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AMERICAN AGRICULTURAL HISTORY

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A Companion to American Agricultural History

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A COMPANION TO AMERICAN AGRICULTURAL HISTORY

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WILEY Blackwell

This edition first published 2022

Registered Office
John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, USA

Editorial Office
The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK

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Library of Congress Cataloging-in-Publication Data

Names: Hurt, R. Douglas, author.
Title: A companion to American agricultural history / edited by R. Douglas Hurt, Purdue University West Lafayette, IN.
Description: Hoboken, NJ : John Wiley & Sons, 2022. | Series: Wiley Blackwell companions to American history | Includes bibliographical references and index.
Identifiers: LCCN 2021037403 (print) | LCCN 2021037404 (ebook) | ISBN 9781119632221 (hardback) | ISBN 9781119632184 (epdf) | ISBN 9781119632245 (epub) | ISBN 9781119632214 (ebook)
Subjects: LCSH: Agriculture–United States–History.
Classification: LCC S441 .H9195 2022 (print) | LCC S441 (ebook) | DDC 338.10973–dc23/eng/20211007
LC record available at https://lccn.loc.gov/2021037403
LC ebook record available at https://lccn.loc.gov/2021037404

Cover Images: © Ron and Patty Thomas/Getty Images, © dhughes9/Getty Images, © Mihai Simonia/Shutterstock, © Bim/Getty Images
Cover Design by Wiley

Set in 10/12pt Galliard by Integra Software Services Pvt. Ltd, Pondicherry, India

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Introduction

The History of American Agriculture

R. Douglas Hurt

The history of American agriculture is the story of its people – Native American, European immigrant, native born, African American, Latinx, and Asian, among others. It is a story of considerable achievement in many contexts, such as the formulation of land and water law, crop and livestock production, and technological and scientific change. The history of American agriculture also is reflected in art, literature, music, and film. It is the story of national expansion, political turmoil, and changing relationships among men, women, and children. It is the story of hard-earned economic gains and the indelible imprint of heartbreak, violence, racism, and despair. The history of American agriculture includes life in the small towns and cities where food processing links workers with the countryside. It is the story of agribusiness in a multiplicity of forms including domestic and international trade. It is the story of contentious government policy that provides nutritional programs for school children and the disadvantaged contending with food insecurity. It is the story of inequitable federal production and income programs and well-intentioned and often successful conservation and environmental programs that benefit urban and rural America. The history of American agriculture is complex with many parts, the synthesis of which enables us to better understand the American experience.

The contributors to this book constitute a gathering of emerging and established scholars who have written accessible and astute chapters on a multiplicity of topics to provide readers with an introduction to their subject. Each chapter offers readers a place to begin their own pursuit of American agricultural history, whether in general or regarding the subject under consideration. The following collection of thirty-one original chapters and an extensive bibliography will enable readers to gain an understanding of American agricultural history across region and time as well as focus on specific subjects, themes, and issues. In the past, many scholars who have written about the topics in this collection analyzed political, social, and economic events to give their histories substance, form, and meaning. In the twenty-first century these subjects often are understood through new interdisciplinary lenses of race, class, and gender as well as the environment that give greater breadth and depth to our understanding of America's agricultural past.

The contents of these chapters begin in 8000 BCE and range to the third decade of the twenty-first century. Specifically, they provide a narrative summary and a critical examination of the historical works upon which the authors have based their assessments. Each chapter

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will prove suggestive for further reading and research. By so doing, the chapters offer a comprehensive overview of critical areas in American agricultural history and, as such, will be useful for introductory students, experienced scholars, and general readers as well as teachers, journalists, public officials, and policy-makers who want a brief survey of specific topics in field-defining chapters in American agricultural history.

These chapters are informative, challenging, and interpretive. Several touch on similar subjects but provide different points of view. Others offer analysis of newly developing areas for research, such as the arts, urban and organic farming, and the environment. Still others assess the gendered nature of American agriculture, as well as matters of race, ethnicity, and power, and still others delve into the world of agribusiness from the meatpacking plants to migrant labor to the marketing of new products, including foods, at home and abroad. Others trace the origin and development of agricultural politics and policies, while others describe changes in science, technology, and government regulations.

We hope that this book will provide a succinct and solid foundation for understanding American agricultural history and offer new insights and fresh, innovative directions and ideas for further research. It is, of course, a superb reference volume for the topics discussed. Moreover, this collection provides an assessment of nearly a century of scholarship written by historians, political scientists, economists, geographers, anthropologists, sociologists, and environmentalists, among others, to constitute a book of chapters that is foundational to the study of American agricultural history.

It has been my privilege to have been invited to organize this collection of chapters and to work with these talented scholars from many disciplines to provide a usable book on the history of American agriculture. Although I would have liked to include additional subjects, any substantive omissions only prove that the field is complex, wide-ranging, and ever expansive. New topics for research and writing are limited only by the imagination, skill, and knowledge of anyone interested in America's agricultural past. I am confident that these chapters will provide a usable, accessible, and suggestive reference for anyone desiring to learn about American agricultural history. More importantly, I hope this book will enable all readers to understand the integral importance of our agricultural past to the American experience.

