

# Top 10 Plants: Increasing Awareness of Plants

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## ABSTRACT

Urbanization, lack of contact with the natural world, and growing up removed from agriculture has contributed to a void of knowledge relating to food and food production, along with a phenomenon known as plant blindness. We sought to change this lack of appreciation and understanding of plants by the creation of a “top 10” list of plants that have most shaped or influenced our respective states. Using the public interface of the Minnesota Landscape Arboretum and the State Botanic Garden of Tennessee, we engaged the public by asking for their nominations of influential plants. The public was interested in proposing and guessing the “winning” 10 plants and learning why each plant was selected. In each state, a panel of experts used six criteria to make the final selections including: cultural or spiritual, economic or industrial, environmental, health, historical, landscape, and sustenance or food. After the results were announced, multiple institutions have held educational events using this theme, including state historical and horticultural societies, universities, botanic gardens, schools, Extension Master Gardeners, 4-H, Ag in the Classroom, and alumni associations. This article outlines how these educational campaigns were developed as well as the programs, events, and publications that were created to educate the public and the next generation about the critical importance of plants and how they contribute to our society, health, and well-being. As Peter Raven (Emeritus Director of the Missouri Botanic Garden) said when reviewing the book *The 10 Plants that Changed Minnesota*, “every state would benefit from a similar effort.”

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**Abbreviations:** MLA, Minnesota Landscape Arboretum; SBTG, State Botanic Garden of Tennessee; UME, University of Minnesota Extension; UMN, University of Minnesota; UT, University of Tennessee; UTE, University of Tennessee Extension; UTIA, University of Tennessee Institute of Agriculture.

**Y**OUNG PEOPLE spend 53 h per week in front of a screen rather than outside on a farm, or in a garden, woods, or natural area (Kaiser Family Foundation, 2010). Do young people today spend even 1 h per week looking at plants? In a society now multiple generations removed from growing up on or near a farm, how many people look at a beet in the grocery store and say “what is that?” If people cannot name and recognize plants, how can they value them and realize how essential they are to our environment and our health and well-being as humans? Are they aware of the loss of plant diversity now happening around the world and how it will affect their own future?

Plant blindness, the inability to see or notice the plants in one’s own environment, (Wandersee and Schussler, 2001), defines a condition that is all too common today. Our concern about the lack of contact with plants, the low recognition of plants in our state’s economy and agriculture’s environmental impact, led us to develop a “top 10” list of plants for our respective states. Determining the plants was an immediate hook for public engagement.

Laws (2015) took a worldwide look at plants and their impact, but we wanted to focus on plants people could relate to locally. We knew botanic gardens could provide contact with the public and a way to “stimulate discussion and thought about man’s relationship

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with the environment and nature, and the things that it provides us with” (Smith and Harvey Brown, 2018). Miller et al. (2015) encouraged public botanic gardens to partner with agricultural research-based institutions (such as land-grant universities), to play an “enhanced role in educating visitors about the food plants and agricultural systems on which we all depend.” Because many botanic gardens are located in urban areas and have an audience that is not agriculturally based, these visitors represent a unique group with which to increase agricultural awareness and importance of natural biodiversity. We wanted to take advantage of the known “green environment” of a botanic garden or arboretum and the “hands on” opportunities provided here, which can result in the most tangible impacts on learners, including benefits that go beyond gaining new knowledge (Smith and Harvey Brown, 2018).

