



**MIDWEST  
ELDERBERRY  
COOPERATIVE**

June 27, 2023

**2023 Advancing American Elderberry Project & Comprehensive Workshop**

Southwest Research Center & Center for Agroforestry, University of Missouri  
River Hills Harvest / Terry Durham

## **Report to American Elderberry Growers**

Christopher J. Patton, President

Commercial elderberry research began 25 years ago in 1998 as Andrew Thomas and Patrick Byers (University of Missouri Research & Extension) were enjoying a bottle of John Brewers' Wyldewood Cellars elderberry wine made from European elderberry concentrate. Commercial production of American Elderberry has come a long way since. If you are new to elderberry, you are benefitting from the dedication and work of many growers and researchers since then.

Co-sponsor Terry Durham (River Hills Harvest and MEC Director) was involved in the development of American Elderberry growers from this 1998 beginning with his first meaningful harvest being picked and processed in 2006. He launched the first "Growing the Grower" comprehensive workshop in 2009 and every year since except 2021. Thanks to his informative, enthusiastic and diligent grower outreach, I have attended all of those workshops since 2011. Friday morning he told his updated story. (For details see some of Terry's past presentations/videos at: <https://grow.midwest-elderberry.coop/presentations.html>.)

Andrew Thomas manages the \$5+ million 2021 Advancing American Elderberry Grant that sponsored the academic program for this combined event. This grant continues through 2025 and plans to conclude with a Second International Symposium on Elderberry on June 18-20, 2025 with annual meetings until then during the second week of June. You can get a good (and visual) overview, links to research papers, from their website: <https://elderberry.missouri.edu/>.

2023: 99 people in attendance with researchers from the Universities of California, Maine, Utah State, the diverse set of Missouri researchers along with a contingent of Canadian growers. Not all researchers are identified.

## HORTICULTURE & ENTOMOLOGY - UNIVERSITY OF MISSOURI

- ◆ **CJP Note:** All of the content is summarized from memory and notes, and much of it is subject to more research, local variability of soil, weather and predator conditions. Some of the 2022 research is repeated in context.
- ◆ Breeding research began recently with targeted pollination, which should yield data regarding questions of cross-pollination and berry set. Bob Gordon cultivar was selected for the base reference genome. Elderberry has diploid structure with 36 chromosomes. The complex *Sambucus canadensis* genome is 24,604 Mbp., while Soy is only 2,200 Mbp. As of 2021, 59 different genotypes identified, which demonstrates the great variety found in this ochlopecies.
- ◆ Despite identifying over 80 different insects on elderflowers, wind pollination seems to be the primary method. Research indicates that elderflowers are more receptive to pollen from other cultivars to set berries, while allowing self pollination after 72 hours. This indicates a better berry set if multiple cultivars are in bloom at the same time. How much of a factor this might be has not been quantified.
- ◆ 12 different cultivars/genotypes of elder are being grown in half acre plots at five different sites ranging northwards from Springfield, MO for 3-4 years. A total of 1400 plants were established in 2022. Plant health and metabolic connections relative to soil nutrients are studied in connection with characteristic phenology of cultivars and their variation by site/latitude: plant height, number of stems, time of flowering and fruiting, tissue samples, cyme weight, plant harvest weights, fruit size, etc.
- ◆ A propagation study of comparing two-node and four-node hardwood cuttings (only one node below ground in both cases) showed that, in general, planting earlier in the year is better and larger sticks succeed more consistently. [At a workshop about ten years ago, I learned that some Canadian growers prefer three-node cuttings planting the middle one at ground level. I have had great success with three nodes personally.]
- ◆ Mites continue to be a problem in more southern areas. Mites overwinter in bud scales. Best control from cutting, removing and burning canes that are infected. General control maintained by coppicing within 6" of ground in late fall/early winter and flailing canes in place. Spray canes with dormant oil in spring. Soaking cuttings in dormant oil greatly reduces the chance of

spreading mites, reducing potential infestation that weakens young plants. Mites may also be reduced by spraying neem oil at bud break.

