Chestnut Growers of America

Promoting Chestnuts and Connecting Chestnut Growers

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The Chestnut Grower

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Chestnut Carbohydrate Availability: Three Questions

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In This Issue

Cover photo courtesy of Tom Wahl.

Recently, we have been giving some thought to chestnut alternate-year-bearing. This is a problem for our industry. Many new growers ask questions about the maximum or expected number of pounds that they can get from their chestnut orchard. Many seasoned growers think about more pollination, optimal fertilizer application, and favorable orchard conditions as a response to the problem. It seems to us that carbohydrate availability is the most concerning issue.

Some years ago, we would joke with students that it takes 55 leaves to make an apple. That response indirectly addresses the available carbohydrate issue.

So, we decided to revisit the issue of available carbohydrates for chestnuts. Which led us to three questions:

1. **How many leaves does it take to grow a chestnut?**
2. **How many pounds of chestnuts can a tree produce?**
3. **Why are chestnut trees alternate-year bearing?**

Let's address the questions in reverse order.

Answer to Question 3: Carbohydrate availability and/or depletion may be an issue.

Answer to Question 2:

Plants and trees are remarkably similar in their functions and characteristics. The sun shines down on the earth at a constant rate and provides solar energy for the trees. The leaves use the solar energy to capture carbon and turn it into carbohydrates (sugar). The tree distributes the

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About Chestnut Growers of America, Inc.

The purpose of Chestnut Growers of America is to promote chestnuts, to disseminate information to growers of chestnuts, to improve communications between growers within the industry, to support research and breeding work, and generally to further the interests and knowledge of chestnut growers. CGA advocates the delivery of only high-quality chestnuts to the marketplace.

CGA began as the Western Chestnut Growers in 1996 in Oregon where about 30 or so chestnut growers understood the need to join forces to promote chestnuts in the U.S. Eventually they realized that they needed to be a national organization and solicited memberships from every grower in the country, which took the membership to over 100. The name of the organization was changed to Chestnut Growers of America, Inc., and it was granted 501(c)(5) status. Annual meetings take place around the country in an effort to make it possible for a maximum number of people to attend. A newsletter, *The Chestnut Grower*, is published quarterly and distributed by mail and/or email. CGA maintains an extensive resource site available only to members containing information helpful in growing and marketing. Visit chestnutgrowers.org for more information.

Annual Membership Dues

Single membership, $45; Household membership, $55; Associate membership, $60. Members receive *The Chestnut Grower* quarterly. Emailed newsletters are included. Mailed newsletters are an additional $5 per year. A $10 late fee is applied to membership renewals submitted after March 1.

Advertising Rates

Full page, camera ready	$20.00
Half page, camera ready	$15.00
Quarter page	$10.00
Business card (4 issues)	$15.00
Classifieds	**FREE**

Email ads to chestnutgrowersofamerica@gmail.com. Send payment for ads to Jack Kirk, 2300 Bryan Park Av., Richmond, VA 23228. Make checks payable to Chestnut Growers of America, Inc. OR visit www.chestnutgrowers.org/paydues.html to submit payment online via PayPal.

Deadlines

Issue	*Deadline*	*Mailed*
Winter	Dec. 10	Jan. 1
Spring	Mar. 10	April 1
Summer	June 10	July 1
Fall	Sept. 10	Oct. 1

Editorial Opinion

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Message from CGA President Roger Blackwell, Chestnut Grower

Hello Chestnut Growers of America! The world we live in has dramatically changed in the last few weeks, and now we are all living through the COVID-19 pandemic. I hope you are all safe and well.

Due to the evolving situation related to the coronavirus and its implications for our members, **the CGA Board of Directors have decided to cancel the Annual Membership Meeting** which was to be held at the Wyndham Garden State College, Boalsburg, Pennsylvania on Sunday June 7 through Tuesday June 9, 2020.

Once the pandemic has lifted, we will work to establish a new date for the Annual Membership Meeting. It is still possible we may be able to schedule our meeting in the same location this year or have the meeting in June 2021. The CGA Board is working with Sara Fitzsimmons, who is our host for the meeting in Pennsylvania, to plan once we determine that we can meet as a group.

This newsletter has several good articles for you about the chestnut industry. I would like to thank Art and Carl DeKleine, Tom Wahl, and Erin Lizotte for sharing their information with all our grower members. Please help Rita Belair, CGA Editor, in the upcoming months by submitting new articles or article ideas for this newsletter. She welcomes any information that can be included for the benefit of the members.

Please see the list of CGA Directors in this publication and thank them for continuing for the next year on the CGA Board.