The idea that plants, as few as 10, could have shaped a state is an intriguing idea. This paper describes how we approached the project, what partners we developed and the educational events and publications that resulted. In 2017, Minnesota ranked first in US sales of grain, such as corn, (*Zea mays* L.), soybeans [*Glycine max* (L.) Merr.], oilseeds, and dry peas (*Pisum sativum* L.) (USDA-NASS, 2017). Tennessee, an agriculturally diverse state, did not rank first in the nation in any crop. However, it ranked in the top 20 in tobacco (*Nicotiana tabacum* L.) cotton (*Gossypium hirsutum* L.), corn, soybeans, snap beans (*Phaseolus vulgaris* L.), and hay (USDA-ERS, 2018). Because of the large economic and environmental impact of agriculture in Minnesota and Tennessee, we knew we needed to present both the positive and negative impacts of agriculture. “Agricultural systems are concurrently degrading land, water, biodiversity, and climate on a global scale” (Foley et al., 2011), and yet they are a major economic necessity and cultural cornerstone in many states. We hoped to bring awareness and knowledge to these complex topics. Throughout the project, we sought to present a balanced approach to each plant by stating positive and negative impacts, in the present as well as the past. The objectives of the 10 Plants educational programs were to identify the top 10 plants in each of our states, and to develop educational programs that would bring awareness to the environmental challenges these plants have presented, along with solutions for increasing sustainable food production, while highlighting the need for plant diversity and conservation.

## MATERIALS AND METHODS

### Minnesota

A public nomination process was launched and publicized by the Minnesota Landscape Arboretum (MLA) marketing and public relations staff in February 2012. Through 15 Apr. 2012, Minnesotans used a simple online nomination form linked on the MLA website to submit plants that they felt should be on

the top 10 list. Participants were asked to state what their nomination meant to them and to Minnesota and to select one or more of six areas for justifying their plant nomination. Justification areas suggested were cultural or spiritual, economic or industrial, environmental, historical, landscape, and sustenance. An “other” category was also an option listed for further comments and justification. Submissions were captured on a spreadsheet that categorized the information and compiled the data. Teachers were encouraged to nominate plants on a specific section of the online submission form, for which they could win a free field trip for their students to the MLA.

In May 2012, submissions were judged using the above criteria and the final 10 plants were selected by a panel of 13 experts from the University of Minnesota (UMN), Minnesota Historical Society, Minnesota State Horticultural Society, Minnesota Department of Agriculture, and industry. The six criteria are self-explanatory; judges considered and defined “landscape” as nonfood landscapes or amenity impact, where humans use nonfood plants as street trees, around homes, etc. Members of the MLA education staff judged teacher submissions.

Once the 10 plants were selected, press releases were distributed through the UMN Extension (UME) and the MLA. Winning teachers were notified by mail. Working in conjunction with the development staff at the MLA, we sought funding through partnerships with organizations, commodity groups, and individual donors with similar educational goals. The 10 Plants website was originally part of the MLA website and later developed into a stand-alone website. The MLA provided ongoing marketing and website development expertise, which was critical to providing public information about each of the 10 plants. A local award winning horticultural author, Susan David Price, was contracted to write the website content, including historical information.

To reach students in 2012, a Freshman Seminar three-credit class was developed through the UMN entitled “The 10 Plants that Changed Minnesota” (HORT 1901), which was based on the requirements of small group learning communities and community engagement. The class was developed to meet the environmental theme for liberal education, one of the requirements for undergraduate education. Working with the MLA education staff, the 2012 class was offered to the public (who sat alongside students) with a nominal weekly registration fee. Guest experts from the UMN lectured weekly. Field trips to historical locations relating to the 10 plants were developed with funding provided through curriculum funding for Freshman Seminars.

In 2013, a 10 Plants Youth Challenge educational contest was developed. With two categories—12 yr of age and under, and 13 to 17 yr of age—the contest’s goal was encouraging youth to learn and appreciate the impact of the 10 plants by developing a game involving the 10 plants, online or otherwise. Submissions were open from 22 Apr. 2013 to 15 July 2013, and the entrants were required to follow several rules: they must be under the age of 18 and a resident of Minnesota, and the game must involve all 10 plants, be educational, and involve different geographic or vegetative regions of Minnesota. Members of the MLA Education staff judged submissions.