- ◆ OMRI approved miticides are available if you have a big outbreak of mites to control. Mites overwinter on the bud shoots & pencil sized cane stems. If making cuttings, treat with dormant oil - dip cuttings in it.
- ◆ Weeds are a major problem during the first few years of elderberry orchard installation. The Weed Management Project is testing several approaches to managing weeds: woven fabric (3 ft. wide, slit in middle down length, irrigation on top, used by 30% of growers), wood chips (4 in. thick, used by 52% of growers, avoid Eastern Red Cedar-kills), cover crops (oats/buckwheat) planted in row that die and form a mulch, herbicide, managed (hand) control and doing nothing. (Note: 64% of growers irrigate and 81% of them use drip irrigation. Growers will mulch with hay, leaves or other materials than wood chips. Herbicide control is most often used by growers who have it on hand for other crops.) This is an ongoing project, so results were not quantified and rated.
- ◆ Using 15' between rows has become more common. Spacing still depends on the equipment used, as you want to make one pass to mow; however, you also need sufficient space between rows to facilitate harvest. You also do not want the rows to get more than 3-4" thick, or you won't have enough flowing air and sunlight to promote healthy plants and even ripening of the berries.
- ◆ If your farm usually gets very strong winds in the spring, you may want to plant your rows parallel to prevailing storm winds to reduce potential wind damage to young canes. The first set of canes facing directly into the wind side may be broken, but they will protect the ones behind them.
- ◆ Pests often come with weeds, and several pest projects are ongoing to identify and test the best management strategies for biological and cultural control. Over 80 different species of insects identified, 12 spiders and 3 mites. Working on a degree-day calendar for elderberry pests. (32% growers report no pest issues; 39% do not use any pest control)
- ◆ **Spotted Wind Drosophila (SWD)** like cool moist weather and dislike hot & dry, so they prefer to stay near the ground - keep grass short, keep rows 3-4 ft. wide and lower areas pruned to maximize sunlight and airflow. SWD life cycle is 10 days, and each female can lay 400 eggs in ripening fruit/

plant, so complete devastation can be quick. Larvae spend time in the ground.

- ◆ Freeze harvested fruit promptly to preserve freshness and kill any larvae in berries. Temps of 32-38F will slow development only for 12-24 hr. **Buyer/makers look for larvae in fruit** by dropping a few cymes in a bucket of salt water, which brings them out: 1 cup salt/gal.
- ◆ While neem oil may disrupt SWD larva in the soil, **Terry Durham mostly harvests ripening fruit promptly / more often - every 2-3 days, in addition to keeping grass mowed fairly short, harvesting lower flowers so that there is little fruit close to the ground, and plenty of moving air and sunlight on fruit.**
- ◆ Infected berry cymes should not be left on the plant or the ground. They need to be bagged and left in the sun long enough and hot enough to kill them, disposed of, or buried over 6 ft. deep.
- ◆ Smaller farms have successfully controlled SWD by using traps early in the season to attract and capture first arrivals to the orchard (May 15 in MO). Traps made with red Solo cups, 1/8" hole in lid filled with water, yeast, sugar, (apple cider) vinegar. + drop of soap. Place 12 traps/acre in the middle of the row within 12 in. of the ground. Mostly traps used to identify presence of pests - Century Red sticky cards and traps. If catch 3.5 mails in 24-48 with 3 traps/field, then there's 90% chance of infestation.
- ◆ Some small operations have opted for 1mm mesh netting, which is not cheap. ProtekNet has a 10-15 yr lifespan. Some research is underway in CA on imported Asian parasitoids that feed on SWD larvae. Looks good so far.
- ◆ Stink bugs and other sucking insects may be treated with neem oil.
- ◆ Japanese beetles (32% growers report issues) and SWD are treated by alternating Entrust (seven days) and Pyganic (12 hours) OMRI insecticides.
- ◆ Eldershoot Borer is a brown moth, about 1.5" across, lays eggs on the ends of growing shoots. A black headed white worm with polkadots eats its way down and kills the cane similar to raspberry tip borers. Manage by hand removal. Same for the large, colorful Elder Borer beetle.
- ◆ Elderberry Rust is an early season fungus (wet leaves 48-64F) that requires sedges for part of its lifecycle. Goes away to 80-85F. Remove by hand.

