Extension
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Missouri Chinese Chestnut Planning Budget

Interest in chestnut production is growing in the U.S., though the country remains a net importer and minor producer. Chestnut acreage nearly doubled from 2,185 bearing-age acres in 2017 to 4,419 in 2022, with an additional 5,692 acres planted but not yet bearing, according to the U.S. Census of Agriculture. If grafted cultivars were used, many of these chestnut acres could be bearing nuts in 2025 and 2026, potentially marking a four-fold increase in chestnut production over nine years. In 2022, Missouri chestnut production ranked eighth nationally, with 391 acres on 115 farms.

This budget is designed to aid Missouri farmers by estimating the costs and returns for establishing and/or maintaining an orchard of Chinese chestnuts. Careful planning is necessary when considering a multigenerational perennial crop. A chestnut orchard is a significant capital investment and will take several years to produce enough chestnuts to potentially provide positive financial returns. Chestnut harvest is a labor-intensive process, so having access to dependable help is crucial. Key budget assumptions are discussed below and can serve as a checklist in your planning process. You can modify the assumptions to fit your orchard plans using the accompanying Chinese Chestnut Budget workbook (XLSX).[1]

Chestnut cultivar choice

Missouri's chestnut industry has both seedlings and improved cultivars. Improved cultivars can offer superior yield, nut size and flavor, and earlier age at first bearing, this budget assumes purchasing two types of grafted Chinese chestnut cultivars to provide adequate cross-pollination. Balancing chestnut blight resistance with yields, this budget models an orchard with 75% Qing cultivars and 25% Mossbarger or Sleeping Giant, as recommended by the University of Missouri's Center for Agroforestry's publication Growing and Marketing Chinese Chestnuts (PDF).[2] Center faculty note that nearly all chestnut varieties cannot self-pollinate and therefore an orchard needs at least two different cultivars; the trees should be placed so that the pollinator cultivar trees are within 200 feet of the other cultivar. Learn more about chestnut cultivars from the University of Missouri's Chestnut Germplasm Repository website.[3]

Most chestnut varieties cannot self-pollinate and therefore an orchard needs at least two different cultivars; the trees should be placed so that the pollinator cultivar trees are within 200 feet of any tree to be pollinated.

A farm enterprise budget is an economic resource that attempts to include all cash and opportunity costs of an enterprise. These budgets allocate equipment purchases to an enterprise proportionally or in whole. In addition, these budgets include opportunity costs that may or may not represent cash expenses to an operation — such as labor hours, land cash rent and interest rates.

Site selection

Chestnut trees grow best in deep, well-drained soils without restrictive layers that limit root growth. They cannot tolerate saturated root zones, making bottomland soils unsuitable. The loess hills along the Missouri River corridor offer ideal conditions for chestnut production. If your soil is less than ideal, expect reduced yields and slower tree development. Because chestnuts are highly frost-sensitive in spring, good air drainage is essential. Plant trees near the tops of slopes and orient the orchard to allow airflow, avoiding natural windbreaks.

Irrigation

Irrigation practices vary among Missouri chestnut growers. Some growers hand-water young trees and rely on rainfall after establishment, whereas others install permanent systems to irrigate throughout the orchard's life. If you install a permanent irrigation system, size it to meet the high water demands of mature trees — hundreds of gallons per day. For a 10-acre orchard, peak water demand to mature trees could require flow rates of 5,000 gallons per hour or greater, depending

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on the layout of the irrigation system. High-volume, shallow wells or surface water storage is necessary for cost-effective irrigation. This budget includes a default cost model for drip irrigation and allocates half of the cost of establishing a $30,000 well to the chestnut enterprise. Users can adjust these cost assumptions in the investment tab of the budget workbook (XLSX),[1] or choose to remove all irrigation costs by deselecting this feature in the input tab. If you plan to operate without irrigation, you should expect greater yield variability from year to year.

Site preparation

Chestnut trees can be in production for 50 or more years, so adequately preparing the site is essential to maximize productivity. Once trees are planted, correcting soil issues becomes more difficult. This budget assumes subsoiling the land to break up deep compaction, one hour per acre of grading to improve drainage, disking for surface leveling, seeding ground cover between tree rows, and installing drip irrigation. If using irrigation, the site preparation year is the most effective time to install the system.