Best regards,

Roger

The Benefits of Seedling Chinese Chestnut Trees Versus Grafted Trees

By Tom Wahl, Red Fern Farm, Wapello, Iowa | tom@redfernfarm.com

Disclaimer: The following remarks apply only to Chinese chestnuts in zones 4-6. They do not apply to other chestnut species, or to any other nut species, or in zones 7-9.

Most experts in the world of academia and in extension offices will say, "You cannot base a commercial nut enterprise on seedling trees. You have to use grafted trees." This is true for most nut species, but it is not true for Chinese chestnuts in USDA Plant Hardiness Zones 4-6. Chinese chestnut seedlings with good genetics are dramatically superior to their own grafted parents when it comes to nut production. Seedling trees will, on average, produce nuts as big or bigger, and just as high in quality as grafted trees, but they will produce a whole lot more of them.

Right now, there are more than 60 farms in Iowa, Illinois, Missouri, and Kansas that are profitably growing Chinese chestnuts on seedling trees. Mine is one of them. We, at Red Fern Farm, are growing over 70 species of fruit, berry, and nut trees, shrubs, and vines, but chestnuts are our main business. We have been growing seedling trees alongside grafted trees for nearly 30 years. Grafted cultivars include Qing, Peach, Gideon, Auburn Super, Mossbarger, Sleeping Giant, Amy, Shotgun, Szego, and perhaps a few others. We had a Colossal, but it died. Our oldest seedling trees are bearing at a rate of around 5,000 lbs. per acre. Because our chestnuts are sold to "Pick-Your-Own" customers who do all the harvesting, we have eliminated the costs of harvesting, sorting, sanitation, refrigeration, packaging, and shipping. Our single largest input cost is mowing the grass under the trees before the nuts fall. Our total production cost is <5 cents per pound. We get $2.75 to $3.00 per pound, depending on the day of the week. We have a waiting list with over 300 names of people who want to come and pick their own chestnuts. If you do the math, you'll see this compares favorably with the most profitable nut enterprises based on grafted trees, but it is the seedling trees that are earning the profits.

Nuts from a seedling tree.

Why is this the case? The arguments in favor of grafted trees include precociousness, productivity, uniformity of nut, uniformity of tree, and uniformity of harvest time. While it is true that grafted trees will come into bearing a year or two before seedlings of comparable size and age, the seedling trees will rapidly catch up, and then surpass the grafted trees in production. As time goes on, the gap in production just gets wider and wider. Grafted Chinese chestnuts do not produce uniform nuts. Nut size can vary dramatically, and not just from year to year and from tree to tree. You can have a small, a medium, and a large size nut in the same bur! Grafted Chinese chestnut trees will not be uniform in size. Grafted trees of the same age may vary from <5% to about 80% of the size of a seedling of the same age. Grafted trees of the same cultivar will not necessarily ripen their nuts uniformly. In some years they may be in perfect sync. In other years you may have two trees of the same cultivar, on

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Annual Membership Meeting Postponed

Due to the public health concern caused by COVID-19, the Chestnut Growers of America 2020 Annual Meeting, which was to be hosted this year at Penn State University June 7-9, has been postponed.

The CGA Board is working to establish a new date for the meeting. Please stay tuned.

Have you renewed your CGA membership?

Your 2020 membership dues are now past due. For members who have not yet renewed, you have two options:

Renew Online

Download a fillable form from the CGA website at www.chestnutgrowers.org/2020_CGA_Membership_Application_fillable.pdf. Complete the form and email it to Jack Kirk, CGA secretary/treasurer, at jackschestnuts@gmail.com. You can then pay your dues through the CGA website by visiting www.chestnutgrowers.org/paydues.html. **Please make sure you submit both your application and payment at the same time!** *~OR~*

Renew by Mail

Please fill out, detach, and return the membership renewal form included in the Winter 2020 issue. Send the form with a check made payable to Chestnut Growers of America, Inc. to Jack Kirk, 2300 Bryan Park Ave., Richmond, VA 23228.

Note: If you are a new member who joined after August 1, 2019, your dues are already paid for 2020. A $10 late fee has been applied to renewals submitted after March 1.

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carbohydrates to various parts of the plant to help it grow. Some of those carbohydrates are used to make nuts (the reproductive tissue). The nuts are harvested and sold with a sign saying

Nutrition Facts

Serving Size	1/2 cup (30g)
Servings Per Container	About 8
Amount Per Serving	
Calories 100	Calories from Fat 10
	%Daily Value*
Total Fat 1g	2%
Sodium 0g	0%
Potassium 250 mg	7%
Cholesterol less than 1mg	0%
Total Carbohydrate 25mg	8%
Dietary Fiber 4g	18%
Sugars 6g	
Protein 3g	

*Percent Daily Values are based on a 2,000 calorie-diet.

INGREDIENTS: 100% Dehydrated Chestnut

*Not a significant source of trans fat.