Part I

Regional

Chapter 1

Native American Agriculture before European Contact

Gayle Fritz

The history of food production in North America before European contact is deep and diverse, with traditions that vary geographically and culturally. Archaeologists, historians, geographers, botanists, and agronomists have studied pre-Columbian agriculture for more than a century, and it remains a widely discussed topic in textbooks and scholarly publications. Members of the general public are also intrigued by information about past Native American farming. These studies, after all, reveal where some of our foods came from and how people grew crops in challenging environments without metal tools or modern mechanical devices. The past might even hold clues to help us cope with issues such as climate change and to explore alternative methods to the low-diversity, high-energy input systems practiced by most American farmers today.

Eastern North America was one of the world's independent centers of plant domestication (Bellwood 2005; Smith 2011; Langlie et al. 2014). Thousands of years before the arrival of maize, kidney beans, or Mexican squashes, a local squash and a group of native seed-bearing plants were domesticated, constituting the Eastern Agricultural Complex (Figures 1.1 and 1.2). The local, eastern squash and sunflowers survive to this day as popular food crops, but most Eastern Agricultural Complex crops fell out of Native American cuisines several centuries prior to the earliest written records, or became such minor foods that they were not included in archival accounts. These "lost crops" have only recently gained the respect they deserve as pre-maize staples and plants whose nutritional properties make them candidates for de-extinction (Mueller et al. 2017; Mueller, White, and Szilagyi 2019).

Maize was domesticated in southern Mexico no later than 7000 years ago (Blake 2015). Maize that spread into eastern North America seems to have come across the Plains from the Southwest, where it was grown by at least 2100 BCE. Although maize agriculture in the Southwest was not preceded by production of locally domesticated crops, farmers in this arid zone developed effective water management systems and strategies of situating fields in the most optimal locations (Cordell and McBrinn 2012). They also selected and bred drought-hardy landraces to comprise distinctive regional crop complexes. In the Hohokam region of southern and central Arizona, large-scale irrigation canals directed water to fields from permanent rivers, while agave plants were grown in extensive rockpile fields along lower slopes of hillsides (Fish and Fish 2014).

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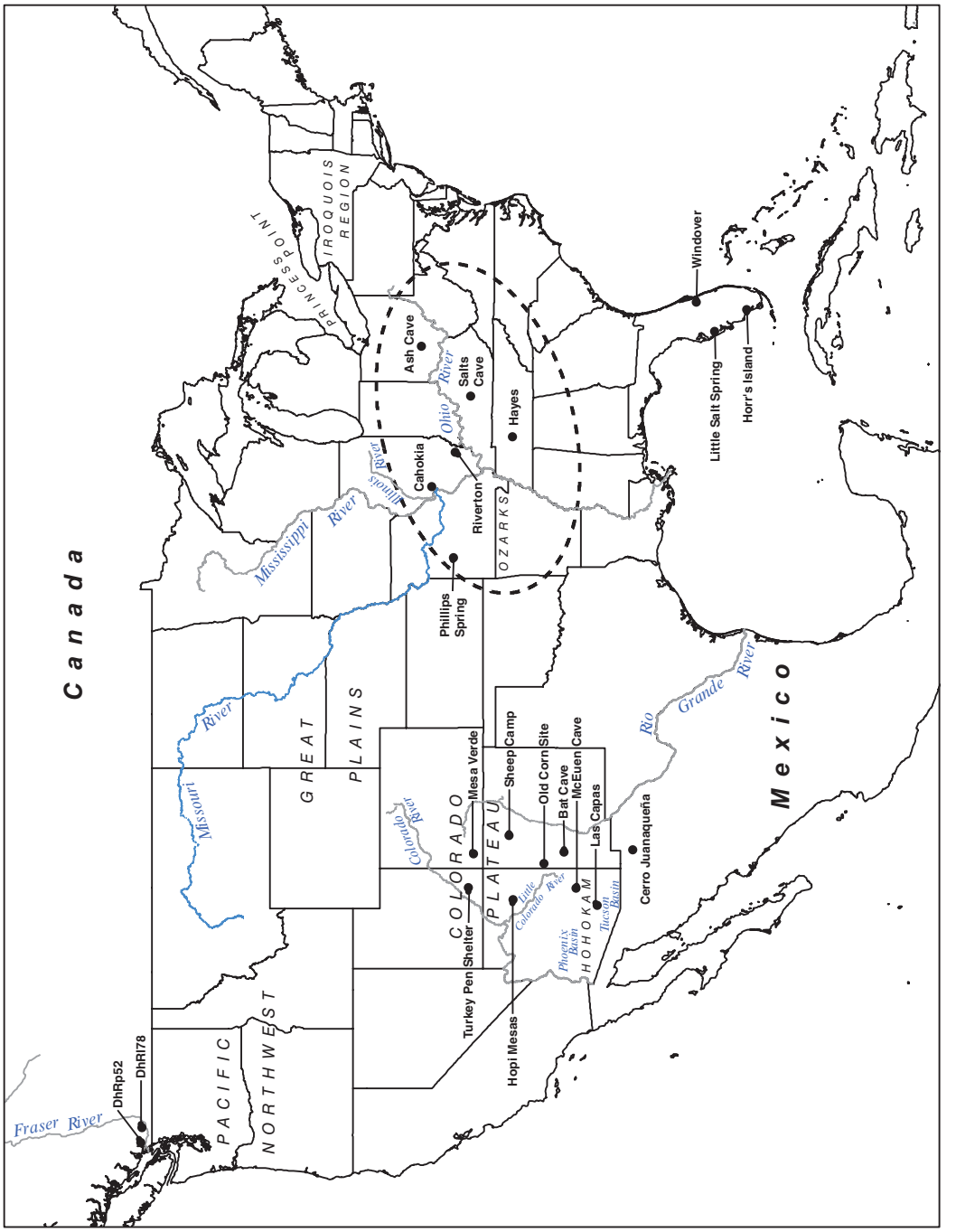