To protect young trees from deer, fencing is strongly recommended. This budget includes a two-layer electrified high-tensile fence as a cost-effective option. More permanent solutions, like 8-to-10-foot woven wire, offer better protection but at higher cost.

Orchard design and planting

This budget assumes 800 square feet per tree. Trees may be planted in various configurations to allow for intercropping. Wider row widths with shorter within-row spacing make orchard activities more efficient and provide greater intercropping opportunities. This budget assumes the alleyways between trees will be mowed; however, the orchard design, costs and revenues can be modified to intercropping practices. Consider the additional crop's sunlight and water requirements as well as harvest timing and the type of ground cover provided to identify a compatible crop to use in alleyways.

Chestnut trees are planted in the spring before budbreak. Trees are planted with 40 feet between the rows and 20 feet between each tree. Planting — including watering, measuring and immediate site prep — takes about 15 minutes per tree. Table 1 summarizes the basic configuration and management strategy in the modeled orchard.

Table 1. Modeled Chinese chestnut orchard configuration.

Category	Unit	Quantity
Orchard size	acres	10
Starting tree density	square feet per tree	800
Tree population	trees per acre	54
Pollinator trees	percentage of trees	25%
First orchard thinning	year of production	15
Trees removed	percentage of original population	50%
Irrigation		Yes

Thinning and pruning

Early pruning is important to shape chestnut trees for long-term health, yield and equipment access. Remove low or poorly placed branches each year until the canopy is above the height of orchard equipment. As trees mature, orchards must be thinned. This budget assumes half the trees are removed 15 years after planting, as canopies begin to touch. Storms, diseases or other damaging events will likely result in thinning over several years rather than all in one year. When selecting trees to remove, be sure to maintain enough pollinator trees for good nut set.

Some intensively managed chestnut orchards may plant as many as 108 trees per acre initially (20 feet by 20 feet). Although this can potentially double production in the first decade, it also doubles planting and tree costs, complicates orchard access and management, and requires tree removal by Year 10. Irrigation systems designed for the final orchard configuration will not provide water to every other row of trees, so manual watering may be necessary for optimal yields.

Soil fertility management

Chestnut trees require annual fertilizer applications for maximum yield. This budget assumes producers annually apply 100 pounds of nitrogen (N) (220 pounds of urea) per acre in a broadcast application after the establishment year to optimize chestnut yields and fertilizer expenses. If an irrigation system is in place, nutrients can be applied via a fertigation system using liquid fertilizer such as urea-ammonium nitrate (UAN). Use a soil test to apply phosphorous (P) and potassium (K), but 20 pounds of P and 30 pounds of K will generally replace the nutrients removed by an average-sized chestnut crop. Growers may consider applying two pounds of boron as a cost-effective way to improve the plants' ability to uptake other nutrients.

Liming is also a crucial part of managing orchard fertility. Applying lime to reach an ideal pH range of 5.5 to 6.5 at establishment is recommended by the University of Missouri's Center for Agroforestry's publication Growing and Marketing Chinese Chestnuts (PDF),[2] with maintenance applications every three to five years thereafter based on soil test results. Plan to routinely assess nutrient deficiencies with soil and tissue tests before yield losses occur for this high-value crop.

Disease and pest management

Chestnuts face a variety of pests and diseases that can adversely affect both yield and nut quality. The chestnut weevil is the primary pest that feeds on the nut of the chestnut tree. Generally, three to four applications of a carbaryl insecticide with one week between applications in August is sufficient for controlling nut-boring pests such as chestnut weevil.

Several insect species, including Japanese beetles, can damage a chestnut tree's leaves and green wood, stunting growth and yields. There is generally no preventive action for managing these pests. Regular scouting for tissue damage and subsequent fogging of the canopy with insecticide can minimize any damage. Fortunately, Chinese chestnuts do not face significant fungal disease pressure, so regular applications of fungicide are not required.

Marketing

This budget assumes a 10-acre chestnut farm sells 75% of its crop directly to customers and 25% wholesale to grocery stores, restaurants or other buyers. At publication, chestnut prices varied. We chose $6.50 per pound for retail and $3.50 per pound for wholesale, reflecting likely prices for new growers without an established market or proven production and processing systems. Smaller farms near urban areas may be able to sell their full crop at retail with minimal marketing. Established growers often build a loyal customer base that returns year after year.

