SPECIALTY CROP DEVELOPMENT FOR TEMPERATE AGROFORESTRY SYSTEMS: SUSTAINABLE MANAGEMENT, MARKETING AND PROMOTION FOR THE MIDWEST REGION OF THE USA

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Abstract

Farmers and rural communities across the American Midwest face numerous sustainability challenges, both economic and environmental. Agroforestry practices present a more sustainable alternative, but key to success is the selection and development of appropriate species to integrate into these systems. The University of Missouri Center for Agroforestry (UMCA), with long-term goals of creating viable on-farm enterprises and promoting the adoption of practices that can contribute to enhanced ecosystem services across the landscape, has focused on the research and development of regionally adapted and promising specialty crops for agroforestry through a comprehensive, multi-foci approach. Key components include breeding and selection of improved cultivars, research and dissemination of production techniques, market research, consumer education and support to growers. This presentation provides an overview of recent advances and remaining challenges of these ongoing efforts.

Keywords: specialty crops; improved cultivars; market development

Introduction

Agriculture is the dominant land use across the American Midwest and the region is home to some of the most agriculturally intensive production in the world. Approximately 66.8 million hectares across the region are under some form of commodity agriculture, just over 50% of the total land surface. U.S. agricultural and rural communities face ongoing challenges including profitability and environmental stresses that threaten the livelihoods and well-being and long-term environmental sustainability of many who work the land and/or live in rural areas. Agroforestry practices present a more sustainable alternative to conventional agricultural practices. An important consideration in the design and promotion of agroforestry systems (AFS) is the selection and development of appropriate species that can be successfully integrated into these systems. For example, comprehensive efforts are underway to develop hybrid hazelnuts as a “third crop” for Midwest agriculture (Molnar et al. 2013). Previous work at the University of Nebraska, beginning in 1999, evaluated the potential of 30 species of fruit and [illegible]eat. The data from these trials confirmed that a market driven approach to encourage natural resource conservation through agroforestry specialty crops can be a viable approach for the region (Josiah et al. 2004).

The University of Missouri Center for Agroforestry (UMCA), recognizing the importance and potential of specialty crops for design of robust, ecologically sustainable and economically productive agroforestry systems, has placed an emphasis on the research and development of regionally adapted and promising specialty crops. This includes genetic improvement and the release and promotion of cultivars of familiar species like native eastern black walnut – (Juglans nigra) as well as lesser known species such as non-native Chinese chestnut – (Castanea mollissima) for managed production within an agroforestry practice.

This presentation provides an overview of UMCA's comprehensive approach to specialty crop development, with an update on advances and remaining challenges of ongoing efforts with specific candidate species: chestnuts (*Castanea mollissima*), black walnuts (*Juglans nigra*), elderberry (*Sambucus canadensis*), pawpaw (*Asimina triloba*), hybrid pine for pine straw (*P. taeda* x *P. rigida*), shiitake (*Lentinula edodes*). The long-term goals include creating viable on-farm enterprises and promoting the adoption of practices that can contribute to enhanced ecosystem services across the landscape.

UMCA's comprehensive approach to specialty crop development includes multiple foci:

1. Develop, test, and deploy improved cultivars
2. Research, test and disseminate field production and management techniques
3. Conduct market, consumer and value-added research
4. Increase consumer awareness and demand (creating market "pull")
5. Create financial decision support tools
6. Provide grower training and support to promote industry "grower clusters" or coops

Development and testing of improved cultivars

To develop a new chestnut industry in Missouri and surrounding states, it has been important to conduct long-term studies that directly compare *C. mollissima* cultivars at the same location or locations over multiple years to determine their local adaptation and performance (Gold and Hunt 2002). At the University of Missouri Horticulture and Agroforestry Center, New Franklin, Missouri, Center for Agroforestry scientists established a collection of 65 known *Castanea* cultivars from 1996 through 2005 in a germplasm repository for long-term evaluation (Hunt et al. 2004).

A second more limited cultivar trial was established in 1999 in an effort to identify outstanding, locally-adapted cultivars that have traits suitable for commercial chestnut production (e.g., large size nuts and high yields). A replicated cultivar trial, with twelve cultivars and five replications (one tree per replicate) of *C. mollissima* and chestnut species hybrids, was established in 1999. Each fall from 2008 through 2011, plus 2015, nuts were collected, counted, and weighed for each tree and combined to determine yield and average nut weight (Table 1).

Over several decades, UMCA has evaluated dozens of improved cultivars of black walnut. A key target criterion for improvement has been the nut yield ratio. Nutmeat from the nuts of wild trees can average between 7-10% of total weight (nutmeat/shell ratio). Nut yield in cultivars under study at UMCA is averaging around 30% kernel, with some cultivars demonstrating consistent nut yields up to 38% (Coggeshall and Romero-Severson 2013).