Figure 1.1 Map of North America showing locations of sites mentioned in text. The area enclosed inside the dotted oval line is the core region within which early Native American farmers grew Eastern Agricultural Complex crops. Map by and with the permission of Kelly Ervin.

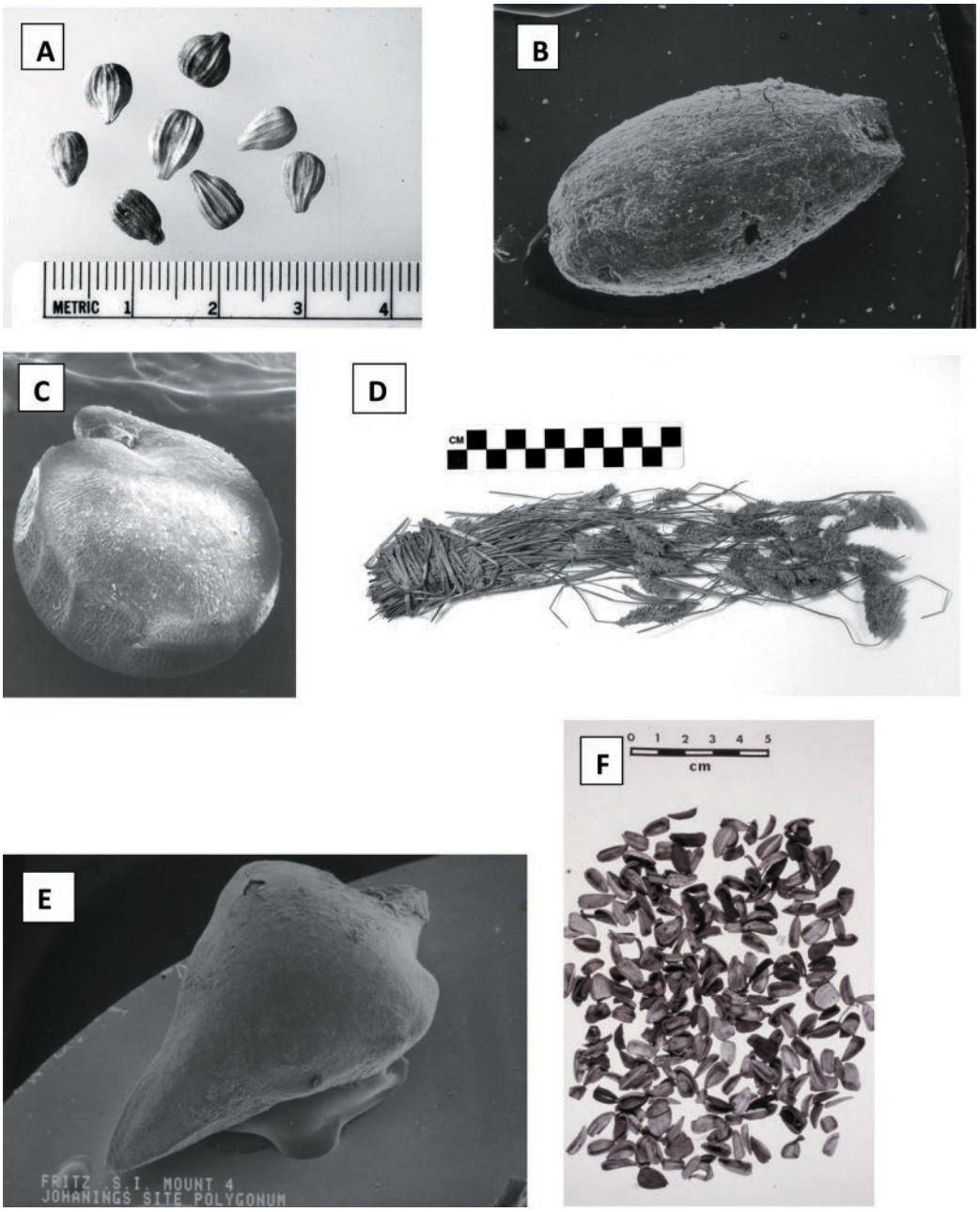

Figure 1.2 Archaeobotanical specimens representing members of the Eastern Agricultural Complex: A. Sumpweed (*Iva annua* var. *macrocarpa*), also called marshelder. Photo of desiccated achenes from Alum Cave, Arkansas, by Kay Clahassey, with the permission of the University of Michigan Museum of Anthropological Archaeology. B. Little barley (*Hordeum pusillum*). Scanning electron micrograph of charred seed from Toltec Mounds, Arkansas, by the author (Gayle Fritz). C. Chenopod (*Chenopodium berlandieri* ssp. *jonesianum*). Scanning electron micrograph of desiccated fruit (seed covered by pericarp) from Edens Bluff, Arkansas, by the author (Gayle Fritz). D. Maygrass (*Phalaris caroliniana*). Photo of desiccated seed head bundle from Gibson Shelter, Arkansas, by Jane Kellett, with the permission of the Arkansas Archeological Survey. E. Erect knotweed (*Polygonum erectum*). Scanning electron micrograph of charred fruit from Johanings Site, Illinois, by the author (Gayle Fritz). F. Sunflower (*Helianthus annuus* var. *macrocarpus*). Photo of desiccated achenes from Brown Bluff, Arkansas, by the author (Gayle Fritz).

Northwest Coast and Interior Plateau societies, long classified as non-agricultural fisher-hunter-gatherers, are now recognized for intricate landscape management practices, including cultivation, that increased the productivity of staple root crops, berries, and other plant foods (Peacock and Turner 2000; Deur and Turner 2005). It is difficult to date the antiquity of these strategies, but there is no doubt that they predate European influence. Combined archaeological and ethnobotanical studies that include authors who belong to Canadian First Nations and US Native American communities expand our knowledge about when and where early residents of the Pacific Northwest applied these methods and how their coastal gardens and upland garden-like meadows fit into long-term cultural trajectories in this densely populated region.

I begin this chapter with a review of plant domestication in eastern North America's Midwest riverine area, focusing first on the Eastern Agricultural Complex, and moving forward in time to maize-based agriculture. The next section is devoted to crops and farmers in the Southwest, where both regional diversity and changes through time are reflected in the archaeological record. In the following section, I cover the Pacific Northwest, summarizing evidence for landscape domestication that included crop cultivation. I conclude by discussing the significance of Native American farming systems for their productivity and efficiency and for the relevance they hold for Americans today.

Eastern North America

