Perennial Vegetable Nutrition

Eric Toensmeier

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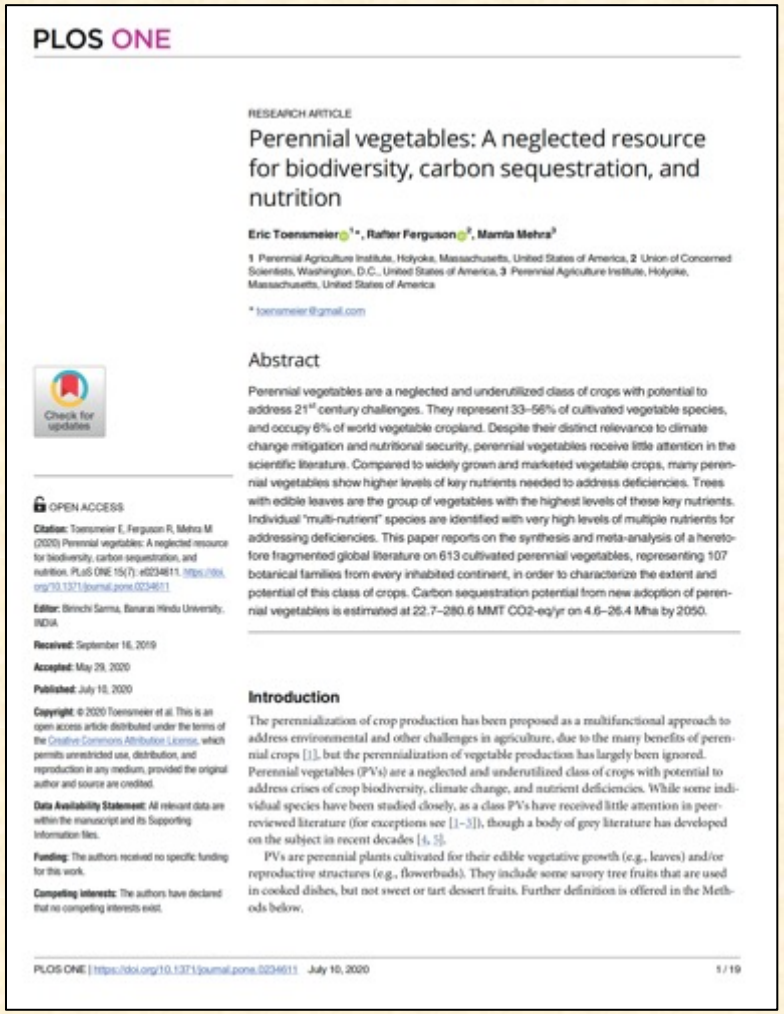
- Literature search and analysis
- Over 300 annual and perennial vegetables
- Peer-reviewed paper
- Free download
- Nutrition spreadsheet on patreon/erictoensmeier



PLOS ONE

RESEARCH ARTICLE

Perennial vegetables: A neglected resource for biodiversity, carbon sequestration, and nutrition

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Abstract

Perennial vegetables are a neglected and underutilized class of crops with potential to address 21st century challenges. They represent 33–56% of cultivated vegetable species, and occupy 6% of world vegetable cropland. Despite their distinct relevance to climate change mitigation and nutritional security, perennial vegetables receive little attention in the scientific literature. Compared to widely grown and marketed vegetable crops, many perennial vegetables show higher levels of key nutrients needed to address deficiencies. Trees with edible leaves are the group of vegetables with the highest levels of these key nutrients. Individual "multi-nutrient" species are identified with very high levels of multiple nutrients for addressing deficiencies. This paper reports on the synthesis and meta-analysis of a heretofore fragmented global literature on 613 cultivated perennial vegetables, representing 107 botanical families from every inhabited continent, in order to characterize the extent and potential of this class of crops. Carbon sequestration potential from new adoption of perennial vegetables is estimated at 22.7–280.6 MMT CO2-eq/yr on 4.6–26.4 Mha by 2050.

Introduction

The perennialization of crop production has been proposed as a multifunctional approach to address environmental and other challenges in agriculture, due to the many benefits of perennial crops [1], but the perennialization of vegetable production has largely been ignored. Perennial vegetables (PVs) are a neglected and underutilized class of crops with potential to address crises of crop biodiversity, climate change, and nutrient deficiencies. While some individual species have been studied closely, as a class PVs have received little attention in peer-reviewed literature (for exceptions see [1–3]), though a body of grey literature has developed on the subject in recent decades [4, 5].

PVs are perennial plants cultivated for their edible vegetative growth (e.g., leaves) and/or reproductive structures (e.g., flowerbuds). They include some savory tree fruits that are used in cooked dishes, but not sweet or tart dessert fruits. Further definition is offered in the Methods below.

