



Overview of Elderberry Nutrition in Missouri



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Outline

- Introduction
- Understanding the supply of essential elements
- Avoidance and correction of nutrient deficiencies
- Selecting and applying fertilizers

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Introduction

- There is much that we don't know with precision regarding elderberry nutritional management.
- Models developed for other crops may be useful

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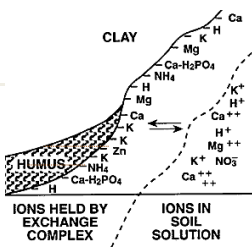


Introduction

- The essential elements
 - Elderberries, like other crops, require adequate supplies of all essential plant nutrients for optimum growth and yield
 - Most soils contain adequate or near-adequate quantities of all nutrients.
 - Nitrogen, phosphorous, potassium, and magnesium are the nutrients most likely to limit production in the Midwest.

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UNDERSTANDING THE SUPPLY OF ESSENTIAL ELEMENTS

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Understanding Cations

- Cation exchange capacity –
 - the total amount of negative charge a soil has to attract cations
 - What are cations?
 - » Positively charged nutrients – potassium (K), magnesium (Mg), calcium (Ca), and ammonium (NH₄)
 - What determines CEC?
 - » the amount of clay
 - » organic matter
 - » soil pH
 - Soils with higher CEC levels have greater plant nutrient holding capacity

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Understanding Cations

Textural Class	CEC (cmol _c /kg)
Sand	3 to 5
Loam	10 to 15
Silt Loam	15 to 25
Clay and Clay Loams	20 to 50
Organic Soils	50 to 100

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Understanding Cations

- Base saturation
 - the fraction of the CEC that is satisfied by Ca, Mg, K, and Na
 - related to soil pH
 - higher pH generally means higher base saturation, improved soil fertility

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Understanding Cations

- Soil pH
 - slightly acidic soils (5.5-7.0) generally have better nutrient balance for plant growth
 - why maintain soil pH at optimum level?
 - Improved base saturation
 - High amounts of Fe and Al precipitate P out of the soil solution, making P unavailable at low or high pH
 - Aluminum toxicity can result in low pH soils – reduced root growth
 - Beneficial soil organisms inhibited in acidic soils
 - Availability of micronutrients increases at low soil pH
 - Direct toxicity symptoms
 - Deficiencies of other elements – see above

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Understanding Cations

Soil pH and macronutrient availability

pH (salt)	Percent Nutrient Availability		
	Nitrogen %	Phosphorus %	Potassium %
4.0	30	23	33
4.5	53	34	52
5.0	77	48	77
5.5	89	52	100
6.5	100	100	100

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Understanding Cations

- Cation balance
 - magnesium and potassium balance is important
 - as soil pH increases (result of liming), magnesium availability increases, and can compete with potassium in the soil and in plant uptake
 - good idea to monitor potassium, and apply if needed, after liming or applying magnesium

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Nutrient Anions and Organic Matter

- Phosphorus availability
- Organic matter

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source: omatfra.gov.on.ca

AVOIDANCE AND CORRECTION OF NUTRIENT DEFICIENCIES

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Soil Analysis

- Detailed soil analysis must be made prior to elderberry establishment, and at intervals during the life of the planting
 - soil pH
 - soil nutrient content
- Collect and submit a representative sample
- Submit top 8 inches and second 8 inches separately

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Soil Analysis

- Recommended soil test results (Missouri) – based on grape and blackberry
 - soil pH – 5.5 to 6.5
 - soil organic matter – 2-3%
 - phosphorus – 40-80 lbs/A = medium
 - potassium – 110-220 lbs/A = medium
 - magnesium – 200-250 lb/A = medium

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Soil Analysis

- Adjusting soil pH with liming materials
 - extremely important to do this before establishment
 - very difficult to change soil pH in all but the top few inches of soil once plants are planted
 - lime is most effective if incorporated deeply and thoroughly

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Soil Analysis

- liming existing plantings
 - monitor soil pH with regular soil testing
 - remember problems with limited effectiveness of surface lime applications; consider routine applications of high quality lime
 - rescue applications – if soil pH has dropped below 5.5
 - broadcast recommended rate and chisel plow 8-10 inches deep
 - do alternate row middles in alternate years to minimize the effects of root damage
 - do in late winter and cultivate prior to bud break