Figure 1. *Nutrition Facts for dehydrated chestnuts.*

Since

$$\frac{100\ Calories}{30\ g} \bullet \frac{453.592\ g}{1\ lb} = 1{,}511.97\ Calories\ /\ lb$$

for dry chestnut flour, and since fresh chestnuts contain 50% water, we estimate 755.98 calories per pound for fresh nuts.

Let's start with solar energy.

The amount of solar energy arriving at the Earth's surface on a clear day is on the order of 1 kW/m^2 per hour. The m^2 area needs to be facing the sun directly, not at some off angle. The tree knows this and thus makes many leaves around the tree looking at the sun from many angles.

For various reasons, photosynthesis, the process by which green plants transform light energy into chemical energy, is not 100% efficient. Most estimates suggest that photosynthesis is about 5% efficient.

If the weather is rainy, overcast, cloudy, or obstructed, not as much energy gets through to the tree.

Let's take a moment to think about energy.

- Joule – The I**nternational Thermal unit** (J/°C) is defined as the amount of heat required to raise the temperature of 1 g of water by 0.24°C.
- BTU - The **British thermal unit** (Btu or BTU) is defined as the amount of heat required to raise the temperature of one pound of water by 1° Fahrenheit, sometimes denoted BTU/°F.
- Calories – In **chemistry**, heat amounts are often measured in calories. Confusingly, two units with that name, denoted "cal" or "Cal", have been commonly used to measure amounts of heat: A "**small calorie**" (or "gram-calorie", "cal") is 4.184 J, exactly. It was originally defined so that the heat capacity of 1 g of liquid water would be 1 cal/°C.
- The "**grand calorie**" (also "kilocalorie", "kilogram-calorie", or "food calorie"; "kcal" or "Cal") is 1,000 small calories, that is, 4184 J, exactly. It was originally defined so that the heat capacity of 1 kg of water would be 1 Cal/°C.

Note, 1 BTU ≈ 1900 J ≈ 252 cal (calories) ≈ 0.25 **Calories** (kilocalories).

So, what is a Joule? Joule is the unit of energy used by the International Standard of Units (SI). It is defined as the amount of work done on a body by a one Newton force that moves the body over a distance of one meter. But, you ask… "Is a Joule energy or work?" They are interchangeable. Energy is the ability to do work. Work = Force * Distance. So, what is a Joule? Since an average apple weighs about 1 Newton, a Joule is the work done by lifting the apple one meter.

For a physicist, heat and energy are equivalent, having the same units. Physicists are often interested in the rate at which thermo energy (heat) is transferred.

One of the most commonly used rates is the Watt.

$$1\ watt = 1\frac{joule}{\sec}$$

The next question is how many Daylight Hours/Sunshine Hours do my trees in Grand Rapids, Michigan see each year? Let's consider the time from July 1 to October 20, the period during which the nuts are growing.

- Average Sunshine in July 31: 9.5 Hours/Day (297.6 Hours)
- Average Sunshine in August 31: 8.5 Hours/Day (263.5 Hours)
- Average Sunshine in September 30: 6.9 Hours/Day (207.0 Hours)
- Average Sunshine in October 1-20: 4.9 Hours/Day (98.0 Hours)

Thus, we have 866 hours of sunshine during the growing season.

Solar energy reaching tree =

$$\frac{1\,kW}{m^2}$$

$$= \frac{1}{m^2} \bullet k\,\frac{J}{\sec} = \frac{1000}{m^2} \bullet \frac{J}{\sec} \bullet \frac{3{,}600\sec}{hr} = \frac{3{,}600{,}000\,J}{m^2 \bullet hr}$$

$$= \frac{3,600,000\,J}{m^2 \bullet hr} \bullet \frac{Calorie}{4,184\,J} = 860.42 \frac{Calorie}{m^2 \bullet hr}$$

$$= 860.42 \frac{Calorie}{m^2 \bullet hr} \bullet 866\ hr = 745,124 \frac{Calorie}{m^2}$$

Chemical energy

$$= 745,124 \frac{Calorie}{m^2} \bullet 0.05 = 37,256 \frac{Calorie}{m^2}$$

Consider now one 15-year-old chestnut tree with a 25-foot drip-line. The radius of the circular region under the tree is 12.5 ft. The area of the region is given by

$$Area = \pi r^2 = 3.14159 \bullet 156.25\ ft^2 = 490.8\ ft^2$$

$$= 490.8\ ft^2 \bullet \frac{0.092903\,m^2}{ft^2} = 45.6\ m^2$$

Thus, the chemical energy generated by the tree is given by:

Chemical energy

$$= 37,256 \frac{Calorie}{m^2} \bullet 45.6\ m^2 = 1,698,883\ Calorie$$

Some of the calories are converted to soluble carbohydrates that are stored in the tree and use to feed the growing tree. Some of the calories are converted to biomass. It has been estimated that the total biomass is distributed in the following approximate percentages: leaves (1%), branches (11%), stems (62%), and roots (26%). Some of the carbohydrates are given off as CO_2 in plant respiration.