Domestication of plants in eastern North America was well underway by 3000 BCE, but the process began thousands of years earlier. People first populated this region during the late Pleistocene, at least 13,000 years ago, and their interactions with edible plants and animals set the stage for future developments. Nuts—especially acorns, hickories, and walnuts——were harvested as soon as post-Pleistocene climatic conditions stabilized, and the burning of understory vegetation served both to enhance mast production and improve hunters' abilities to procure deer using atlatls (Wagner 2003).

Eastern Agriculture before the Widespread Adoption of Maize

Bottle gourds (*Lagenaria siceraria*) were used as implements very early, a curious fact because this species is native to Africa and apparently floated across the Atlantic Ocean multiple times, being spread by people in Florida and elsewhere in the Western Hemisphere as early as 8000 BCE (Kistler et al. 2014). By 2500 BCE, bottle gourds were cultivated in Missouri at the Phillips Spring site, along with a native squash (*Cucurbita pepo* ssp. *ovifera*), the seeds of which were larger than wild-sized, indicating that the process of domestication was underway (King 1985; Smith, Cowan, and Hoffman 1992). This squash——the eastern North American wild pepo gourd—was widely distributed and propagated during the mid-Holocene (6000–3000 BCE). Charred *Cucurbita* fragments from sites in Maine, Pennsylvania, and Illinois are within the rind thickness range of wild populations, but these sites are located north of the species' expected natural growing range. The rind fragments and associated artifacts indicate that fisher-foragers used the small, gourd-like fruits from these easily grown plants, probably for multiple purposes including fishnet floats, containers, rattles, and food (Fritz 1999).

Sumpweed (*Iva annua* var. *macrocarpa*, also known as marshelder) (Figure 1.2A) and sunflower (*Helianthus annuus* var. *macrocarpus*) (Figure 1.2F) were apparently domesticated in similar riverine and upland savanna settings. Botanists consider the sunflower to have been a western North American species that spread eastward as a camp-follower or took advantage

of bison trails and wallows, increasing its range and visibility to people. Archaeological kernels (true seeds) and achenes (fruits with hard outer shells enclosing the kernels) too large to represent wild populations were excavated from the Hayes site on the Duck River in central Tennessee, dating to 2800 BCE (Crites 1993; Smith 2014). This dovetails with genomic studies that situate domestication in the US Midwest (Harter et al. 2004). Domesticated sunflowers were increasingly widespread across eastern North America and the Plains after 1000 BCE, grown by later pre-contact farmers from North Dakota to the Atlantic coast, contributing nutritious, oil-rich seeds used alone or mixed with other foodstuffs in many dishes and for cosmetic purposes such as hair oil (Heiser 1976; Yarnell 1978).