- ◆ Cane Dieback Disease occurs at the shoot tips in the early spring when the plant is growing rapidly. Spray with neem oil.
- ◆ Leaf Spot is a fungus that can reduce the amount of fruit to no fruit. Spraying copper is the solution, spraying in November before leaf drop or later before bud break.
- ◆ Commercial cultivation of elderberry in Maine has only worked on small scale using Adams, York, Scotia and Nova. They have not succeeded in scaling it up like with wild blueberries (50,000-100,000 lb./annually).
- ◆ 65% of growers market their own berries; 31% flowers; 50% cuttings; 41% other products; 36% sell at farmers markets; 64% on farm sales; 39% other market outlets; 30% other (like through MEC).
- ◆ **Jed Wiebe** (distributes to 40 stores; <https://www.elderberrygrove.ca/>) reported on his productive elderberry orchard in British Columbia, Canada. He detail/hand prunes a large number of both European and American varieties of elderberry. This approach shortens the time to harvest and helps to manage pests. One bud = one shoot, which gives one or more cymes. Small cyme plants, like European *S. nigra* need many (32-64) buds, while large cyme *S. canadensis* like Bob Gordon/Ranch, need fewer (16).
- ◆ Blue elderberry (*Sambucus cerulea*) native to areas west of the Rocky Mountains, grow 20-30 ft. tall and live about 30 years with no identified cultivars and variable fruit quality. They are heat and drought tolerant and may be multi-stemmed. The berries are nutrient dense and vary in composition from *S. canadensis*. Both flowers and berries are sold. (Sonja Brodt, Dir U of CA Sustainable Ag Research & Education program)
- ◆ **Dr. Brent Black from Utah State** presented his journey into trialing blue elderberry in Logan Canyon, where fruit is grown between 4200-5000 ft. elevation. Main crop is tart cherries but also peaches, apples, raspberries and grapes. Utah is the second driest state after Nevada, and the soil has a 7.5-8.5 pH. Blue elder so grow there, but propagation is difficult.
- ◆ **Health** In 2022 Dr. Chung Ho Lin (UMO) introduced metabolic analysis of American elderberry's health promoting compounds. Using high resolution spectrographs across 21 cultivars, their team identified 32 health producing compounds of usable quantity (out of 173 bioactive compounds) with antiviral, immunomodulating, antioxidant, anti-

inflammatory, antibacterial and insulin-stimulating properties. A key question is how much and how often does a person need to consume to enjoy any of those benefits and to what degree. He also saw strong potential to increase elder berry and flower extracts in cosmetics.

- ◆ This year Dr. Chung reported on the U of MO's continuing, research projects, which identified elderberry's ability to inhibit RNA endonuclease function, thus inhibiting viruses' ability to attack healthy cells and reproduce.
- ◆ His associate, Dr. Isa Kupke presented on her research and trials are being done at the U of MO using elder berries and flowers in cosmetics and skin care. They extract tinctures using ethanol, propylene glycol and Hielscher ultrasound equipment.
- ◆ **Powder** is the ingredient format easiest to store (having a long shelf life) and use by commercial food and beverage makers. Spray or freeze drying elderberries presents two primary challenges: the powder is very hygroscopic, absorbing water quickly, which causes clumping, and the anthocyanins are unstable. The berries are consistently high in quercetin, one of the flavonols, and Vitamin C. BRIX consistently ranges between 8-13. Pomace by-product from juicing is another source of powders used in food colorants as a source of cyanidins.
- ◆ In 2022 Kiruba Krishnaswamy (UMO) reported positively on the feasibility of spray drying elderberry juice using a screen to remove seeds. Besides being more economical than freeze drying, their research showed that elderberry powder's clumping can be solved by mixing it with a small amount of protein powder. So far the best results come from mixing with 8% soy protein to create a free flowing powder. The proteins migrate to the surface of the dried particles, which reduces their attraction to water. Another processing quality factor: Vitamin C is also very sensitive to oxygen, resulting in discoloration.
- ◆ **Brain Health** Dr. Michael Greenlief (UMO) updated his proteomics studies of the brain's microglial cells. (See the above chart.) In 2022 he noted that the quercetin common to all cultivars, along with other polyphenol flavonols, reduce brain cell inflammation. They found that combining quercetin and DHA from fish oil (salmon, for example) was even more effective. Nerve cells degenerate when inflamed, which is considered a primary reason for cognitive loss with aging, so elderberry should help.