In 2015, the editor of the Minnesota Historical Society Press was contacted to discuss a possible book contract. In 2016, funding was solicited to develop a 10 Plants teacher activities handbook, to create teacher workshops, and to purchase the

10 Plants books for life science teachers. The teacher activities were developed by a UMN horticulture graduate student and were aligned with the Minnesota Standards for seventh and tenth grade life science. Twelve independent teachers were solicited to review the teacher handbook and were rewarded with a national department store US\$50 gift card. Edits were made to the activities based on reviewer suggestions.

## Tennessee

The 10 Plants project in Tennessee was inspired by the effort in Minnesota and began after consultation with project leaders in Minnesota. A public nomination process started the Tennessee project in February 2018. An online Qualtrics submission form was developed and housed on a newly designed page on the Tennessee Extension Master Gardener website. The online form contained three questions for participants including the name of the plant they were nominating, the impact of the plant (cultural or spiritual, economic, food, health, historical, and landscape) and how the submitter thought the plant had changed Tennessee. Categories were not explicitly defined for participants submitting nominations because they were considered self-explanatory. These categories were similar to those used in Minnesota, but in Tennessee, the landscape category was intended to encompass the environmental aspects of plants across the state, and the health category was added. Through the online evaluation system, all nominations were captured in a spreadsheet that enabled sorting, counting, and categorization of the responses.

Nominations were promoted by University of Tennessee Institute of Agriculture (UTIA) marketing and communications personnel with coordinated publicity through the State Botanic Garden of Tennessee (SBGT) and University of Tennessee Extension (UTE). In February 2018, promotional packets were mailed to all 95 UTE county offices to enable use by both 4-H and horticulture agents. Members of the general public, in addition to volunteers and others affiliated with UTIA, UTE, and SBGT, were encouraged to participate. In addition to digital and print media promotions, a teacher packet was created specifically to support elementary educators in assisting students in submitting nominations. A lesson plan was developed for third through fifth grade educators or 4-H Extension agents to help students consider the role of plants in Tennessee. Paper applications were acceptable forms of student nominations; however, none were received. Educators directed students to the online submission portal. A 10 Plants Facebook page was also created to engage teachers, students, and the general public in this process. This page, as well as the main nomination page, has now been deactivated.

In June 2018, all nominations were compiled, sorted, categorized, and sent to an expert panel. This panel was composed of UTIA and UTE research, teaching, and Extension faculty and specialists from a range of subject areas. The same six criteria used in the nomination process were used by the expert panel to select the 10 plants that shaped Tennessee. Selection and deliberation took place during late summer and fall 2018.

Once the 10 plants were selected, the UTIA Marketing and Communications Department in conjunction with the UTIA Department of Plant Sciences coordinated the release of the selections in February 2019. A new webpage was created to be housed on the UTIA Plant Sciences website (UTIA, 2019a).

## RESULTS AND DISCUSSION Minnesota

We found that botanic gardens in our respective states were well positioned to reach the public, promoting the identification of the top 10 plants, as well as further development of educational programming with this theme. In just over 3 mo, nearly 500 Minnesotans submitted plants that they felt should be on top 10 list. One hundred and thirty-seven different plants were suggested by the public, from a “cutie” orange (*Citrus × clementine*) to invasive buckthorn (*Rhamnus cathartica* L.), dandelions (*Taraxacum officinale* F.H. Wigg.), and showy lady’s slipper orchids (*Cypripedium reginae* Walter). The public had a lot to say about their nominations. Many included personal stories, drawings, images, and quotes as to why their plant should be selected. On 29 May 2012, the final selections were revealed in a press release from the MLA, along with the justification and number of public nominations (Table 1).

The 10 plants selected were not a popularity contest and were critically judged by the team of experts using the six criteria of cultural or spiritual, economic or industrial, environmental, historical, landscape, and sustenance. No one nominated the American elm (*Ulmus americana* L.), and only two people nominated purple loosestrife (*Lythrum salicaria* L.), whereas 54 nominated apples (*Malus domestica* auct. non Borkh.) (UMN apple breeders developed the Honeycrisp apple), and 35 nominated wild rice (*Zizania palustris* L.) (Table 1). Media throughout Minnesota carried the results of the contest, including several lengthy articles and radio interviews. A website was developed that included information about each of the plants, comments from the public nominations, and resources for teachers (Davis Price, 2012).