Sumpweed is a close relative of sunflower, but it lacks attractive flowers. Nevertheless, selection for larger seeds and fruits resulted in achenes with volumes several times larger than those found in wild populations. The earliest known domesticated archaeological sumpweed specimens come from sites in west-central Illinois and date to at least 2500 BCE (Asch and Asch 1985; Wagner and Carrington 2014).The oily seeds of sumpweed constitute "an exceptionally nutritious package, comparable to sunflower" (Wagner and Carrington 2014). We have no direct evidence for how they were prepared prior to consumption, but their presence in 87 percent of 100 human paleofecal specimens from Salts Cave, Kentucky analyzed by Yarnell (1969) demonstrates that sumpweed fruits were readily consumed during the first millennium BCE. The ubiquity of sumpweed in dry Ozark rockshelter caches dating to as late as 1400 CE points to persistence of this crop until shortly before European contact (Fritz 1994a), and scattered domesticate-sized specimens are reported from protohistoric and historic sites from the Plains to North Carolina (Wagner and Carrington 2014). Why it disappeared, whereas sunflower survived, is one of the unanswered questions in eastern North American archaeology.

Early garden plots might have been located at the margins of base camps along alluvial terraces or in nearby upland zones, with clearings maintained by burning along with girdling and removing unwanted trees. Open patches of disturbed soil enriched by organic midden waste would have become beds in which selection pressures favored seeds that germinated and grew quickly, either because they were larger or because dormancy mechanisms were reduced by virtue of thinner seed coats. Domestication of chenopod (*Chenopodium berlandieri ssp. jonesianum*) (Figures 1.2C and 1.3) and knotweed (*Polygonum erectum* ssp. *watsoniae*) (Figure 1.2E), two more members of the Eastern Agricultural Complex, is seen as having progressed in these anthropogenic settings under the watchful gaze of gatherers—almost certainly women—who brought edible wild and weedy seeds home to cook and sometimes to plant where they were most likely to thrive (Watson and Kennedy 1991).

The Riverton site in southeastern Illinois yielded the earliest (to date) flotation-recovered assemblages with a suite of Eastern Agricultural Complex crops: thin-coated chenopod; cultigen-sized sunflower and sumpweed; bottle gourd rind; and *Cucurbita* rind fragments (Smith and Yarnell 2009). The occupation at Riverton dates to 1800–1700 BCE. Most of the Riverton chenopod seeds and fruits (seeds covered by a papery pericarp) are pale, preserved without charring by having been deposited in prepared clay house floors that made the plant remains appear mineralized. This early manifestation of low-level food production shows that native crops were integrated into a broader subsistence regime dominated by walnuts, hickory nuts, hazelnuts, acorns, and of course, game animals and fish (Smith and Yarnell 2009).

Erect knotweed entered the Eastern Agricultural Complex by 1000 BCE, with pits in dry rockshelters in eastern Kentucky used to store this relative of Old World buckwheat, along with other Eastern Agricultural Complex crops (Mueller 2017). Paleofecal assemblages from Salts Cave, Kentucky, provide direct evidence for consumption of knotweed by cavers between 800 and 300 BCE, although the earliest specimens showing effects of domestication date only to c. 1 BCE (Mueller 2017). In the case of knotweed, selection was in favor of

Figure 1.3 Two-thousand-year-old cache of domesticated chenopod (*Chenopodium berlandieri* ssp. *jonesianum*) seeds stored in a bottle gourd (*Lagenaria siceraria*), found at White Bluff rockshelter site in the Arkansas Ozarks. University Museum of Arkansas, Photo negative # 320115. With the permission of the University Museum of Arkansas.

larger seeds with a high proportion of smooth and thin pericarps, a process that continued throughout the first millennium CE and into the second.

Maygrass (*Phalaris caroliniana*) (Figure 1.2D) joined the complex during the early first millennium BCE (Fritz 2014). This early season grass, ubiquitous in human paleofeces and storage pits, occurs at many archaeological sites far north of its natural range and always associated with known cultigens including thin-testa chenopod, large sunflower, and large sumpweed seeds. Flotation at sites across the Midwest and Upland South dating to the Middle and Late Woodland periods (300 BCE to CE 900) reflects increasingly high levels of maygrass production, with large concentrations of charred seeds found in the Illinois and Ohio river valleys. By 1050 CE, farmers had carried maygrass as far north as southern Wisconsin.

Little barley (*Hordeum pusillum*) (Figure 1.2B), the last member of the Eastern Agricultural Complex, becomes highly visible in deposits dating to the early first millennium CE. This relative of Old World barley added early season insurance, along with maygrass, to the diets of food producers whose middens include the entire suite of these crops in greater numbers throughout the first millennium CE. Little barley's natural range includes the whole Midwest-riverine area, so a range extension argument does not work for it as it does for maygrass, but morphological signs of domestication include naked grains no longer covered by tightly adhering glumes and wrinkled, asymmetrical grains possibly reflecting selection for three fertile florets per spikelet rather than the single floret borne by wild plants (Hunter 1992). Little barley is ubiquitous in flotation-recovered samples from Middle and Late Woodland sites in Illinois, Missouri, and Arkansas, constituting up to 40 percent of total seed assemblages (Asch and Asch 1985).

Increased commitment to the food production sector of the economy is correlated with dramatic Hopewellian earthwork building and long-distance exchange networking between 200 BCE and 400 CE, and with post-Hopewellian advances in ceramic technology. Thinner-walled pottery vessels manufactured in the Midwest after 400 CE could better withstand long-term, direct exposure to heat during the cooking of gruels and other seed-based foods (Braun 1983). Population growth in the region is indicated by higher site densities and either longer-term or more frequent occupations of favorable locations. Together with the archaeobotanical record for heavy dependence on native starchy and oily seed crops, Late Woodland societies (400–900 CE) are sometimes called "farmers" (Johannessen 1993; Fritz 2019). Classification schemes that relegate food producers in the North American heartland to categories below the level of farming by applying such terms as "gardening" or "horticultural" fail to appreciate the settlement patterns, demographic trends, material culture, and especially the archaeobotanical subsistence remains from sites occupied during the first millennium CE.

