH NORTH AMERICAN AGROFORESTRY CONFERENCE

July 23-25, 2025 | Columbia, MO

National conference hosted by the Association for Temperate Agroforestry. For more information, visit the UM Center for Agroforestry website at centerforagroforestry.org/event or contact toddsc@missouri.edu.

If you have an upcoming meeting or event related to temperate nut or native fruit trees and you would like the NNGA to list your event, please submit your information to editor@nutgrowing.org or a member of the Publications Committee. State nut-growing associations are strongly encouraged to submit information about their upcoming meetings and events.

Send Change of Contact Information or Address to:

Joe Hietter, NNGA Membership Coordinator
Email: help@nutgrowing.org
6475 Refuge Rd SW, Etna, OH 43062

Precocity in Swamp White Oak (*Quercus bicolor* L.) – Evaluating Acorns

Shaneka Lawson, Niall Lue Sue, & Mark Coggeshall

To facilitate effective management strategies for hardwood forests, it is essential to understand both the economic and ecological objectives associated with forest or orchard development, especially for timber and nut production. Most of the forested land within the Central Hardwood Forest Region (CHFR) is privately owned or managed by governmental agencies. As such, private landowners, or persons in management positions within governmental entities are charged with developing the land to best suit the economic/wildlife interests of the property owner. If such management options include use of reforestation seedlings, a high economic return is one of the primary goals for those planting using the most lucrative species, i.e., black cherry (*Prunus serotina*), black walnut (*Juglans nigra*), and oak (*Quercus* spp.). A secondary management goal usually includes the additional benefits to wildlife, especially for mast production.

Development and implementation of new methodologies for predicting future growth and success of fine hardwood trees is a broad goal embraced by many researchers, breeders, and landowners. Barriers to making accurate predictions of future tree performance include local influences of abiotic and biotic stressors, anecdotal evidence, incomplete recordkeeping, and unfamiliarity with such species at the local level.

Given the complexity of hardwood forest management, research endeavors are pivotal in addressing the challenges and optimizing outcomes for both economic returns and wildlife conservation. Investigations of new lines of science are needed to adequately address the current lack of improved seed/propagule sources for important

hardwood tree species in the CHFR. Genetics and environmental conditions are two major factors known to impact acorn production. Thus, closer examination of phenological events such as early flowering in hardwoods may indicate functional differences between hardwoods are influenced by soil microbial processes. In this preliminary study of swamp white oak (*Quercus bicolor* L.), acorn production is the primary focus. It is evident that assessing variability in acorn production is crucial for informing management strategies.

The goals of this work are to identify and use the most cost-effective approaches to understanding variability in mast production from a group of precocious swamp white oak. Specific questions we seek to address are:

- How does acorn size relate to mast production?
- Is there a particular family (genotype) that is precocious and high mast producing?
- Do precocious and non-precocious oaks within this stand differ in phenology?
- Do precocious and non-precocious oaks within this stand differ in root microbiome composition?
- Which methods can be used moving forward for use in expanding this project moving forward?

Drawing from insights in the literature, our study aims to unravel the intricate dynamics of mast production in swamp white oak through a multifaceted approach encompassing genetics, phenology, and environmental factors. According to older literature, acorns in some oak species are typically produced when the tree is between 50-100 years old

although some varieties may produce acorns as early as 15-20 years (Savill and Kanowski 1993; Olave *et al.* 2021). Heavy mast crops are irregular and generally occur every 4 to 7 years in this wind-pollinated species (Brooke *et al.* 2019). As we explore the drivers of acorn production, it is evident that both genetics and environmental factors play significant roles.

As with most growth phenomena, genetics and the environment share roles in early flowering and acorn development (Wang *et al.* 2005; Caignard *et al.* 2019, Olave *et al.* 2021). It is known that grafting the ortet of a precocious individual onto a suitable rootstock will result in replicating this same flowering and fruiting pattern among the resulting grafts leading to continued precocity, but little is known about what causes the precocity phenomena (Coggeshall *et al.* 2006; 2008). Further, previous studies by Dey *et al.* (2004) reported a significant increase in acorn production for those seedlings grown using the Root Production Method (RPM®) developed by Forrest Keeling Nursery (fknursery.com). It was also reported that acorn production in swamp white oak is a response to initial tree height and diameter at planting (Dey *et al.* 2004) and has been linked with early acorn production in other oak species (Grossman *et al.* 2003; Bruhn 2013). Brooke *et al.* (2019) noted acorn production increased in trees within canopy gaps, likely a function of sunlight, but remains a caveat that may be evaluated for this planting in the future. It is evident that further exploration is warranted to elucidate the mechanisms governing mast production in hardwoods, paving the way for innovative approaches in forest and orchard management and conservation.