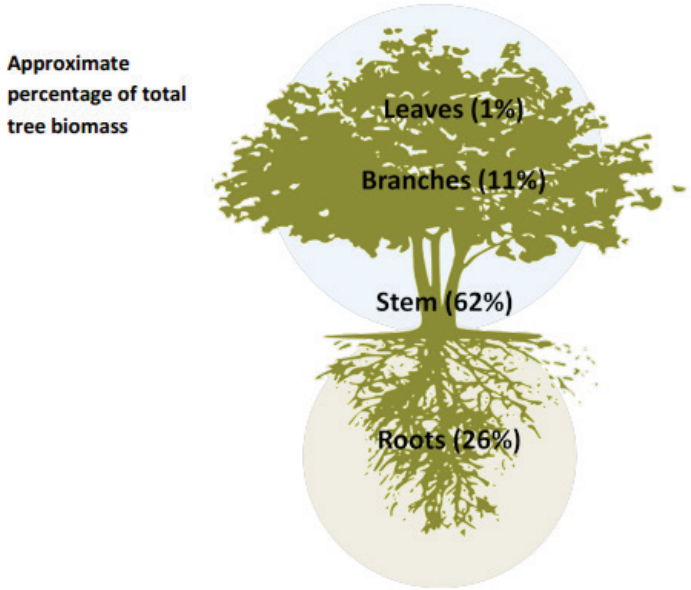

Figure 2. *Approximate biomass distribution in trees.*

E.H. Wenk and D.S. Falster (2015) define reproductive allocation (RA) as the fraction of surplus energy allocated to reproduction. H. Genet, N. Bréda, E. Dufrêne (2010) have estimated RA for beech to be 8%. A good guess is that ½ of that amount is allocated to nut growth, the other ½ to catkins, duds (burs with no nuts), and nut burs.

We can now hypothesize the pounds of nuts produced by our 15-year old chestnut tree with a 25-foot drip-line.

RA (reproductive allocation) = 1,698,883 *Calories* * 4% = 67,955 *Calories*

The nut production on this 15-year-old chestnut tree with a 25-foot drip-line can be estimated as

Nut weight =

$$67,955\ Calories \bullet \frac{1\,lb}{755.98\ Calories} = 90\ lb$$

If this old tree is planted in an orchard with a tree spacing of 25' x 25', each tree will be allocated 625 ft^2. At this spacing, one acre (43,560 ft^2) will hold 70 trees.

Corollary:

A 15-year old chestnut square orchard with trees spaced 25' x 25', 10' strips between the rows, and each tree with a 25-foot drip-line can produce 4,212 lb per acre.

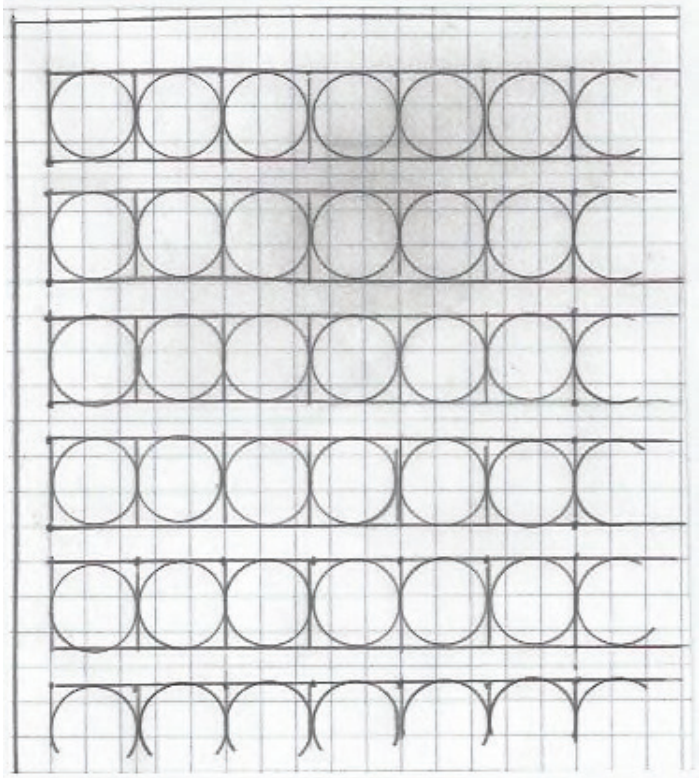

Figure 3. *Orchard spacing illustration.*

Assume that our 15-year-old tree is planted in a 25' x 35' region as illustrated.