Tobacco

Tobacco is not strictly a member of the Eastern Agricultural Complex because no species in the genus *Nicotiana* is native to this region. I mention it here, however, because tobacco was cultivated along with the native crops centuries before maize became important. Native Americans grew tobacco (*Nicotiana rustica* and possibly *N. quadrivalvis*) in eastern North America no later than 2000 years ago. Smoking pipes date to centuries earlier, but native wild plants may have been smoked before tobacco was acquired (Wagner 2000). Tobacco seeds have been recovered from three sites in Illinois dating between 100 BCE and 400 CE (Asch and Asch 1985; Simon and Parker 2006), and residues on a possibly earlier pipe from Ohio tested positively for nicotine (Rafferty 2002).

Maize, Cushaw Squashes, and Beans

Many questions surround the initial acquisition—or more likely, multiple early acquisitions—of maize by Eastern Woodlands societies. Groups in the core Midwest-riverine zone were already producing pre-maize crops, whereas others incorporated maize into hunting-gathering-fishing economies that lacked earlier domesticates except bottle gourds or native pepo squash/gourds. The earliest evidence for maize is currently in the form of microbotanical remains: starch grains and phytoliths (opaline silica bodies) preserved in residues on pots dating to c. 300 BCE to 100 CE (Hart and Lovis 2012; Raviele 2011; Albert et al. 2018). These early reports come from Michigan and New York, unexpectedly far north and east for a crop that spread into eastern North America from the Southwest. Maize-like fragments from a handful of sites were believed to date to the early or middle first millennium CE, but several of these finds have been reexamined and redated: most were either not really maize or were centuries younger than expected (Adair and Drass 2011; Simon 2017). Stable carbon isotope evidence for increased maize consumption postdates 900 CE (Emerson et al. 2020).

Archaeologists have offered diverse explanations for why maize was available but did not become a staple food for so many centuries after its initial introduction (Scarry 1993; Hart and Lovis 2012; Simon 2014, 2017; Gremillion 2018). These include lack of adaptation to the new environment, lack of storability, use restricted to rituals, and farmer conservatism. What seems certain is that maize was not quickly embraced as a substantial source of carbohydrates, at least not at a scale visible in the isotopic or archaeobotanical records.

A dramatic shift occurred shortly before or after 900 CE, as reflected by high frequencies of cob and kernel fragments after that date (Simon and Parker 2006; Simon 2014, 2017). Intensification of maize did not, however, result in the abandonment of Eastern Agricultural Complex crops, particularly not in the American Bottom region of southwestern Illinois where Cahokia—the largest center north of Mesoamerica—arose quickly and dramatically after 1000 CE. With more than 100 mounds and multiple plazas in the central precinct alone and dozens more in the larger vicinity, Cahokia was an urban complex whose core area and surrounding countryside were inhabited by tens of thousands of people attracted by the rich resources of the floodplain and adjacent upland zones (Pauketat 2004, 2009; Iseminger 2010).

Massive amounts of flotation and archaeobotanical analyses in the greater American Bottom leave no doubt that Eastern Agricultural Complex crops were produced along with maize in greater quantities during the tenth, eleventh, and twelfth centuries CE (Lopinot 1994; Simon and Parker 2006; Fritz and Lopinot 2007; Fritz 2019). This strategy combined the seasonal staggering of early-season and late-season species with risk-reducing mechanisms including high agrobiodiversity and the scattering of fields across alluvial and upland landforms that vary in degree of soil moisture content and drainage capacity (Fritz 2019). Maize was a key staple at early Cahokia and became more dominant throughout the centuries of Cahokia's occupation, but chenopod, erect knotweed, maygrass, eastern pepo squash, sunflower, and sumpweed did not disappear until after depopulation of the region at 1350–1400 CE. A new squash—the cushaw (*Cucurbita argyrosperma* ssp. *argyrosperma*), domesticated in Mesoamerica—had spread into eastern North America by 1000 CE, appearing at Cahokia both in the archaeobotanical record and on a stone figurine depicting an Earth Mother deity hoeing the body of a feline-headed serpent (Fritz 1994b).

Common beans (*Phaseolus vulgaris*), also domesticated in Mesoamerica and thought to have spread across the Plains via the Southwest, were latecomers to Cahokia, appearing after 1250 CE, when thousands of people had already moved away (Pauketat and Lopinot 1997; Simon and Parker 2006). Hoe and digging stick technology, along with multicropping and intercropping of Eastern Agricultural Complex crops and maize, probably made it unnecessary to incorporate a nitrogen-fixing legume in order to maintain soil fertility. Protein was unlikely to have been lacking in the diets of farmers who grew chenopod, sunflower, and other species more nutritious than maize.