Individual customers may prefer different sizes of chestnuts. Good postharvest management practices include sorting chestnuts by size, but producers have found that consumers are willing to pay the same price for high quality nuts of all sizes. This budget assumes chestnuts are sorted by size, but the same price is received for all sizes of sellable nuts.

If you are planning to sell online, plan for two-to-three-day delivery to maintain a high-quality product. Chestnuts are around 50% water by weight, and the nut quality declines quickly as humidity levels fall and temperatures increase; poor storage can lead to mold. Most of the continental U.S. can be reached in the three-day window with expedited shipping. At the time of publication, Missouri growers cannot sell to consumers in Washington, Oregon or California due to import restrictions, so note that any orders placed by customers in these states cannot be legally fulfilled.

This budget allocates 15% of retail revenue and 5% of wholesale revenue for marketing. For more on estimating marketing costs by sales channel, see MU Extension publication G647, Refining Market Channel Selections Based on Cost.[4]

Interest and opportunity costs

This budget assumes producers have an operating interest rate of 8%, which is applied to all operating costs under the assumption the producer uses a line of credit with the bank. The balance of the line of credit is carried for six months. The budget also assumes a capital interest rate of 7% and compensates all nonharvest labor at $18.50 per hour. In addition, the budget includes an annual land charge of $200 per acre. The budget workbook (XLSX)[1] includes the ability to model the long-term opportunity costs of this crop. Opportunity costs represent the earning potential of capital invested into the orchard if it were used for some other purpose. Interested users should contact the authors for a more-detailed explanation.

Machinery and equipment

Most chestnut orchards in the U.S. rely on basic farm equipment for mowing, gathering fallen debris, spraying and fertilizing. Harvesting is largely a manual process. Although vacuum-sweeper harvesters are used in countries like China and Italy, U.S. trials of the equipment have had poor results; users report missed and damaged nuts and increased ground debris, dirt, twigs, grass and other foreign objects in the harvest. These issues often outweigh the labor savings due to higher postharvest cleaning costs and lower marketable yields. Read more about harvest mechanization considerations on Michigan State University Extension's Chestnuts website.[5]

Chestnut processing also lacks commercial-scale equipment for small farms. Fortunately, most chestnut species grown in the U.S. drop cleanly from the burr, simplifying harvest. To sell whole chestnuts, producers must sanitize and sort nuts to maintain quality. Limited examples of factory-built processing systems exist. Most growers choose to adapt equipment made for other industries or create their own pieces to best fit their operation. Pennsylvania State University constructed a mobile processing unit to demonstrate options for

Table 2. Machinery and equipment in Chinese chestnut enterprise.

Item	Budget equipment price (dollars)	Quality equipment price (dollars)
General farm equipment, purchased Year 1		
Tractor	10,000	23,000
Utility terrain vehicle (UTV)	8,000	13,000
Air blast sprayer	3,300	16,000
Weed sprayer	700	3,000
Rotary mower	3,000	20,000
Wagon/trailer 1	2,500	15,000
25% of pickup	5,000	15,000
Handheld tools	1,834	1,834
Processing equipment, purchased Year 5		
Forklift/pallet jack	400	12,000
Processing line equipment	9,750	9,750
Inspection table	450	450
Bagger	750	2,000
Cold storage	10,000	25,000
Harvest equipment, purchased Year 5		
15 utility carts	2,250	2,250
100 harvest tubs	2,400	2,400
15 handheld nut harvesters	1,125	1,125
Digital scale	170	170
Total	**61,629**	**157,979**

local producers. Schematics and a video explaining the operation of the chestnut mobile sorter and hot water treatment unit are available on Penn State's website.[6] This budget assumes a home-built processing unit comparable to that built by Penn State. The approximate cost of building the processing system in July 2025 was $9,750; more details can be found on the investment sheet of the budget workbook (XLSX).[1]

Table 2 shows estimated equipment costs for establishing, maintaining, harvesting and processing chestnuts on a 10-acre farm as of 2025. Users can choose between a budget equipment option (primarily used equipment with shorter lifespans) and a quality equipment option (a mix of new and used equipment). Details on these assumptions — price, useful life, salvage value, depreciation, interest, repair rate, and annual average repair costs — can be found in the budget workbook (XLSX).[1] The budget assumes quality equipment by default, but this setting can be modified. Users should consider that older and less-capable equipment may not have the same capabilities and efficiency as newer models. More details on managing a chestnut orchard and a calendar briefly describing a grower's schedule can be found in the MU Center for Agroforestry publication Growing and Marketing Chinese Chestnuts (PDF).[2]