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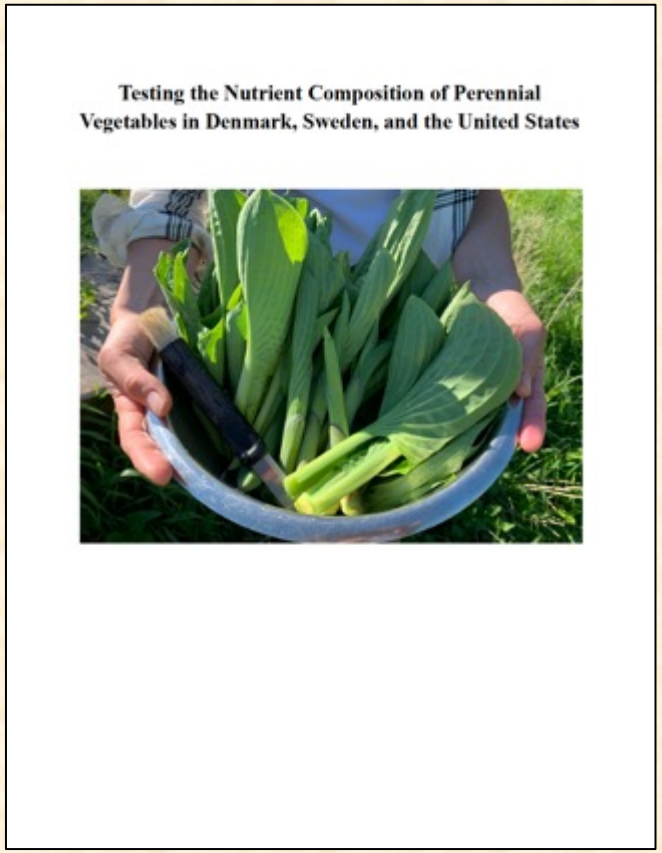
Paper Two

- Original research
  - Perennial Agriculture Institute (USA)
  - Myrrhis Forest Garden and Agroforestry Project (Denmark)
  - Robinson Hill Beef's Perennial Vegetable Research Project (USA)
  - Skillbyholm Research (Sweden)
  - Edgewood Nursery (USA)
  - Mångfaldsträdgården (Sweden)
  - Puttmyra Forest Garden (Sweden)
- Self-published
- Free download



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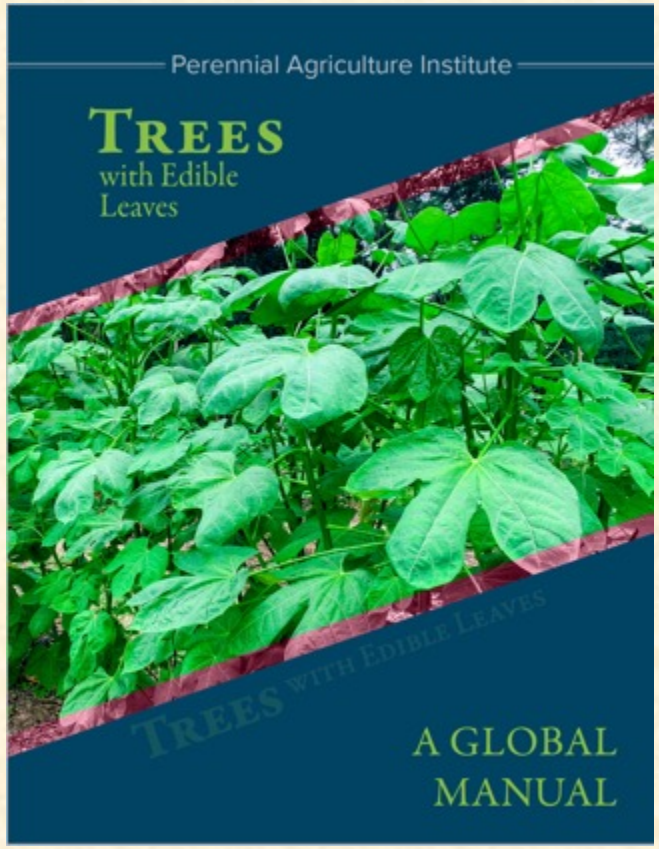
Trees with Edible Leaves

- Additional literature search
- Self-published
  - English
  - Spanish
  - French (soon!)
- Free downnload



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Nutrition: Nutrient Deficiencies