One acre has an area of 43,560 ft^2; thus 10 acres will have an area of 435,600 ft^2 and a side length of 660 ft. This 10-acre plot will have 18 rows, 26 columns, and 468 trees. These trees should produce 42,120 lb of nuts, or 4,212 lb per acre.

Which brings us to…

How many leaves does it take to grow a chestnut?

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Answer to Question 1:

Not all leaves on a tree are equally effective. Leaves need sunlight to produce carbohydrates. Leaves at the top of a tree are more effective and shaded leaves are less effective. Leaves on the side of a tree are more effective during one part of the day than another part.

In this article we will think about leaves facing the sun. We will consider the sun looking down on a tree and consider the area observed. We will call that area the effective area. We will look the area of an average size leaf and ask how many average size leaves does it take to cover the effective area. We can then calculate the amount of carbohydrates produced and the number of nuts produced by the tree. We will also calculate an average size chestnut and then ask how many leaves would be needed to produce that chestnut.

A hypothetical tree might look something like the following:

We will assume:

1. That our hypothetical chestnut tree is a 15-year old chestnut tree with a 25-foot drip-line and
2. The tree canopy is the top half of a prolate spheroid.
3. The height of the canopy is 1.25 times the radius of the canopy.
4. The effective area is a circular area under the tree with a radius of 12.5 ft.
5. The area of the effective area is 490.8 ft^2.
6. The tree produces 90 lb of nuts.
7. The area of a typical chestnut leaf is 10 in^2.
8. CGI lists A size chestnuts at 25 nuts per pound. We will assume this represents a typical nut.

Then,

$$\frac{1\ leaf}{10\ in^2}\bullet\frac{144\ in^2}{1\ ft^2}\bullet\frac{490.8\ ft^2}{1\ tree}\bullet\frac{1\ tree}{90\ lb}\bullet\frac{1\ lb}{25\ nuts}=\frac{7067.52\ leaves}{1\ tree}$$

$$\bullet\frac{1\ tree}{90\ lb}\bullet\frac{1\ lb}{25\ nuts}=\frac{7067.52\ leaves}{2250\ nuts}=3.14\frac{leaves}{nut}$$

Three leaves and a volunteer friend (or three leaves working overtime) work every daylight hour as hard as they can (no lunch break, no potty break, no talking to their neighbor) … it sounds unreasonable!

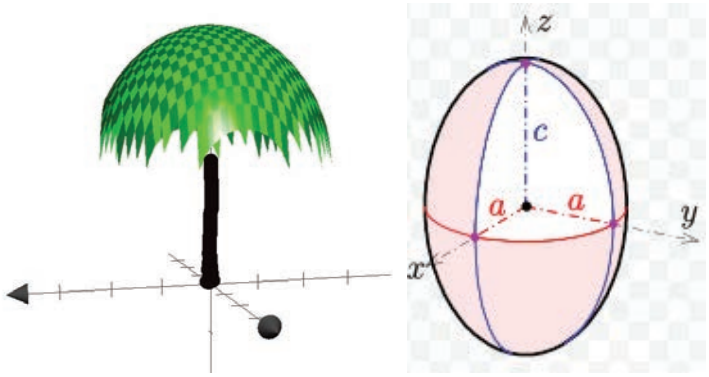
It looks like this tree has a lot of leaves not doing their fair share! So how many leaves are making a contribution? Let's count the productive leaves around the tree.

As noted, we will assume:

1. The tree canopy is the top half of a prolate spheroid.
2. The height of the canopy is 1.25 times the radius of the canopy.

There is a relatively simple formula for the surface area of a prolate spheroid.

Let **a** = 12.5 and **c** = 15.25.



The computed area of the tree canopy is 1,096.48 ft^2. Thus,

$$\frac{1\ leaf}{10\ in^2}\bullet\frac{144\ in^2}{1\ ft^2}\bullet\frac{1096.48\ ft^2}{1\ tree}=15789.312\ \frac{leaves}{tree}$$

$$\frac{15789\ leaves}{1\ tree}\bullet\frac{1\ tree}{90\ lb}\bullet\frac{1\ lb}{25\ nuts}=\frac{15789\ leaves}{2250\ nuts}=7\frac{leaves}{nut}$$

I think 7 leaves per nut is a better answer!