Eight teachers entered the contest and one was selected to receive a certificate for a free school field trip to the MLA. Nearly 25 participants entered the youth contests. First, second, and third prizes were awarded with a choice of an electronic tablet or gift certificate to an electronic store. Winners were notified by mail and celebrated at an event in August 2013 at the MLA, where youth showed their winning games and created videos about their projects.

The MLA provided in-kind resources and marketing expertise throughout the project. The Minnesota Corn Growers Association, Minnesota Soybean Research And Promotion Council, Minnesota Cultivated Wild Rice Council, Minnesota Turf And Grounds Association, and a private foundation provided funding for the original website, along with the teacher and youth contests and the teachers activities handbook and other educational publications, workshops, and events developed for specific audiences from 2012 through 2017 (Table 2).

The Freshman Seminar “The 10 Plants that Changed Minnesota” was first offered as a three-credit class (HORT 1901) in fall 2012. The first class, held at the MLA as a free, public evening event with weekly guest speakers

**Table 1. The 10 plants that shaped or changed Minnesota and Tennessee selected by a panel of experts based on criteria listed.**

States	Plant	Criteria for selection†	Public nominations
Minnesota	Apple ( <i>Malus domestica</i> )	Cultural, historical, sustenance	54, of which 29 were Haralson
	Alfalfa ( <i>Medicago sativa</i> )	Economic, historical, environmental	18, of which 6 were Grimm
	American elm ( <i>Ulmus americana</i> )	Environmental, historical, landscape	none
	Corn ( <i>Zea mays</i> )	Economic, environmental, historical, sustenance	31
	Lawns, turfgrass ( <i>Poa</i> , <i>Festuca</i> , and <i>Lolium</i> spp.)	Cultural, economic, environmental, landscape	3
	Purple loosestrife ( <i>Lythrum salicaria</i> )	Environmental, landscape	2
	Soybeans ( <i>Glycine max</i> )	Economic, environmental, sustenance	14
	Wheat ( <i>Triticum</i> spp.)	Economic, environmental, historical sustenance	23
	White pine ( <i>Pinus strobus</i> )	Economic, environmental, historical, landscape	23
	Wild rice ( <i>Zizania palustris</i> )	Cultural, environmental, historical, sustenance	35
Tennessee	American chestnut ( <i>Castanea dentate</i> )	Cultural, economic, historical, food, landscape	4
	Beans ( <i>Glycine max</i> and <i>Phaseolous vulgaris</i> )	Economic, food, historical, cultural	73
	Corn ( <i>Zea mays</i> )	Economic, food, historical, cultural	66
	Cotton ( <i>Gossypium hirsutum</i> )	Economic, historical, cultural	75
	Dogwood ( <i>Cornus florida</i> )	Economic, landscape	19
	Grasses (prairie and turfgrass species)	Economic, historical, landscape	6
	Ginseng ( <i>Panax quinquefolius</i> )	Economic, cultural, historical, health	3
	Kudzu ( <i>Pueraria montana</i> var. <i>lobate</i> )	Landscape, cultural	19
	Tobacco ( <i>Nicotiana tabacum</i> )	Economic, historical, cultural, health	25
	White oak ( <i>Quercus alba</i> )	Economic, landscape, cultural	16

† Criteria for selection in Minnesota: cultural or spiritual, economic or industrial, environmental, historical, landscape and sustenance; in Tennessee: cultural or spiritual, economic, health, historical, landscape (environment), and food (sustenance).

was promoted by the MLA and drew from 2 to 20 public attendees each week. The 20- to 25-student class has been offered annually since 2012, with total enrollment of 140 students on the St. Paul campus of the UMN. Class field trips travel to the MLA; the Grimm Farmstead, home of Grimm alfalfa (*Medicago sativa* L.); the Gideon Historical Marker; and the Horticulture Research Center, birthplace of Minnesota’s apple breeding industry.