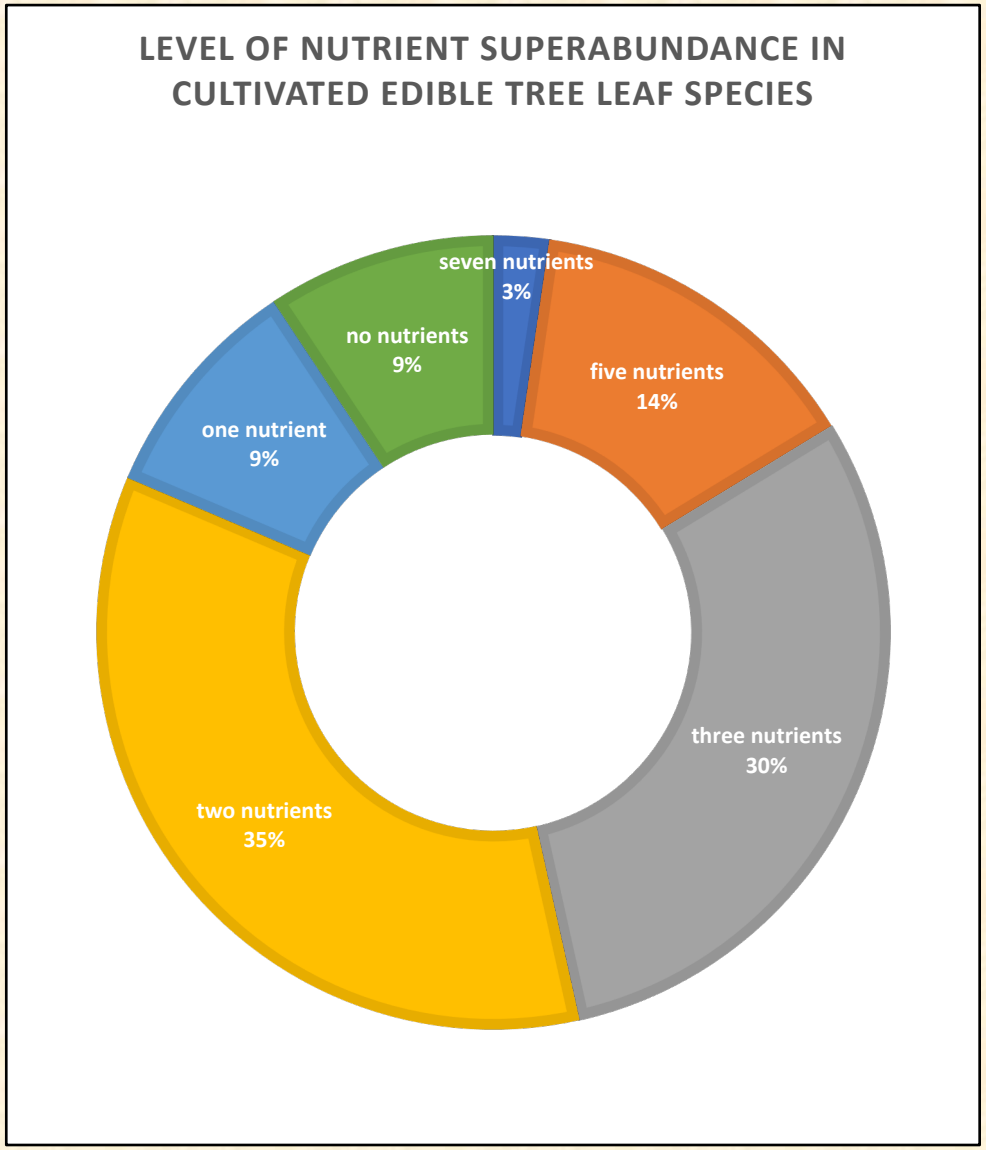
	Nutrients missing	Health impacts
Traditional malnutrition	Iron, zinc, vitamin A, folate, (iodine)	Anemia, congenital disorders, impaired immune systems, blindness and slowed growth in children
Industrial diet deficiencies	Fiber, calcium, magnesium, vitamins A, C, E	Diabetes, obesity, high blood pressure, heart disease, osteoporosis

- Billions of people are lacking these nutrients
- Meeting demand requires tripling global vegetable and fruit production

Toensmeier et al (2020) “Perennial vegetables: A neglected resource for biodiversity, carbon sequestration, and nutrition”