Table 1: Average yield per tree (kg and lbs) and per acre (hectare) summed over 4 years, 2008-2011, plus 2015

Cultivar	2008-2011 Average yield / tree kg tree / lbs tree		2015 (Age 16) Average yield / tree kg tree / lbs tree		2008-2011 Average yield / ac. kg hectare/ lbs Acre		2015 Yield kg hectare / lbs acre	
Colossal	42.1	92.6	---	---	5,187	4,631	---	---
Qing	24.0	52.8	42.9	94.4	2,957	2,640	5,285	4,719
Eaton	14.8	18.0	34.6	46.0	1,823	1,628	2,575	2,299
Sleeping Giant	11.3	17.6	29.9	58.7	1,392	1,243	3,289	2,937
Homestead	8.2	14.7	20.9	44.2	1,010	902	2,476	2,211
Mossbarger	8.0	13.6	26.7	70.4	986	880	3,942	3,520
OK-Kwang	6.7	52.8	20.1	76.1	825	737	4,263	3,806
Peach	6.2	32.6	32	65.8	764	682	3,684	3,289

Market research and development

Launching and growing a specialty crop industry is more likely to achieve success when it is "pulled" along by market forces and when development efforts follow a market-oriented strategy. However, for new or emerging niche specialty crops, there is often a lack of detailed market information. Therefore, research into market dynamics and potential has been essential. An important tool guiding much of this research is the Porter Five Forces Model (Porter 1980) (Figure 1).

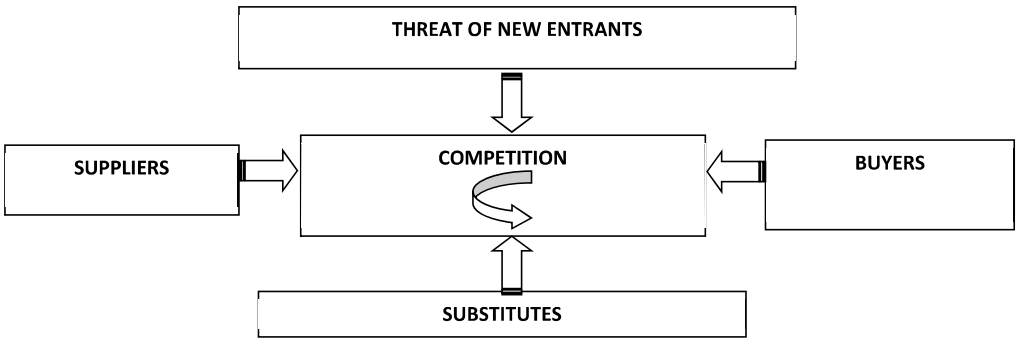

Figure 1: The Porter Five Forces Model (PFFM) (Porter 1980).

This framework is a useful guide for analyzing competition within an industry and considers five areas of competition (competition among producers, bargaining power of suppliers, bargaining power of buyers, potential for substitutes and threat of new entrants) and interaction between these "forces" which defines an industry's structure and nature of the competition (Cernusca et al. 2012). The methodology is particularly useful for farm businesses that are looking to enter new markets, the typical case for agroforestry practices that integrate niche specialty crops.

A nationwide survey of U.S. chestnut (*Castanea spp.)* producers was conducted using a variety of tools (i.e., Strength-Weakness-Opportunity-Threat (SWOT) analysis, the Porter Five Forces Model, Conjoint Analysis choice preference questions) to understand the U.S. chestnut market (Gold et al. 2006). Results indicated that the U.S. chestnut industry is in its infancy. The majority of chestnut producers have been in business less than 10 years and are just beginning to produce commercially. Volume of production is low (less than 1.5 million lb.). U.S. chestnut producers are mainly part-time or hobby farmers with small, manually harvested operations (Gold et al. 2006).

Additional information revealed through the national chestnut market survey (Gold et al. 2006) indicates that demand for quality chestnuts exceeds supply. Demand for fresh chestnuts is expected to continue increasing by 10% - 25% over the next 5 years. Producers who grow chestnuts from cultivars, grow organically, or sell under a brand name achieve the highest prices. Subsequent market surveys have consistently shown that demand exceeds supply.

Conclusion

Expanding access to well researched perennial specialty crops and expanding markets for their products can contribute to more widespread adoption of a range agroforestry practices and ultimately to the long-term economic and environmental sustainability of farming systems throughout the Midwest and beyond. UMCA research and development efforts have followed a strategic approach focusing on several key areas of development and testing of improved cultivars, developing viable markets and promotion and support with producers.

Numerous challenges for the development of emerging specialty crops have been identified and are being addressed. In the early stages, some priming is often required to promote interest, stimulate demand and catalyze the innovation that can fuel the growth of a specialty crop industry. Access to improved cultivars, solid production guidelines, reliable product supply, growing consumer demand, and sound financial decision support tools are supporting the growth of the specialty crop industry and having positive impacts up and down the supply chain. With adequate and reliable supply from growers, processors and entrepreneurs are more likely to invest and expand. In turn, existing growers and potential growers are more likely to expand production if there are active processors and clear consumer demand, a “market-pull” based strategy for increased production, supply and demand. Another important dimension of UMCA efforts includes bioactive phytochemical research to elucidate and test unique compounds found in plants, including the potential to patent and market value-added products for pharmaceutical, cosmetic, and industrial applications. This provides another avenue to create market opportunities and increase the economic attractiveness and adoption of agroforestry.

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