The Minnesota Historical Society Press published the *Ten Plants that Changed Minnesota* book by Mary H. Meyer and Susan Davis Price in 2017. The Minnesota Historical Society and Press are known for their extensive image and museum collection of Minnesota artifacts, as well as their publication of historical books. Several local county historical societies and individuals who had submitted nominations provided information and images for use on the website, the Freshman Seminar, and the book.

The UMN College of Food, Agricultural, and Natural Resources Sciences Alumni Association selected the 10 Plants book in 2017, 2018, and 2019 as the Norman Borlaug Science Achievement Award gift distributed to outstanding junior high school students for science achievement. Peter Raven, President Emeritus Missouri Botanical Garden, said, “Minnesotans are fortunate to be able to enjoy and learn from this fascinating book. Every state would benefit from a similar effort.” Peter Olin, Emeritus Director of the MLA, reviewed the book as “educational, timely, and interesting.” Since the book publication in 2017, it has been used as the textbook for the Freshman Seminar university class.

Also in 2017, the *10 Plants Teacher Activities Handbook: 70 Activities for Middle And High School Students* by Gail Brown Hudson and Mary H. Meyer was published by the UME. The Regional Development Partnership program, also part of the UME, provided funding for teacher workshops around the state to introduce teachers to the program and provide training for use in their classrooms. Eleven 6-h regional workshops were developed and held across the state, during which teachers were introduced to 10 Plants activities for their classrooms. Additionally, books and handbooks were distributed through four statewide conferences in 2017 and 2018. In 2017, 270 teachers were directly reached, and an additional 53 teachers were reached in 2018. In 2017 and 2018, teacher workshops were presented at the Minnesota Science Teachers Conference, and 10 Plants books and teacher handbooks were distributed to teachers. Life science teachers throughout Minnesota continue to be offered free 10 Plants books and teacher handbooks through the Minnesota Science Teachers Association.

Librarians with the Andersen Horticultural Library at the MLA developed online adult and youth reading lists (Andersen Horticultural Library, 2013). Marketing staff at the MLA developed a spin-the-wheel game featuring the 10 plants, which was used in a public booth for 2 yr at the Minnesota State Fair. The UME through the Master Gardener program provided public educational presentations on the 10 plants throughout the state. Extension Master Gardeners were provided with a 56-slide deck with notes to enable them to self-learn or make presentations in their local communities (Meyer, 2016).

**Table 2. Events, programs, and publications developed and used in the 10 Plants educational campaigns in Minnesota (Minnesota Landscape Arboretum [MLA], University of Minnesota Extension [UME], and University of Minnesota [UMN]) and Tennessee (State Botanic Garden of Tennessee [SBGT], University of Tennessee [UTN], University of Tennessee Extension [UTE], and University of Tennessee Institute of Agriculture [UTIA]).**