Our study site was in New Franklin, Missouri (39.01691, -92.75043). There are a total of 157 trees present (66 parent trees, 91 offspring). For those trees producing mast, a minimum of 25 acorns were collected, though up to 100 acorns were collected on the highest mast producing trees. If yield for a tree was below 25 acorns per mast producing tree, as many acorns as possible were collected. Acorns within this planting were only collected from the lower branches of each tree. No acorns were collected from the ground to ensure the mother tree was accurately assigned to each acorn. It was noted that 12% of the trees within the planting produced very few or no acorns, while others produced significantly more mast. When the trees were 5 years old (they are currently 15 years old), a fraction of unproductive trees were thinned resulting in a series of random gaps for the remaining trees to grow. In addition, records from previous years indicated the trend for acorn production was consistent across years, with some trees producing essentially no nuts, while others produced either sparse numbers of nuts, or high numbers of nuts each year. A schematic of the site reveals where these producers are located within the stand (fig. 1).

Since some trees consistently produced copious quantities of nuts (fig. 2A), we wanted to ascertain whether there was a negative impact on growth metrics such as length, width, and weight of acorns from heavy masting trees compared to those producing fewer nuts. It was suggested by Funk (2017) and Llanderal-Mendoza et al. (2017) that climate and water-use efficiency influence acorn size. The resource partitioning required to produce larger quantities of acorns would mean those acorns would be smaller in size (length, width), while those trees expending less effort and producing fewer acorns would display larger nuts (fig. 2B and 2C). We believe this variation lies primarily with genetics and reproductive cycles. While differences in length and width were seen between acorns from

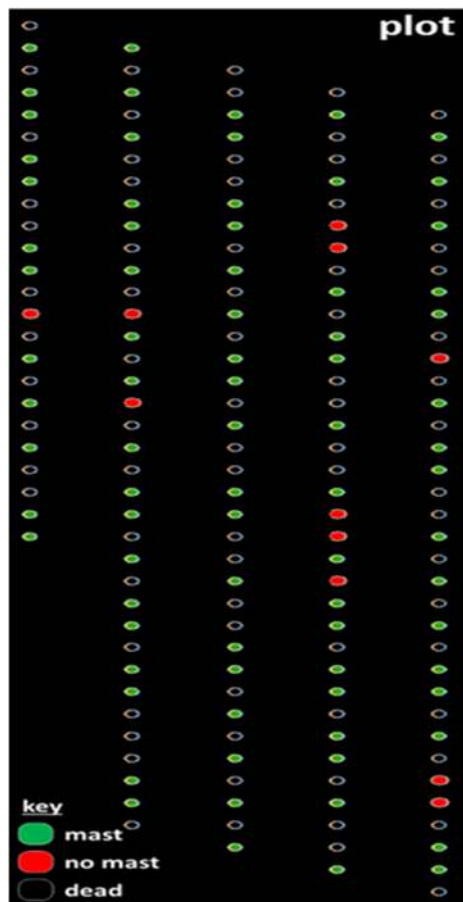


Figure 1.—Stand positioning. Illustration of field position of those swamp white oak that have or have not produced mast.

various trees, it was not correlated with past production history.

We also explored the question of whether acorn weights are as a function of productivity. Acorn weights may be correlated with production as trees producing fewer acorns may produce those with greater weights instead (fig. 2D). This too, was not significantly different across the site. A final thought was to look at the maternal origins of these trees, to ascertain if those individuals within the same family would then exhibit similar acorn productivity patterns. This approach revealed several differences as certain families, each designated a color descriptor, produced nuts almost identical in size, shape, and weight (fig. 3). This lack of variation was surprising as many of the other families differed to a greater extent. As we continue to explore new research avenues, it becomes evident that innovative methods hold promise for

further understanding and harnessing the potential of hardwood tree species.