# Preliminary investigation of the effects of elderberry juice on cognition in mild cognitive impairment

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## INTRODUCTION

- Currently, more than 6 million Americans are living with Alzheimer's disease (AD)<sup>1</sup>.
- Mild Cognitive Impairment (MCI), a prodromal phase of AD, has been identified as a risk factor for later AD diagnosis<sup>2</sup>.
- Little research, however, has been successful in identifying non-invasive effective treatments to slow the progression of cognitive decline.
- Elderberries have been shown to have anti-inflammatory and antioxidant effects, which shows promise for improving cognition<sup>3</sup>.
- Evaluating the effect of elderberry, a non-invasive nutritional intervention on cognition, is critical to determine whether the course of dementia can be altered in this vulnerable population.

**GOAL:** To examine the effect of elderberry juice on cognitive function in MCI patients

## METHODS

### Participants

- Diagnosed with MCI and aged 50+ years of age
- Clinical Dementia Rating Scale (CDR) score of 0.5
- Mini Mental Status Examination (MMSE) 24+/30,
- Report no known sensitivity to elderberry products
- No current diagnosis of diabetes, presence of a bleeding disorder, currently pregnant
- No other neurodegenerative diseases (e.g. MS).



### Procedure

- Participants were randomly assigned to either receive **elderberry juice** (5 ml by mouth, diluted in 8oz of water) or a **placebo juice** (colored, flavored liquid with no nutritional content three times daily).
- During a total of 3 visits (baseline, 12 weeks after baseline, 6 months after baseline), participants were tested on a variety of cognitive measures.

### Cognitive Measures

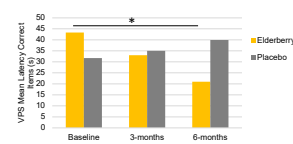
- Hopkins Verbal Learning Test (HVLt)**
  - Assesses verbal memory
- Anagrams**
  - Assesses reasoning
- Rey Complex Figure Test**
  - Assesses visuospatial ability
- Visuospatial Problem Solving (VPS) Battery**
  - Adapted from "matchstick" problems, assess spatial cognitive flexibility

### Statistical Analyses

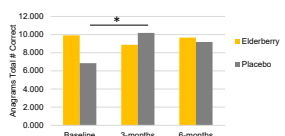
- Multilevel Modelling (SPSS V. 27, AR1 covariance structure) tested fixed effects of group (Elderberry, Placebo), time (baseline, 3-months, baseline, 6-months) and the group by time interaction
- Pairwise comparisons within groups over time examined for both significant effects (alpha  $\leq$  .05) and trends (alpha  $\leq$  .10).

## RESULTS

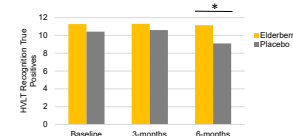
Variable	Elderberry (n=11)	Placebo Control (n=13)
Mean (SD)	Mean (SD)	Mean (SD)
Age	76.45 (8.47)	76.23 (7.73)
Sex (M/F)	8/3	7/6
Race Ethnicity (%)		
White/Caucasian	(11, 100%)	(13, 100%)
Black/African American	(0, 0%)	(0, 0%)
Native American/American Indian	(0, 0%)	(0, 0%)
Education (%)		
Less than High School	(0, 0%)	(0, 0%)
High School or Equivalent	(6, 46%)	(3, 23%)
Associate's Degree	(1, 9%)	(0, 0%)
Bachelor's Degree	(1, 9%)	(4, 31%)
Master's Degree	(3, 27%)	(5, 38%)
Doctoral Degree	(1, 9%)	(1, 8%)



For VPS Latency, Group x Time interaction was trending towards significance at 6-months (p = .10). For Elderberry group only, performance was trending towards improvement at 6-months (p = .10).



For Anagrams Total Correct performance, Group x Time interaction was significant at 3-months (p = .01). For Placebo group only, performance improved at 3-months (p = .01).



For HVLt Recognition, Group x Time interaction was trending towards significance at 6-months (p = .10). Elderberry performed better than Placebo at 6-months (p = .009).