Project title	Type of project or event	Collaborating institution	Target audience
Nominate your 10 plants that changed Minnesota	Online public nomination contest	MLA	General public
HORT 1901: 10 plants that changed Minnesota	Freshman Seminar, three-credit academic class	UMN	College freshman
Adult and youth reading lists	Online reading lists: <a href="http://top10plantsmn.org/resources/">http://top10plantsmn.org/resources/</a>	Andersen Horticultural Library	Youth and general public
Youth contest	Competition for best game associated with the 10 plants	MLA	Youth K-12
10 plants that changed Minnesota	Book, 274 pages published in 2017	Minnesota Historical Society Press	General public, teachers
10 plants that changed Minnesota	Online 56-slide deck for public presentations and Extension Master Gardener use: <a href="http://top10plantsmn.org/resources/">http://top10plantsmn.org/resources/</a>	UME, and Extension Master Gardener	Extension Master Gardeners; general public
Teachers handbook and activities guide to 10 plants that changed Minnesota	Online print on demand 71-page booklet: <a href="http://top10plantsmn.org/for-educators/">http://top10plantsmn.org/for-educators/</a>	UME and Rural Development Partnership Program	Classroom teachers, 4-H leaders, informal teachers, Master Gardeners
Teacher workshops: 10 plants that changed Minnesota	6-h teacher workshops held throughout Minnesota in 2016, 2017, and 2018	UME and Rural Development Partnership Program	Classroom teachers, 4-H leaders, informal teachers, Master Gardeners
Name one of the 10 plants	Spin-the-wheel contest at State Fair	MLA	General public
10 plants that changed Minnesota	Website: <a href="http://top10plantsmn.org/">http://top10plantsmn.org/</a>	MLA	General public
Ten Plants Tennessee nomination	Online submission form portal and webpage to enable nominations from the general public	UTIA Marketing and Communications	General public
Ten plants that shaped Tennessee	Website and information on each plant: <a href="http://tenplants.tennessee.edu">http://tenplants.tennessee.edu</a>	UTIA Plant Sciences and Marketing and Communications	General public
Ten Plants press release video/news story	Promotional video to showcase the 10 plants that shaped Tennessee: <a href="https://www.youtube.com/watch?v=fWj-ol8oXVY">https://www.youtube.com/watch?v=fWj-ol8oXVY</a>	UTIA Plant Sciences and Marketing and Communications	General public
Teacher packet	Lesson plan and resource kit to introduce students to the impacts of plants in Tennessee: <a href="https://extension.tennessee.edu/MasterGardener/Documents/TenPlants_TeacherPacket.pdf">https://extension.tennessee.edu/MasterGardener/Documents/TenPlants_TeacherPacket.pdf</a>	UTIA Plant Sciences and Agricultural Leadership, Education and Communications	Classroom teachers, 4-H agents
Corn: Ten plants that shaped Tennessee	Video snapshot with UTIA expert: <a href="https://www.youtube.com/watch?v=1q09F1QGvk">https://www.youtube.com/watch?v=1q09F1QGvk</a>	UTIA Plant Sciences	General public
Cotton: Ten plants that shaped Tennessee	Video snapshot with UTIA expert: <a href="https://www.youtube.com/watch?v=vikws6Wg_14">https://www.youtube.com/watch?v=vikws6Wg_14</a>	UTIA Plant Sciences and Marketing and Communications	General public
Grasses-Tall Fescue: Ten plants that shaped Tennessee	Video snapshot with UTIA expert: <a href="https://www.youtube.com/watch?v=HCNPU83gX8E">https://www.youtube.com/watch?v=HCNPU83gX8E</a>	UTIA Plant Sciences and Marketing and Communications	General public
Kudzu: Ten plants that shaped Tennessee	Video snapshot with UTIA expert: <a href="https://www.youtube.com/watch?v=y3_QfkeE07Q">https://www.youtube.com/watch?v=y3_QfkeE07Q</a>	UTIA Plant Sciences and Marketing and Communications	General public
White oak: Ten plants that shaped Tennessee	Video snapshot with UTIA expert: <a href="https://www.youtube.com/watch?v=iuDyZ1bJBnM">https://www.youtube.com/watch?v=iuDyZ1bJBnM</a>	UTIA Plant Sciences and Marketing and Communications	General public
American chestnut: Ten plants that shaped Tennessee	Video snapshot with UTIA expert: <a href="https://www.youtube.com/watch?v=3K4N3PoUX94">https://www.youtube.com/watch?v=3K4N3PoUX94</a>	UTIA Plant Sciences and Marketing and Communications	General public
Beans-soybeans: Ten plants that shaped Tennessee	Video snapshot with UTIA expert: <a href="https://www.youtube.com/watch?v=pboZln_q_SQ">https://www.youtube.com/watch?v=pboZln_q_SQ</a>	UTIA Plant Sciences and Marketing and Communications	General public
Dogwood: Ten plants that shaped Tennessee	Video snapshot with UTIA expert: <a href="https://www.youtube.com/watch?v=JDPj81r9bk">https://www.youtube.com/watch?v=JDPj81r9bk</a>	UTIA Plant Sciences	General public
UT Plant Sciences Instagram	Ten Plants posts: <a href="https://www.instagram.com/utplantsciences/">https://www.instagram.com/utplantsciences/</a>	UTIA Plant Sciences	General public
UT Plant Sciences Facebook	Ten Plants posts: <a href="https://www.facebook.com/UTPlantSciences/">https://www.facebook.com/UTPlantSciences/</a>	UTIA Plant Sciences	General public