Examination of characteristics aside from these acorn metrics such as phenology and microbiome composition are also currently being considered. Gougherty and Gougherty (2018) investigated the development of flowers and leaves in native, deciduous angiosperm tree species in the Great Lakes region of North America and the potential links between flowering and other phenological events. They specifically noted events such as fine root production and twig growth as worthy of continued investigations as efforts to link these have not been thoroughly studied in the context of overall fruiting performance of a tree. Phenology (bud break only considering the size of the trees) will be addressed next spring. It is essential to consider the broader ecological context of tree growth and development when exploring the relationship between phenological events and mast production.

Research methodologies such as sequencing to reveal bacterial and fungal compositions, offer promising avenues for understanding belowground environmental conditions and their impact on tree physiology. In the last decade, use of sequencing to reveal bacterial and fungal compositions beneath forested stands, agriculture fields, and fallow lands has become a hot topic for research. Xu *et al.* (2023) indicated that additional work targeting the microbiome is needed to gain a better understanding of belowground environmental conditions with a particular emphasis placed on soil physicochemical properties and microbial communities.

We would also like to investigate whether below-ground processes differ beneath precocious and non-precocious swamp white oak trees. Rubin *et al.*, (2014), reported plant growth promoting rhizobacteria (PGPR) were associated with plant roots and the root zone

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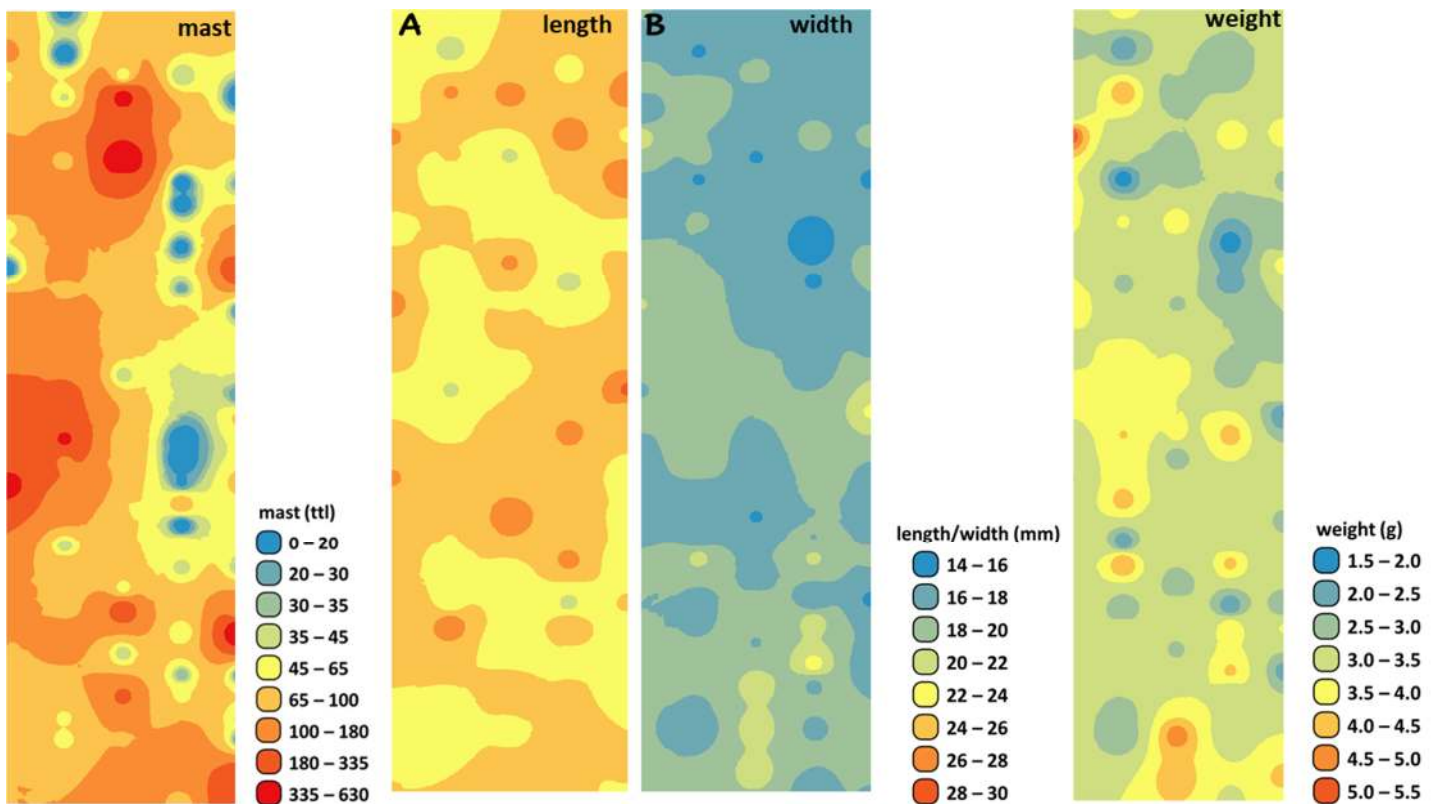