Superabundant species

- Higher levels of key nutrients than any commonly marketed reference vegetables



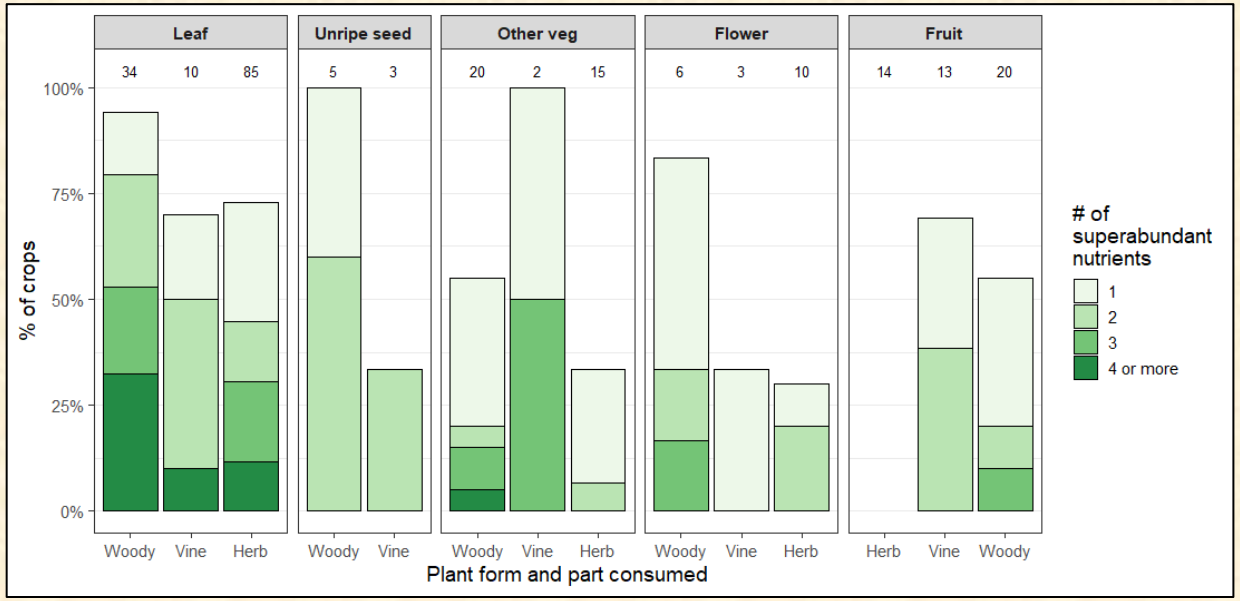
Toensmeier et al (2022) *Trees with Edible Leaves: A Global Manual*

Superabundant Perennial Vegetables

	Fiber	Calcium	Magnesium	Vitamin A	Vitamin C	Vitamin E
Extremely high	*Eleutherococcus senticosus, E. trifoliatus, Vitis vinifera*	*Angelica keiskei, Atriplex halimus, Eleutherococcus trifoliatus, Morus alba, Morus hybrid*	*Atriplex halimus, Lycium chinense*	*Crambe maritima, Eleutherococcus trifoliatus, Lycium barbarum, Scorzonera hispanica, Taraxacum campylodes, Toona sinensis, Vitis vinifera*	*Asclepias syriaca*	*Angelica keiskei, Eleutherococcus senticosus, Humulus lupulus, Lycium chinense, Silene vulgaris, Toona sinensis, Urtica dioica*
Very high	*Atriplex halimus, Beta vulgaris maritima, Chenopodium bonus-henricus, Crithmum maritimum, Dystaenia takesimiana, Eleutherococcus nodiflorus, Gundelia tournefortii, Humulus lupulus, Kalimeris indica, Kalopanax septemlobus, Morus alba, Myrrhis odorata, Osmunda japonica, Scorzonera hispanica, Silene vulgaris, Typha angustifolia, T. latifolia, Ulmus pumila*	*Asclepias syriaca, Eleutherococcus trifoliatus, Hosta longipes, H. sieboldiana, H. sieboldii, Plantago major, Salix reticulata, Toona sinensis, Urtica dioica, Vitis vinifera*	*Crithmum maritimum, Eleutherocccus nodiflorus, Epilobium angustifolium, Hablitzia tamnoides, Kalopanax septemlobus, Morus alba, Morus hybrid, Salix reticulata, Vitis vinifera*	*Asclepias syriaca, Atriplex halimus, Chenopodium bonus-henricus, Eleutherococcus senticosus, Houttyunia cordata, Rumex arcticus, Salix pulchra, Silene vulgaris*	*Aegopodium podagraria, Allium ursinum, Chenopodium bonus-henricus, Diplotaxis tenuifolia, Epilobium angustifolium, Hosta sieboldiana, Morus alba, Polygonum bistorta, Salix pulchra, Toona sinensis, Urtica dioica*	*Aralia elata, Houttyunia cordata, Taraxacum campylodes*

Multi-Nutrient Species

- For key nutrients
- Higher levels than commonly marketed vegetables
- For multiple nutrients
- Trees with edible leaves rate highest



Top Woody Species for Industrial Diet Deficiencies

Atriplex halimus

Eleutherococcus senticosus

Eleutherococcus trifoliatus

Lycium chinense

Morus alba

Toona sinensis

Vitis vinifera

Top Herbaceous Species for Industrial Diet Deficiencies

Asclepias syriaca

Bunias orientalis

Chenopodium bonus-henricus

Epilobium angustifolium

Hablitzia tamnoides

Silene vulgaris

Urtica dioica

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