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Plant Tissue Analysis

- Reveals the concentration of elements in tissue
- To be meaningful, analysis must entail:
 - **standardized tissue sample procedure**
 - accurate and precise analytical methods
 - **standard references to compare diagnostic sample values**
 - **means of interpreting diagnostic data and making fertilizer recommendations**
- Useful for:
 - Routine nutrient status evaluation
 - Troubleshooting suspected nutrient problems

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Elderberry Plant Tissue Analysis



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Materials and Methods

- Study conducted at two sites
 - MSU State Fruit Experiment Station
 - MU Southwest Center
- 3 cultivars/selections
 - ‘Bob Gordon’
 - ‘Adams 2’
 - ‘Netzer’

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Materials and Methods

- Two types of tissue collected
 - Leaves from new shoots that arise from crown
 - Leaves from shoots that arise from old shoots
- Three collection times
 - After spring flush
 - At bloom time
 - At harvest time

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Materials and Methods

- Fully expanded leaves collected from mid shoot; each sample consisted of 25 leaves
- Leaves dried, ground, and analyzed for nutrient content
- Nutrients analyzed - N, P, K, Ca, Mg, Zn, Fe, Mn, Cu, and B

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Results

- N, P, Fe, Zn, and Mn were highest during the spring flush collection period
- Cu was highest at anthesis
- Ca, Mg, and B were highest at fruit ripening
- As a general trend, the elements N, P, K, Fe, Zn, and Mn were at higher levels early in the season (spring flush to anthesis), while the elements Ca, Mg, and B were higher later in the season.

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Discussion

- How do we evaluate a fertility program?
 - plant appearance
 - plant growth
 - productivity
- What about foliar analysis?
 - measuring actual elemental uptake by the plant
 - predicting elemental disorders in advance of visible symptoms
 - diagnosing visible elemental disorders

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Discussion

- Leaf elemental content measurements are made at times during the growth cycle when these elements are at maximum or stable levels
- A tissue type is selected that consistently contains high elemental levels

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Discussion

- Based on this study:
 - Foliar collection times following spring growth flush for N, P, K, Fe, Zn, and Mn
 - Foliar collection times at fruit ripening for Ca, Mg, and B
 - Sample leaves from new shoots originating at the crown
- For troubleshooting, collect samples at any time

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Plant Tissue Analysis

Estimated elderberry petiole nutrient sufficiency levels

Macronutrients	%	Micronutrients	mg·kg ⁻¹
Nitrogen	4.47	Iron	71
Phosphorus	0.39	Manganese	147
Potassium	2.82	Boron	63
Calcium	1.60	Copper	8
Magnesium	0.60	Zinc	24

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Plant Tissue Analysis

Grape petiole nutrient sufficiency levels

Macronutrients	%	Micronutrients	ppm
Nitrogen	1.70-3.00	Iron	40-300
Phosphorus	0.15-0.50	Manganese	30-150
Potassium	1.50-2.00	Boron	30-100
Calcium	1.30-3.00	Copper	5-50
Magnesium	0.30-1.50	Zinc	25-100

Source: MU Soil and Plant Testing Laboratory

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Visual observations

- How to diagnose problems – examine the pattern of the problem
 - within the planting
 - pattern on a given plant
 - pattern on a particular leaf

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Visual observations

- Symptoms of nutritional disorders
 - poor leaf color
 - poor fruit set
 - weak growth
 - delayed fruit maturity
 - excessive vigor
- Watch out for other factors – disease/insect problems, herbicide damage, water stress, overcropping

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source: Brie Menjoulet

SELECTING AND APPLYING FERTILIZERS

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Choosing a fertilizer

- Analysis of fertilizer
- Acid forming fertilizers
- Cost per unit of nutrient
- Dry and liquid fertilizers
- Organic fertilizers

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When to apply a fertilizer

- Nitrogen containing fertilizers
 - During periods of active uptake (based on grape)
 - Bloom to 6 weeks post-bloom
 - Can split the application
 - Post harvest applications useful to address current season problems
 - Annual rate – 60-80 lb/acre (based on blackberry)
- Phosphorus, potassium, other nutrients – anytime

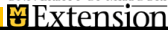
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Other considerations

- Apply fertilizers over the root system
 - Sodded row middles – band under plants
 - Clean cultivation – broadcast over floor
- Foliar applications (no experience)
 - generally short term correction of problems
 - Use soluble forms
 - Use caution when mixing with pesticides

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Any Questions?



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