Figure 2.—A) Nut volume. Illustration of average mast production among swamp white oak and their location within the plot. NOTE: Unbalanced comparisons could not be helped as some individuals only produced a few acorns. B) Average swamp white oak acorn lengths within the plot. C) Average swamp white oak acorn widths within the plot. D) Acorn mass for twenty-five acorns collected from each tree (when possible).

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(rhizosphere) making this a distinct possibility. These bacteria have been shown to produce enzymes, metabolites, and influence root nutrient uptake. Because of these diverse activities, there may be a link between bacterial species and the role of the microbiome in early flowering. When elucidating the role of below-ground processes in mast production, it is essential to consider the potential interactions between soil microbial communities and tree physiology.

While at the 2023 Northern Nut Growers/ Chestnut Growers of America and Walnut Council Joint Conference in Columbia, MO, a fresh soil sample was collected from the 7-10" horizon beside each standing tree and from those areas where trees died or were removed. All samples were stored on ice, before being driven back to Purdue and prepped for immediate DNA extraction. This represents significant cost savings, as no

one would need to be hired to perform that portion of the project. As funds are obtained, these samples will be sequenced for both bacteria, fungi, and flowering-specific primers will be used for general amplification of these genes to look for mutations.

During field presentations at the 2023 Conference, ideas for additional studies into the induction of flowering in swamp white oak (*Q. bicolor*) were solicited. Two methods were proposed by meeting attendees including gibberellic acid application and girdling. In fruit species, such as mango (*Mangifera indica* L.), application of potassium nitrate is extensively used to induce flower production and maximize fruit growth (Bondad and Linsangan 1979; Prates *et al.* 2021). For conifers, research into use of gibberellic acid, specifically GA₄ and GA₇, alone or in tandem with other growth hormones, to induce cone formation has been conducted for decades (Ross and Bower 1991). Numerous studies of genera

within the Pinaceae family have shown this method to be highly effective on conifer species [contact the authors for a species list and literature citations]. Gibberellic acid has been shown to increase male flower initiation in English walnut (*Juglans regia* L.) (Hassankhah *et al.* 2018).

Consideration of the broader context of horticultural techniques used in other tree species are important as we explore potential methods for inducing flowering.

While this method was proven to be successful in some research studies, there were unexpected results. Interestingly, some studies noted a variability in the male and female response to this treatment (Vargas-Hernández and Vargas-Abonce, 2016) while other researchers reported considerable phyto-toxic effects following the injections leading to stem and flower dieback. These effects were usually reversed the following year (Shearer *et al.* 1999). Die back of primary needles and some terminal and lateral branches occurred on approximately half to nearly

all the study trees, but not the controls. Trees exhibiting this damage usually recovered the following year.

The presence of severe stress can also induce floral production. Girdling is a process typically used to kill tree by removing a strip of bark around the circumference of the trunk. Incomplete or partial girdling allows the tree to continue obtaining nutrients and can also be used to stimulate flowering as a stress response (Ross and Bower 1991; Vargas-Hernández and Vargas-Abonce, 2016). Effective in many species, this method has been used effectively in aspen (*Populus tremula*) (Lihavainen *et al.* 2021), English oak (*Quercus robur* L.) and silver birch (*Betula pendula* Roth.) (Percival and Smiley 2015). Typically, gibberellin application is used in combination with girdling to take advantage of the heightened stress levels and maximize the potential for eliciting the desired response (Bonnet-Masimbert 1982; Ross and Bower 1991; Smith 1998; Shearer *et al.* 1999; Kong *et al.* 2008; Gutierrez *et al.* 2012). Considering the potential risks associated with flower induction treatments, we aim to explore alternative methods that minimize adverse effects on tree health.