## DISCUSSION

- Preliminary findings suggest that elderberry juice may provides slight benefit to objective cognitive function in patients with MCI
- Benefits of the supplement appear to be related to recognition memory and visuospatial processing.
- Future planned work will examine the impact of elderberry vs. placebo on blood-based biomarkers of inflammation to better understand potential mechanisms of action.
- Studies with larger samples evaluating longer-follow-up effects are warranted.



**Elderberry juice may provide some benefit to recognition memory and visuospatial problem solving in MCI patients**

## Acknowledgements

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## References

- Matthews, K.A., et al., 2018.
- National Institute of Aging, 2022.
- Zafra-Stone, S., et al., 2007.

The university has done both lab and mouse model studies that indicate positive signaling for functional pathways to indicate potential improved behavior. At this early point in research, Bob Gordon berries seem to be richer in the brain specific nutrients than other cultivars.

- ◆ This year, David Beversdorf, MD, MU Prof of Radiology, Neurology, Psychological Sciences reported on a limited clinical study to see if elderberry juice could slow the progression of Alzheimers Disease in people. The participants were not diabetic and did not yet suffer enough from the disease to impair function. The hypothesis is that the elderberry juice would reduce brain inflammation and slow decline. During this double blind test half received 5 ml of elderberry juice in 8oz of water, and half received colored water for 6 months. Their cognitive abilities were assessed at the beginning, after 12 weeks and at the end using a Hopkins Verbal Learning Test and Visuospatial Problem Solving Test. The elderberry group trended better in this small sample.

- ◆ **Katie Reneker** - Carmel Berry, CA (<https://carmelberry.com/>) Katie and Ben Reneker's interest in the elderberry started at home and quickly grew into their wider elderberry farming community. When their two boys grew to school age, the family started looking into ways to chase off classroom bugs and discovered their fondness for an immune-supporting morning shot of elderberry syrup. Because the products came from Europe, Katie was surprised and delighted when she began identifying these captivating plants growing wild in her local community.

Katie soon began growing her own American Elderberries and created Carmel Berry Co., one of the first elderberry brands to source domestically. Even though she has lost access to her orchard, Katie tirelessly champions new elderberry growers, offering workshops, mentorships, and grants and thoroughly enjoys every opportunity to be out in the fields or sharing with others her enthusiasm for elderberries! (MEC member)

- ◆ **Food Safety & Sustainable Elderberry Production** - Patrick Byers, MU Cooperative Extension Service Field Specialist in Commercial Horticulture. Patrick formally presented twice, and some of his horticultural contributions appear elsewhere in this report. In regards to food safety, he emphasized the importance of keeping good records. This is our best tool to improve as well as to protect our credibility with authorities, so avoiding onerous penalties. He discussed best practices and cottage production laws, which may be broadly similar across stateliness, but significant differences between states require growers to work well with local rules and officials.

If you plan a serious investment of time and money in inform production, then consider first a set of planning sessions with inspectors and a GAPS audit (\$1000) once you are ready for production. A dependable, potable water source is critical. Test any source from your property. Use a good fruit/vegetable sanitizer EPA approved, test for correct concentration. Set up a sanitation schedule and record test results. Product lots are framed by cleaning events. Use a lot code. (River Hills Harvest has one.) Monitor storage equipment. Freezer daily temperature log. Drying is a kill step.

Fence out animals pre-harvest. Apply manure in the late fall. Document compost use. Compost should reach 130F. Soil test then foliar test in early stages. Planting berms 3-4 ft. wide and 12-18 in. high. Tensiometer and soil blocks to monitor moisture. Elder need 1.5-2 in. water/week. Drip irrigation



with 18 mm tube and emitters at 18 in. for fertigation. Sandy soil needs more frequent but shorter cycles. Apply Nitrogen at 80 lb./acre on average. Dry applications of ½ in spring and then weekly until September 1. Elder infected with viruses have curly edged leaves, looking similar to damage from herbicide drift.

**Ripe fruit stats:** BRIX 11-13, juice pH 4.5-4.8, titratable acidity .85-.92.

- ◆ **Midwest Elderberry Cooperative's Commercial Growth Plan.** You will find my presentation online (<https://grow.midwest-elderberry.coop/presentations.html>). For a written summary of it, go to the Project 22-50 June 2023 Update based on this presentation. (<https://grow.midwest-elderberry.coop/project-22-50/project-22-50-updates.html>)