Harvesting

Harvest is the most labor-intensive part of growing chestnuts. Experts across Missouri generally accept that available mechanical harvesters are inadequate, and producers are better off collecting nuts manually using handheld wire basket nut-gathering tools. Existing growers estimate that an average unexperienced temporary worker can collect 50 pounds of chestnuts per hour. Daily sweeps of the orchard should be performed while nuts are falling to maximize nut quality. Nuts should be placed in cold storage the same day they are harvested to prolong shelf-life and reduce predation by birds and wildlife.

You will need to source labor before harvest begins at the end of September. A 10-acre orchard like the one modeled will likely need at least eight harvesters working eight-hour days during peak nut drop for an estimated 10 days. When the orchard is in full production and yielding 3,000 pounds per acre — an average of 300 pounds per acre per day — the assumption is that each harvester is gathering 400 pounds of nuts each day. The farm will need additional labor to support the postharvest processing (sorting, washing, and bagging) and moving the harvest into cold storage. Having more temporary workers available will reduce the number of hours each worker spends per day collecting, which may open your labor pool to students and full-time workers seeking additional income. The ideal harvesting situation is to collect all chestnuts the day they drop from the tree and place the nuts, washed or unwashed, in cold storage before nightfall. Consider paying harvest workers by the pound collected to incentivize efficiency and provide flexibility to their work schedule. In any case, adequate harvest labor is crucial for the success of a chestnut enterprise.

Chestnut orchard labor

Establishing and maintaining a chestnut orchard is more labor intensive than pecan production. Establishing the orchard is estimated to require 31 hours per acre in Year 1, with 14 hours of this time spent planting the trees. Maintaining the orchard in the years before harvest requires 21 hours an acre per year — five

hours of pruning, eight hours of mowing and other orchard maintenance, and eight hours of managing and maintaining the irrigation system. This time commitment continues annually during the orchard's lifespan, with the exception that pruning ceases when the trees are 15 years old. When harvest begins, the annual required labor hours increase depending on the volume of nuts to be collected and processed. The budget assumes all nonharvest labor hours are compensated at $18.50 per hour, and harvest workers are paid $0.50 per pound collected. You can modify the labor productivity assumptions and adjust expected labor costs per hour in the budget workbook (XLSX).[1]

Economics of Chinese chestnut production

Table 3 presents planning budget estimates for a Missouri chestnut orchard based on assumptions and prices in June 2025. Use the "Your estimate" columns in Table 3 to plan your chestnut operation's costs and returns. Detailed assumptions and capital investments are summarized in tables 1 and 2 above. Table 4 illustrates the potential returns to a 10-acre chestnut operation, based on the assumptions of this model, carried forward 20 years.

Long-term chestnut model summary

Because chestnuts are a perennial crop that is sensitive to drought, cultivar choice, soil types and late-spring frosts, yields can vary widely. The long-term model summary in the budget workbook (XLSX)[1] provides smoothed estimates of potential expected yields, costs and net income for 50 years after planting; your actual on-farm results will vary based on soil conditions, water availability, management, and pest and predator pressures.

At a production scale of 10 acres and based on the assumptions above, the farm is estimated to have some trees producing between 4 and 5 pounds of chestnuts per tree by Year 5, triggering the start of harvest activities and revenue generation. Table 4 provides more detail about the production, revenue generation and expenses of a 10-acre chestnut farm for 20 years after establishment.

The budget assumes the orchard will be thinned once, after which yield per tree increases as light, nutrient and water access increases. In practice, the yield increase after thinning will occur over multiple years as trees compensate for the change in their environment, rather than one year, as the model allows. The model follows average yield data from a variety of sources but does not account for natural disasters, pest or disease outbreaks, or other events that have a dramatic impact on orchard productivity.

The long-term model is an oversimplification of an extremely variable process to raise new trees in an orchard to maturity. Use the information presented by this model as an example for what orchard performance could be, not an expectation for the orchard that is to be planted.