Continued from page 3...

the same kind of rootstock, on the same soil type, and only 40 feet apart, but one will start dropping nuts just as the other is finishing up. None of the benefits that are supposed to come with grafting occur with Chinese chestnuts. All that said, the area where grafted Chinese chestnuts really fail is in nut production. The reason for this is two-fold. First, an unacceptably high percentage of grafted trees suffer from what is called "delayed graft union failure." Trees will be growing and appear healthy, then very suddenly they wilt and die for no apparent reason. Sometimes there is a warning, such as a swelling at the graft union, but usually it comes as a surprise. This can happen any time from one to fifteen years after planting. In my zone 5B area of southeast Iowa, it happens to about 40% of grafted trees. The second problem with grafted trees (the ones that don't die) is low vigor. As stated earlier, the vigor of grafted trees will range from <5% up to about 80% of a seedling tree. Since production is strongly correlated to tree size, that means <5% to 80% of the production compared to a seedling. In my area, the average vigor for a grafted Chinese chestnut is around 25%-30%. If you take the surviving portion (60%) and multiply by the average vigor/production (I'll be generous and say 30%) you get 0.6 x 0.3 = 0.18 or 18%. Grafted Chinese chestnuts will produce 18% as much as a seedling. Another way of saying this is that seedlings will out-perform grafted trees by 500%-600%. Even in the Deep South where average vigor is higher and graft union failure is lower, grafted trees only approach, but never match the production of seedlings.

A typical grafted tree for a 27-year-old chestnut (compare to above).

A typical seedling tree for a 27-year-old chestnut (compare to below).

Nice-looking nuts!

After all of this you might conclude I don't think grafted trees are good for anything. Not so. Grafted trees are good for something—just not nut production. Grafted trees are good for producing the superior seedlings that are good for nut production. When you stumble upon a superior tree, it is seldom right next to another superior tree. By planting two grafted trees next to each other, of cultivars known to produce good seedlings, we can maximize the probability that the seedlings from that cross will grow into valuable, commercial-quality trees. Even if grafted trees don't produce enough to support a nut business, they do produce enough superior seedlings.

Chinese chestnut seedlings with superior genetics are not only viable in a commercial nut enterprise, but they are dramatically more productive than their grafted parents, and they can support a downright lucrative business.

Michigan Chestnut Weevil Management in 2020

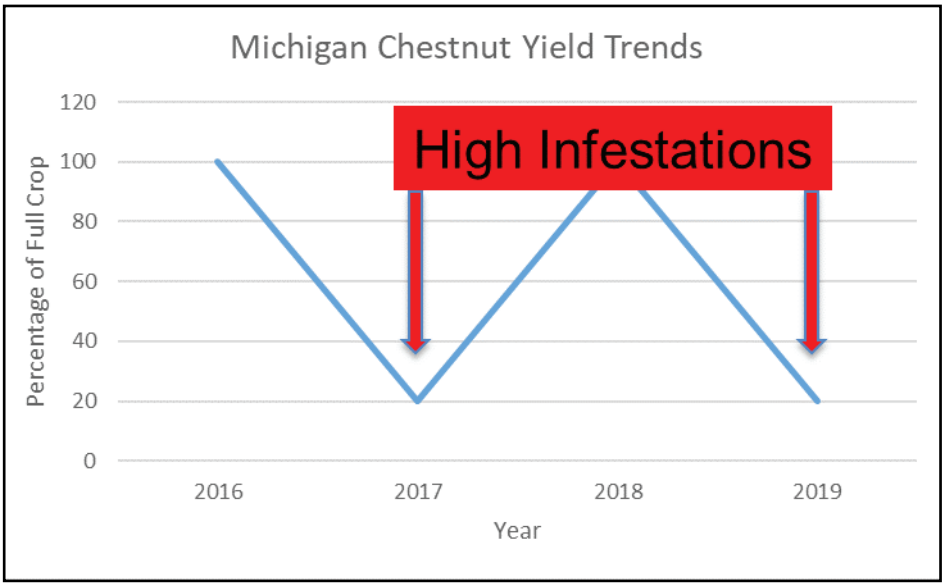
By Erin Lizotte, IPM Educator, Michigan State University Extension | taylo548@msu.edu

The most important insect pest of chestnut in the central-eastern United States is the lesser chestnut weevil (*Curculio sayi*). Large chestnut weevil (*C. caryatrypes*) is also an important pest but is less prevalent. Large and lesser chestnut weevil are native to North America and are host-specific, only infesting tree species in the genus *Castanea* (American chestnut, Chinese chestnut, European chestnut and chinquapin). Large and lesser chestnut weevil both lay eggs on developing nuts, with developing larvae feeding on and compromising the kernel. If left unchecked, the larvae can infest and destroy the nuts. Larvae can be present at harvest resulting in "wormy" nuts making their way to consumers.

Over the last few years, Michigan chestnut producers have seen a growing issue with larvae in nuts at harvest. It is likely that the larvae are immature chestnut weevils, though the exact weevil species has not been identified. As an emerging issue, Michigan producers have had very little experience with chestnut weevil and no formal research has been done on this pest in Michigan. However, based on field observations in Michigan and research out of Kentucky and Missouri, we can make some educated estimations about chestnut weevil biology and management in Michigan.