Beyond the Central Mississippi River Valley, pathways to agriculture were different than those just described for Cahokia. Pre-maize crops other than eastern pepo squash were minor economic concerns in northeastern North America, except at a few sites in Pennsylvania (Crawford 2011). Maize phytoliths have been reported from residues inside pots from New York dating to 100–300 BCE (Hart, Brumbach, and Lusteck 2007), but serious maize production did not occur until much later. Sites belonging to the first millennium CE Princess Point complex of southern Ontario yielded relatively high frequencies of maize fragments, but the onset of agriculture in New York and New England postdates 1000 CE, in some places by several centuries (Crawford 2011).

Full-blown agriculture among the historical Haudenosaunee and their ancestors (Iroquois speakers who founded the Six Nations League of upstate New York) was dominated by maize, beans, and squashes, crops so important that they were called the Three Sisters and "were included among those beings to whom religious ceremonials were addressed" (Waugh 1916). Maize was planted in low hills and spaced approximately 1 m apart with its stalks supporting bean vines. Squash could be planted on the sides of hills to spread across the ground, facilitating soil moisture retention and controlling weed growth. Agronomist Jane Mt. Pleasant (2006, 2015) has studied and practiced traditional Three Sisters agriculture, correcting old myths about low productivity and need for frequent shifting and fallowing. Yields actually obtained during Mt. Pleasant's experiments and yields described by early observers or

estimated from their accounts are higher than those achieved by colonial Euro-American farmers growing Old World crops, and the plows introduced by Europeans depleted soil fertility much more rapidly than hoe and digging stick techniques, contributing to the need for colonists to expand westward and displace more and more Native farmers from their land.

Successful, productive agricultural systems predated Europeans across eastern North America south of the Great Lakes and Canadian Shield and north of southern Florida and the southern Texas Gulf Coast. Commonalities were that maize was the primary crop, women were the primary farmers, and wild plant resources were heavily harvested—also by women—in anthropogenic patches where the productivity of nuts and fruits was enhanced through frequent understory burning. Regions varied according to whether and on what scale Eastern Agricultural Complex crops had been grown, whether Eastern Agricultural Complex crops were intensified along with maize (as at Cahokia) or dropped soon thereafter, the timing of the adoption of beans, and the roles played by crops in political and ritual economies (VanDerwarker, Bardolph, and Scarry 2017).

The Southwest

Beginnings of Maize Cultivation

Hunter-gatherer groups in the Southwest were thinly scattered across the landscape before some of them began planting maize no later than 2100 BCE. Sites yielding early maize are located at both lower and higher elevations in the Sonoran Desert of southern and central Arizona and Sonora, the Mogollon Highlands of southwestern New Mexico, and the Colorado Plateau where the states of Utah, Colorado, New Mexico, and Arizona meet in a point giving its name to the Four Corners region (Figure 1.1). What early maize sites have in common is better-than-average access to moisture in the form of high local water tables or proximity to springs, seeps, or rainwater runoff (Hanselka 2017). Maize predating 1000 BCE had small cobs that archaeologists think were relatively low in food value compared to later varieties (L. Huckell 2006).

Mitigation of cultural resources in the right-of-way of Interstate Highway 10 alongside the Santa Cruz River in the Tucson Basin revealed an astonishing cluster of deeply buried, early agricultural settlements dating between 2100 BCE and 100 CE, a time period called the Early Agricultural Period. Canal construction in the Tucson Basin began as early as 1500 BCE (Vint 2017). The site of Las Capas is remarkable due to its associated system of canals and rectangular fields, more than five acres (2 ha) of which were exposed by backhoes with 7-foot wide blades. By the first millennium BCE, an estimated 12.4 acres (5 ha) of land surrounding Las Capas might have been irrigated (Vint 2017).

Occupation of the Santa Cruz floodplain was not necessarily continuous throughout the entire 2000-year time frame called the Early Agricultural Period, and degree of sedentariness, even during stretches of optimal climate, is a topic debated by archaeologists (Roth 2016; Vint 2017). Faunal and floral remains reflect a pattern of logistic mobility that included the hunting and harvesting of wild resources, without evidence for significant pressure on either large or small animals. Maize is estimated to have contributed approximately 30 percent of caloric intake on an annual basis, with amaranth and other weedy plants encouraged in and near fields as supplemental foods (Vint 2017).

The Tucson Basin was not the only place in the Southwest where early farming communities practiced irrigation. Similarly ancient canals have been found at La Playa in northern Sonora, Mexico, and at a site dating to 1000 BCE near Zuni in western New Mexico (Damp, Hall, and Smith 2002; Hanselka 2017). Terraces (*trincheras*) built on hills in southern Arizona and northern Chihuahua demonstrate another form of organized

communal labor. Cerro Juanaqueña is a prime example, with nearly 500 rock-lined earthen terraces covering the flanks and summit of a 140 m high basalt hill overlooking the fertile Casas Grandes river valley in Chihuahua. The major occupation at Cerro Juanaqueña dates to 1300–1100 BCE, with maize found in 69 percent of the features excavated (Hard et al. 2008). Terraces served as foundations for domestic structures and pits, with crops grown in the river valley below.