Modeled annual net income and cumulative returns for planning purposes

Annual net income (revenue minus expenses) is estimated to be negative during years 1 through 10 while the orchard is growing and yields continue to increase to an average of 12 pounds per tree. During the first 10 years, the orchard is estimated to accumulate a deficit of around $21,000 per acre from the costs of establishing and maintaining the enterprise.

The chestnut enterprise is expected to continue to grow revenue over expenses, and the cumulative return to the enterprise is expected to be positive around Year 17, when average yields are around 81 pounds per tree.

Chestnuts can remain productive for a long period; the budget workbook (XLSX)[1] outlines 50 years of production costs and estimated revenue per acre and for the overall enterprise. Based on available recommended management practices, cultivars and yield assumptions, we estimate potential annual net income will be around $7,500 per acre by Year 15 and will continue to grow incrementally for another 25 years before full maturity and maximum yield potential have been obtained. Note that these assumptions are based on present day input costs, labor costs and retail prices as well as the structure of the current economy. Given that trees become a multigenerational farm investment, these estimates are provided for planning purposes only.

Table 3. Missouri 10-acre pecan budget, dollars per acre per year.

Item	Year 1 Planting	Your estimate	Years 2–4 Maintenance	Your estimate	Year 12 Commerical production	Your estimate
Chestnut production (pounds per tree)	0		less than 4		20	
Income per acre						
Chestnuts – retail					5,257	
Chestnuts – wholesale					944	
Operating costs per acre						
Establishment	2,154					
Soil tests	100		25		25	
Leaf tissue analysis	60		60		60	
Nitrogen	19		48		48	
Phosphorous	37		18		18	
Potassium	62		18		18	
Zinc sulfate	18		70		9	
Lime	60		15		15	
Broadcast herbicide	30		15			
Spot applied herbicide	20		30		20	
Insecticide	40		40		160	
Labor	315		379		855	
Irrigation water	27		27		41	
Mowing	30		50		50	
Fuel and utilities	300		150		200	
Facility and equipment repair	167		150		334	
Marketing and professional services	10		10		946	
Miscellaneous	10		10		10	
Operating interest	332		118		108	
Total operating costs	4,040		1,251		2,811	
Ownership costs per acre						
Depreciation on equipment	281		281		795	
Interest on capital investments	260		260		728	
Land charge	200		200		200	
Overhead, taxes and insurance	200		200		200	
Total ownership costs	941		941		1,923	
Total cost per acre	4,981		2,192		4,734	
Income over operating cost per acre	**–4,040**		**–1,251**		**3,390**	
Income over total cost per acre	**–4,981**		**–2,192**		**1,467**	

Table 4. Chestnut yields and economic outcomes on a 10-acre farm, by year in long-term model.

Production year	Tree population	Yield per tree (pounds)	Expected yield (pounds)	Annual revenue (dollars)	Total costs (dollars)	Net income (dollars)	Cumulative returns (dollars)
1	540	0	0	0	49,811	–49,811	–49,811
2	540	0	0	0	21,919	–21,919	–71,730
3	540	0	0	0	21,919	–21,919	–93,649
4	540	0	0	0	21,919	–21,919	–115,568
5	540	4.7	2,538	14,302	36,778	–22,477	–138,044
6	540	5.6	3,046	17,162	37,408	–20,246	–158,290
7	540	6.8	3,655	20,594	38,163	–17,569	–175,859
8	540	8.1	4,386	24,713	39,070	–14,357	–190,216
9	540	9.7	5,263	29,656	40,158	–10,502	–200,717
10	540	11.7	6,315	35,587	41,463	–5,876	–206,593
11	540	15.4	8,336	46,975	43,969	3,005	–203,588
12	540	20.4	11,004	62,007	47,278	14,729	–188,859
13	540	26.9	14,525	81,849	51,645	30,204	–158,655
14	540	35.5	19,173	108,041	57,410	50,631	–108,024
15	540	46.9	25,309	142,614	65,019	77,595	–30,429
16	270	61.9	16,704	94,125	80,481	13,644	–16,785
17	270	81.7	22,049	124,245	60,110	64,135	47,349
18	270	84.1	22,710	127,972	60,931	67,042	114,391
19	270	86.6	23,392	131,812	61,776	70,036	184,427
20	270	104.7	28,269	159,297	67,825	91,472	275,899

Note: All values except tree population and yield per tree represent the farm as a whole.

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