Despite the support of previous research groups, Ross (1991) shared that girdling was unable to stimulate flower production in Douglas-fir, whether alone or in combination with GA_{4/7}. This work also stated that root pruning effectively induced flowering. Li *et al.* (2021) reported that girdling in conifers (e.g.,

Japanese larch (*Larix leptolepis*), ponderosa pine (*P. ponderosa*), white pine (*Pinus strobus*)) must be done following a set of guidelines. Selected trees should be growing in good soil, healthy, and free of pests and disease. Girdles should also be 1.2 m above the ground (1-2 cm below dbh). Increased flower production should be seen in the following 3-5 years. The procedure should be performed one month before bud differentiation, which is not well known or established in most hardwood tree species, and nutrients should be provided to aid in the recovery process. In addition, Prates *et al.* (2021) supported the use of girdling in tropical and subtropical regions for mango cultivars. They further stated that the practice of girdling on branches was extraordinarily successful in organic fruit orchards. In our search for effective flower induction techniques, it is essential to consider the species-specific requirements and potential risks associated with each method.

It is apparent from the literature that flower induction treatment results varied greatly and sometimes resulted in detrimental health effects across a variety of tree species (Wheeler *et al.* 1985; Moncur and Hasan 1994; Ülger *et al.* 2018; Ito *et al.* 2021). None of the aforementioned studies were in *Quercus* spp. thus, verification of the effectiveness of this technique will come only after additional experimentation to identify the most effective flower induction procedure. Thus, as this planting is the only one of its kind and is incredibly useful because of the

known genetic variation within, the least invasive option to consider will likely include some sort of gibberellic acid applications in the future. Other horticultural methods such as drought treatments, fertilization, paclobutrazol application, and pruning may also prove to be effective in stimulating flower induction in oaks. We seek to prioritize novel approaches to induce flowering that minimize potential risks to tree health and maximize effectiveness across diverse environmental conditions.

As we continue to think outside of the box for new research approaches, additional methods or ideas for how to proceed are always welcomed. Precocity is a much sought-after trait in fine hardwoods, and we feel it is prudent to apply the experiences gained here to other oak plantings in the future to gain additional insights into the mechanisms and interactions associated with mast production in oaks.

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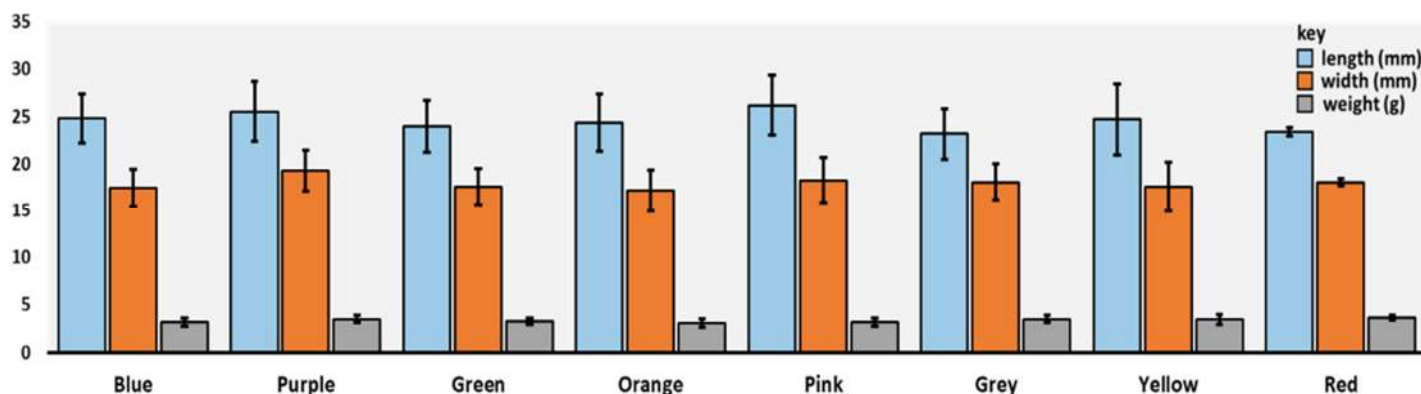


Figure 3.—Average swamp white oak acorn lengths, widths, and weights within the plot by family ($n > 100$, when possible, per color).

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ABOUT THE ARTICLE

This article expands on the oral and field presentations given by Shaneka Lawson and Mark Coggeshall in July 2023 at the Northern Nut Grower/Chestnut Growers of America/Walnut Council Joint Conference held in Columbia, Missouri.

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Shaneka Lawson (shaneka.lawson@usda.gov) is a Research Plant Physiologist with the USDA FS Northern Research Station, Hardwood Tree Improvement and Regeneration Center, Purdue University, West Lafayette, IN. She worked in human genetics before deciding to obtain a Ph.D. in plant stress physiology and genetic engineering.