Firm evidence for domesticates other than maize in early components is surprisingly rare. Squash (*Cucurbita pepo* ssp. *pepo*) as old as 1700 BCE has been reported from McEuen Cave in the Gila Mountains of eastern Arizona, and fragments predating 500 BCE came from two sites—Sheep Camp Shelter and Bat Cave—in New Mexico (Hanselka 2017, table 15.2). Bottle gourd (*Lagenaria siceraria*) phytoliths were reported from field sediments at Las Capas (Vint 2017). Common beans (*Phaseolus vulgaris*) were apparently not grown by the earliest southwestern food producers, which is not surprising in light of the late initial domestication date for beans—c. 300 BCE—in Mesoamerica (Kaplan and Lynch 1999).

Hohokam Agriculture

By 450 CE, the culture known as Hohokam, which was based on intensive farming, developed in the Phoenix and Tucson basins and immediately surrounding areas. Maize was ubiquitous, as it had been previously, but additional crops had joined the system. These included common beans, lima beans (*Phaseolus lunatus*), and tepary beans (*Phaseolus acutifolius*). Teparies are supremely well adapted to Sonoran Desert aridity and were possibly domesticated north of the Mesoamerican culture area, in northwestern Mexico (Muñoz et al. 2006). Squash species grown along with *Cucurbita pepo* ssp. *pepo* include the cushaw squash (*C. argyrosperma* ssp. *argyrosperma*) and butternut squash (*C. moschata*). Cotton (*Gossypium hirsutum* var. *punctatum*) was an important Hohokam fiber crop, utilized locally and traded to regions where neither irrigation nor rainfall were adequate for meeting its moisture requirements (Adams and Fish 2011). Two species of cultigen amaranth—*Amaranthus cruentus* and *A. hypochondriacus* were grown for grain and probably other uses including edible green leaves (similar to spinach, mustard greens, collard greens) and dye (Fritz et al. 2009).

Agaves (*Agave* spp.) are recognized as locally cultivated crops essential to the Hohokam economy (Adams and Fish 2011; Fish and Fish 2014; Hodgson, Salywon, and Doelle 2018). They were grown in rockpile fields that extended for kilometers along the lower slopes of *bajadas*, above irrigable river terraces but at lower elevations than where wild agave plants thrive without human care. Extensive rockpile-dotted landscapes yield tabular stone knives used for stripping leaves from agave hearts, and the fields include large roasting pits for baking the carbohydrate-rich hearts. Agaves were not only an important source of food, but their fibers were used for ropes and textiles, and drinks were likely made from the sugary juice in ancient times as they are still today. Wendy Hodgson and colleagues (2018) recognize seven extant species of agave in the Southwest as surviving examples of ancient domesticates. Most are rare today and found only in proximity to archaeological settlements and/or ancient rockpile fields (Figure 1.4).

The Hohokam culture is justifiably called "one of the major irrigation societies in the ancient world" (Adams and Fish 2011). Canal construction began by 650 CE, with trunkline canals in the Phoenix Basin alone extending over 500 km in length. Canals connected irrigation communities that were integrated socially by ballcourts before c. 1150 CE, and later by platform mounds and adobe "great houses" such as the one preserved at Casa Grande National Monument. A high level of coordination anchored by experts with superb engineering and agronomic skills was required for construction and maintenance of canal systems of this magnitude.

Figure 1.4 *Agave murpheyi* growing in a cultivated rockpile field at the Arizona Sonora Desert Museum. Source: Photo by the author (Gayle Fritz), April 2002.

Other forms of water management coexisted with canal irrigation. These included: (i) diversion of runoff from seasonal storms, sometimes using structures made of brush and earth; (ii) check dams; (iii) stone terraces; (iv) reservoirs; (v) stone or earthen grids for moisture retention; and (vi) rock mulches (Adams and Fish 2011). Wild and managed plants were always important foods, with some, such as mesquite pods, being stored along with crops. Many seeds from species of weedy plants probably reflect use of tolerated, encouraged, or cultivated resources that grew in and near formal fields.

Several crops native to the Sonoran Desert, in addition to agaves, seem to have been domesticated to some extent by ancient farmers in this region. Sonoran panic grass (*Panicum sonorum*), with large, pale grains and heavy panicles, was a notable floodplain crop formerly sown in receding floodwaters of the lower Colorado River by Yuman-speaking forager-farmers and still grown by Piman groups in Sonora, Mexico (Nabhan and DeWet 1984). Little barley (*Hordeum pusillum*) seeds show signs of selection for naked (hull-less) grains (Adams 2014). Devil's claw (*Proboscidea parviflora*) was bred for longer, more pliable fibers, but not until a market for O'odham baskets arose in historic times (Nabhan et al. 1981). Cholla (*Cylindropuntia* spp.) and Mexican crucillo (*Condalia warnockii* var. *kearneyana*) may also have been transplanted or otherwise cultivated, judging by archaeological distributions outside their known phytogeographic ranges (Bohrer 1991).

The "Hohokam Millennium," started before 500 CE, was over by 1500 CE (Fish and Fish 2007). Europeans encountered Pima-speaking farmers in the Salt and Gila river valleys growing maize, squashes, and beans including the tepary, but population density and degree of sociopolitical integration were far lower than before. Platform mounds and great houses were no longer built. The massive irrigation canals fell into disuse, although Native farmers still used small-scale water management systems. Traditional agricultural knowledge was