The Minnesota Department of Agriculture's Ag in the Classroom selected the "10 Plants that Changed Minnesota" as their theme for the 2012–2013 academic year, with each issue of their newsletter highlighting one or more of the 10 plants.

## Tennessee

In 2018, the University of Tennessee (UT) received over 675 nominations as part of their educational campaign to determine the 10 plants that shaped Tennessee. A wide range of different plants were suggested by the public from poison ivy [*Toxicodendron radicans* (L.) Kuntze] to irises (*Iris* spp.), tomatoes (*Solanum lycopersicum* L.), and roses (*Rosa* spp.). Nominations ranged from a likely student nomination of carrots with a justification of "people's eyesight is better" to academic nominations complete with scientific names and numerous citations. As evidenced in the Minnesota project, participants were invested in these nominations and included statistics, scientific justification, and personal histories illustrating plant impacts, both positive and negative.

Although the nominations were a crucial component of the selection of the 10 Plants project, they were only the first piece of the selection process. A panel of experts was tasked with choosing the final list focused on the economic, food, landscape (environmental), health, historical, and cultural or spiritual context in the past and present. This included consideration of plants important across all of the specific regions of Tennessee. Distilling the list down to 10 plants was difficult but was made somewhat easier by combining some species into a more categorical group. As an example, although soybeans are currently the number one cash crop in terms of farm gate receipts in Tennessee, they were included on the top 10 list in the bean category that combined the historically, culturally, and economically significant growing of snap and pole beans (*Phaseolus vulgaris* L.), with soybeans due to the fact that soybeans are a relatively recent addition to Tennessee agriculture and economy. Similarly, prairie, turf, and forage species of grass were selected as a single group because of their overall impact on the state. This included landscape (environmental), historical, and economic impacts of several species over time in Tennessee. The panel also considered current and formerly predominant forest species, as well as horticultural crops that are important to residents and producers in Tennessee.

With a diverse climate and geography, the landscape and agricultural economy of Tennessee differs widely across the regions of the state. Some crops, such as tobacco, resonated more with eastern and middle Tennessee regions, whereas cotton is important but only predominant as a crop in western Tennessee.

In February 2019, the final selections were revealed in a press release from UTIA along with website information (UTIA, 2019a) and a video (UTIA, 2019b) to provide

justification and context to each selection (Table 2). The website contained descriptions, images, and additional information about each plant (UTIA, 2019a). Additionally, a wide range of print and digital educational content was produced and released through UTIA and local media sources. Media outlets in several large Tennessee cities carried the original press release or a more comprehensive story with details about each of the 10 selected plants.

Over the course of February, March, and April 2019, educational videos were shared through the UTIA Plant Sciences YouTube channel (UTIA, 2019c) and other social media platforms. These videos each featured a UTIA researcher or Extension specialist that has expertise in the specific crop or plant on the list. These videos provided the opportunity to further showcase the 10 plants that shaped Tennessee and integrate current UTIA research and outreach on these crops with the public education focus of the project.

The UT Department of Plant Sciences currently offers a class entitled "Plants that Changed the World" (PLSC115). This course introduces students to how plants have affected the world across all cultures over time. Content is currently being developed to incorporate "Tennessee 10 Plants" activities into this course. This is being paired with the development of standards based educational material for fourth through sixth grade students.