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Mark Coggeshall (coggeshallm@missouri.edu), before his retirement, was the Tree Improvement Specialist for the Hardwood Tree Improvement and Regeneration Center and earlier for the University of Missouri Center for Agroforestry. He is responsible for the establishment of the swamp white oak and multiple black walnut planting at the Horticulture and Agroforestry Farm in New Franklin, MO. 🌳



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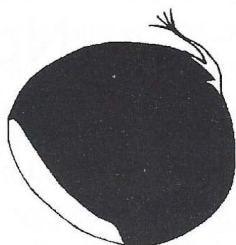
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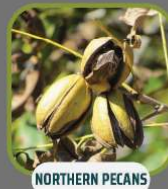
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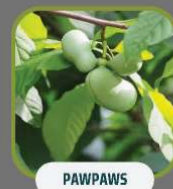
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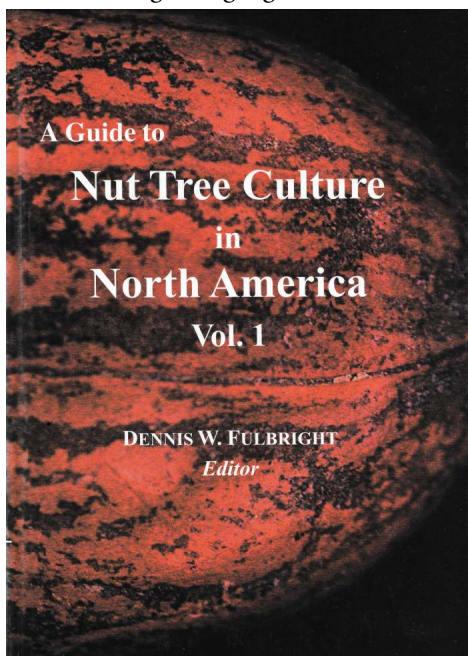


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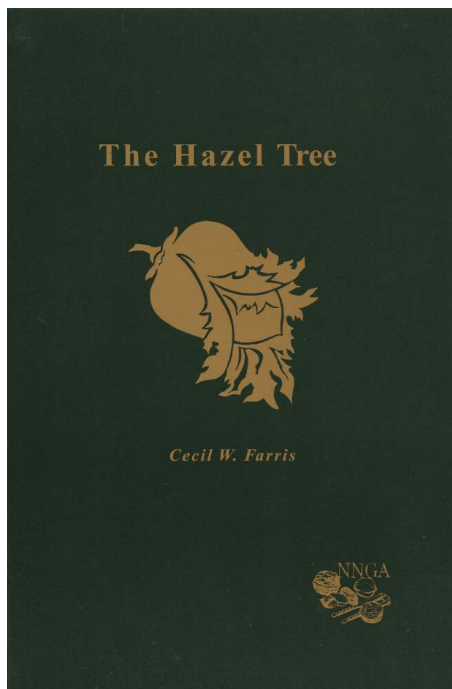
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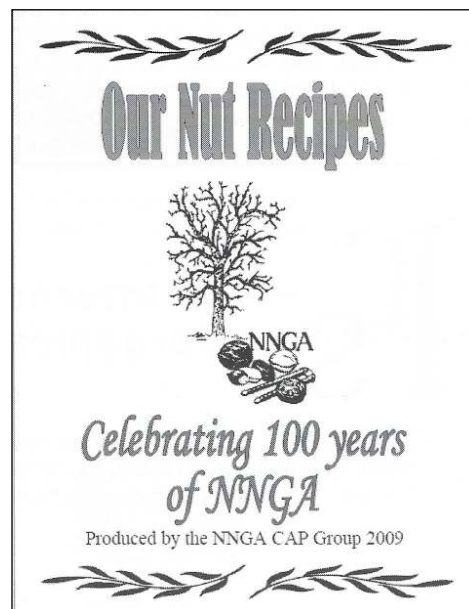
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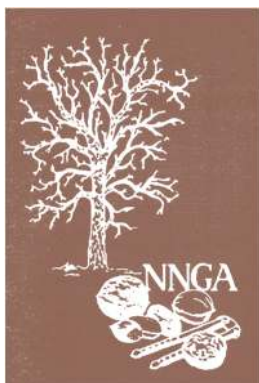
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