Large chestnut weevil on bur. Photo by Todd Luety, Ontario Ministry of Agriculture, Food & Rural Affairs.

During the years of 2017 and 2019, some farms experienced high levels of weevil infestation at harvest. Affected orchards can be heavily infested, while other farms have effectively no larvae in nuts at harvest. At this time, chestnut weevil populations appear to be localized and cyclic in Michigan, with higher infestation percentages coinciding with low-yield crops, which generally occur on a biannual basis.



Low yield years appear to be associated with a high percentage of nut infestation.

It is important to understand the biology of chestnut weevil to effectively monitor and manage it on the farm. The lesser chestnut weevil adults likely emerge during two separate periods in spring around bloom (May-June) and early fall before burrs open (September-October). Spring populations feed on catkins while they are available. Once the catkins decline, the population disappears. It is unknown if they return to the soil or feed on other plants. Eggs are deposited in the downy lining surrounding the nut as burs open and hatch in approximately 10 days at which time the larvae feeds on the kernel and develops within the shell. After 2-3 weeks, the larvae chew a small exit hole and drop to the soil. Most overwinter as larvae, pupate in the soil the following fall and overwinter as adults. The total lifecycle is completed in 2-3 years.

The large chestnut weevil adults likely emerge in August-September and begin laying eggs in immature burrs almost immediately, well before lesser chestnut weevil begin laying eggs. Eggs hatch in

5-7 days and the larvae feed and develop within the nut for 2-3 weeks. The larvae usually exit the chestnut before the nuts drop to the ground, overwintering in the soil. Pupation and adult emergence take place the following summer. A small population of larva may overwinter a second winter before pupation. The total lifecycle is completed in 1-2 years.

Lesser and large chestnut weevils both have robust bodies, long snouts and are dark brown or tan with brown mottling or stripes. Lesser chestnut weevil is ¼ inch in length, with a snout of equal or greater length. The body of the large chestnut weevil is 3/8 inch long, and the snout is 3/8 - 5/8 inch long.

Figure 3. Large chestnut weevil. Photo by Todd Luety, OMAFRA.

Scouting for adult weevils should begin just before bloom and continue regularly until harvest. At this time, effective passive trapping techniques for chestnut weevil have not been identified; growers should instead focus on the limb-tapping technique. To use the limb-tapping technique, place a light-colored sheet under the limb you are sampling and tap the branch with a padded pole or stick (gently to avoid damage to the tree). Jarring the branch causes the weevils to drop from the tree onto the sheet. Weevils will "play dead" when disturbed, so don't be fooled. Chestnut weevils are substantial in size and should be easily visible if present. Growers should sample at least 30 branches per acre. Scouting locations should include both the edges and interior of orchards as well as any known hotspots.

There are two primary goals in management of chestnut weevil. The first goal is to prevent larvae in nuts at harvest making their way to consumers; the second goal is to prevent nut damage from feeding. The four weeks prior to harvest are the most critical time for management as eggs laid during that timeframe can result in larvae in the nuts at harvest. There are chemical, cultural and postharvest treatments available to control chestnut weevils. Ideally, a combination of cultural and chemical management techniques would effectively control the weevil in the field and eliminate the need for postharvest heat treatments, which can diminish quality and the marketable yield.

Cultural control through sanitation is the first step in the management of these pests.

Chestnut kernel compromised by weevil larva. Photo by Erin Lizotte, MSU.

Collecting and destroying fallen nuts can remove some developing larva from the orchard. Insecticides should target the later windows of potential adult activity; August-September for large chestnut weevil adult emergence, and September-October for lesser chestnut weevil fall adult emergence. Insecticides should not be applied during adult activity in May-June as bees are often foraging in the orchard at this time. Application of insecticide should only be made in response to significant weevil pressure.

Growers should consider a number of factors when selecting an insecticide for weevil control including relative efficacy against other relevant pests like scarabs and leafhopper, known weevil efficacy in other crops, toxicity to beneficials, mode of action, preharvest interval, and the number of applications allowed per season. Based on pest biology, the most critical applications for preventing larvae in the nuts at harvest occur in the four weeks before harvest and target controlling adult weevils to prevent egg-laying. Once larvae enter the kernels, insecticides will be ineffective. Chemical control for the entire period of kernel development will more thoroughly prevent damage but may not be economically practical unless the orchard has experienced substantial weevil crop losses in the past.

The following table includes the likely best candidates for chestnut weevil management in Michigan based on the selection criteria previously described.