The 10 plants that shaped Tennessee project is a more recent effort, with educational components still being developed to increase outreach and education. Specifically, the Tennessee team is working to provide teaching materials and resources to support use of the 10 plants in classrooms by teachers, as well as 4-H agents, in programming across Tennessee. Lesson plans are currently in development targeting middle school students to connect state teaching standards in math, science, and language arts with activities for classroom delivery. This project includes collaborations of Plant Science teaching and Extension faculty, as well as Agricultural Leadership, Education, and Communications faculty and 4-H curriculum Extension specialists. In addition to curriculum focused on students, adult educational materials to support Extension Master Gardener engagement and other volunteers will also be developed.

## Lessons Learned

For states or organizations that may wish to create similar projects, we have the following recommendations. Engage and involve marketing and communications colleagues from the beginning. Their expertise in setting timelines and using the media can be very valuable. Determine your primary audience; whether adults or youth, the strategies to engage the audience will be different. Tennessee focused on youth first, whereas Minnesota targeted the general public as a first audience. In the second or third year of the project, a new audience can become the program focus.

Involvement of 4-H, Extension Master Gardeners, and county Extension offices can be a very effective means of disseminating the 10 Plants educational programs; however, it is important to be clear in your expectations with these groups and to provide them with appropriate educational information. Establishing a 10 Plants task force or advisory board was something neither of our states did, but it could provide an excellent platform to define the program while creating involvement and buy-in from several collaborators or partners.

Minnesota program leaders reached out to commodity groups as partners, particularly for funding, shortly after the selection of the 10 plants, which also helped to reach a broader audience.

## CONCLUSION

In conclusion, we consider the 10 Plants educational programs to have been very successful in the scope of programs and people reached. We found that as soon as people knew there was a list of the top 10, they would try to guess the plants. The idea was intriguing and a hook to get people thinking about plants.

We recommend that other states consider using this method to identify impactful plants in their states. Not only will this engage the public in thinking about plants, it will help to begin a dialogue about how these plants are grown and how they affect the environment. For food crops, this can be an entry point for learning about crop wild relatives and the need for conservation. Production agriculture is not well known by the public. While studying word meaning mapping by the general public, Stofer and Newberry (2017) found that very few participants made an association between the words agriculture and science. Given this low level of awareness and understanding, we must seek new means of raising awareness of agriculture and plants. Botanic gardens and arboreta are well positioned to reach the public in urban areas. Agriculture is a necessity, but it should be managed to maximize food production without increasing its environmental impact, incorporating solutions that have been proposed (Foley et al., 2011) and can be highlighted in educational programming. It is interesting and fun to know what 10 plants made a difference in our states, but we encourage educational projects to move beyond simply naming the plants and provide examples of how people can personally become involved in plant conservation or show personal actions that will improve the environmental impact of major agricultural crops. Partnering with agricultural groups can initiate this programming.

We recommend specifically targeting young people from middle school through college in teaching plant science and conservation. Too often this age group is omitted from programming, especially at botanic

gardens. Zhang et al. (2014) found that Chinese students from urban schools that had less contact with nature had different attitudes about conservation, and “children’s contact with nature was significantly positively related to their biophilia and negatively related to their biophobia.” Such findings show the critical importance of field trips to farms, growers, and botanic gardens for urban kids who lack contact with nature. Additionally, many of the educational programs devised as part of this project use plants as the lens to teach other subjects and meet state-wide educational standards. It is possible and advantageous to use plants to teach a variety of subjects, and this method should continue to be explored.

An additional challenge, as with many educational programs, is the sustained impact of the programs and their continued usage. Events such as the Freshman Seminar at the UMN and using the 10 Plants book as a high school student science award are examples of ways to sustain the discussion of how plants affected our past and how to preserve their diversity and sustainable use in the future.

## Conflict of Interest

The authors declare that there is no conflict of interest.

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