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Selected Pesticides for Chestnut Weevil Management, 2020

Active Ingredient (Mode of Action)	Products Labeled	Pesticide Efficacy[1]			Beneficial Insect Toxicity[2]			Per Acre Rates			Max Applications per Season	Application Interval Minimum	Days of Control	PHI	Notes
		PLH	Scarabs	Plum Curculio	Bees	Mite preds	Insect preds	Fruit	Chestnut	Seasonal Max					
Phosmet (1B)	Imidan 70W	G-E	E	E	T	S	M	2.125 lb	4.3-8.5 lbs	17.14lbs	2-3		3-10 days	28 days	Imidan is an organophosphate insecticide and provides good broad-spectrum control of many pests in Michigan.
Carbaryl (1A)	Sevin 4F	E	G-E	G	T	T	T	2-3 qts.	4-5 qts.	15 qts.	4	7	3-10 days	14 days	Sevein is an organophosphate insecticide and provides good broad-spectrum control of many pests in Michigan.
Acetamiprid(4A)	Assail 30SG	E	E	E	M	S	M	2.3-3.4 ounces	4.1 ounces	16.4 ounces	4	14	7 days	14 days	Targets aphids, leafhoppers, leafminers, Japanese beetle, plum curculio, as well as some lepidopteran pests. This translaminar (locally systemic) material has a long residual inside the plant.
Clothianidin(4A)	Belay	E	E	E	M	S	M	6 fl.oz.	3-6 fl.oz.	12 fl.oz.	2	10 days	7 days	21 days	Targets aphids, leafhoppers, leafminers, curculio, Japanese beetle and lepidopteran pests. As a foliar spray Belay is a translaminar (locally systemic) material, and has long residual inside the plant.

1. Pesticide efficacy ratings; E-excellent, G-good, F-fair, P-poor, U-unknown, N-pest not included on label. **2.** Beneficial insect toxicity; S-safe, M-moderate, T-toxic, U-unknown, not evaluated on chestnut.

* OMRI approved for organic production. ** Products containing these active ingredients are classified as a restricted use pesticides and require the applicator to retain a pesticide applicator license.

Pesticide efficacy and beneficial insect toxicity is based on trials in fruit crops with products containing the same active ingredient, as reported in the E154 Fruit Management Guide, Michigan State University Extension.

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Growers should be using a minimum of two modes of action in rotation to prevent resistance development. Late in the season, the use of pyrethroids may also be considered. Pyrethroid use in early-mid growing season is not recommended as it can result in increased pest mite populations. For a complete list of registered pesticides, visit www.chestnuts.msu.edu for the latest Michigan Chestnut Management Guide.

Well-timed applications, good sanitation practices, and persistent scouting will be the key to successful chestnut weevil management in Michigan. There is still a lot to learn about the prevalence and activity of chestnut weevil in Michigan. Thankfully, research into chestnut weevil is getting a big boost in 2020, led by the McCullough lab at Michigan State University in partnership with the Midwest Chestnut Producers Council. As we learn about the biology of this pest and the efficacy of various insecticides, management recommendations will likely improve.

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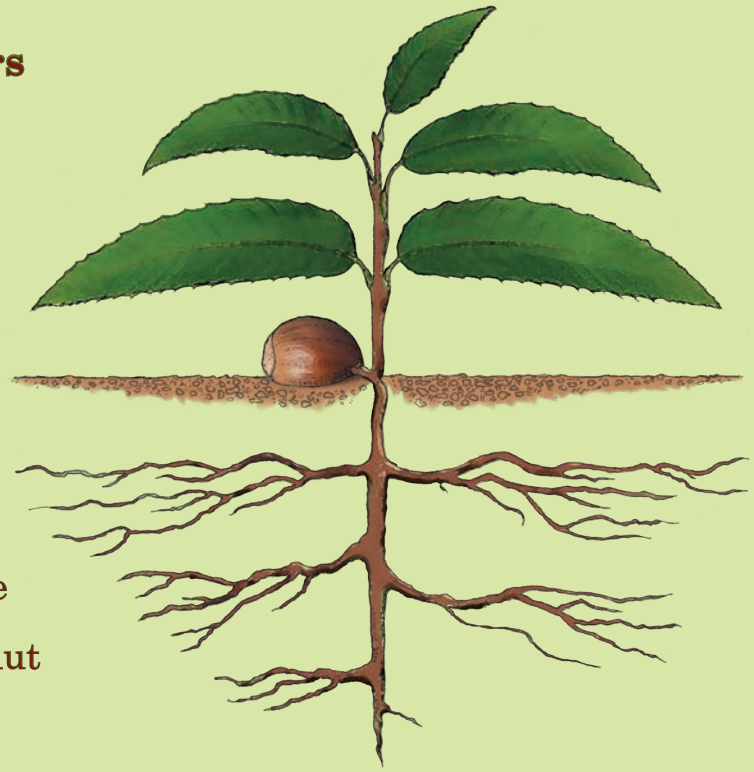

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